NANYANG TECHNOLOGICAL UNIVERSITY

ESTIMATION OF FOREIGN EXCHANGE EXPOSURE FOR PUBLIC-PRIVATE PARTNERSHIP INFRASTRUCTURE PROJECTS

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Abstract

Economic foreign exchange (FX) exposure is an important risk factor which affects Public-private partnership (PPP) projects in developing countries. The risk exists because PPP projects typically sell their outputs domestically and generate revenues in local currency, while their financing costs and operating and maintenance costs are often denominated in hard currencies. Traditionally, FX risk is tested through the use of risk factors on revenue and costs or by adopting conservative assumptions in the cash flow. While this method provides a range of the risk value based on scenarios it does not give the potential FX risk exposure. What constitutes minimum and maximum risk values is often defined on the basis of subjective judgments.

This research contributes to the solution of this problem with a methodology to quantify annual economic FX exposure in project companies financed under project finance modality. The application of the developed FX index to describe the project feasibility on economic FX exposure is superior as it is an extra tool which is linked to the financial models without the ambiguities to incorporate risk factors in the cash flow. It is a unique mathematical process for dimensioning currency risk on a various set of cash flow positions.

A first-order second-moment reliability method based on the Hashofer-Lind reliability index beta is undertaken to reflect the uncertainties of market risks with impact on the cash flow of the PPP project. The FX index is modelled via an expanding dispersion ellipsoid in the original space of random variables. The input variables in the proposed foreign exchange exposure (FEE) model include inflation rates, interest rates and foreign exchange rates. The variables form the ellipsoid of an n-dimensional shape. It reflects not only the effect of the mean values but also the covariances of the random variables influencing a defined investability domain. The computation of the FX index involves eigenvalues and eigenvectors, rotation of the reference frame, and transformed space for the random variables.

Additionally, a country reliability risk (CRR) index is designed to evaluate risk mitigation instruments (RMIs). FX risk exposure is often mitigated by RMIs. The value of RMIs depends on the affordability and the willingness of the government to compensate unforeseen FX fluctuation in the project. Factors influencing country reliability can be identified in the ability to repay debt obligations, liquidity difficulties and political difficulties.

Both methodologies, the FX index and the CRR index represent strategic components in the set of quantitative tools. The models can be used as a monitoring tool for performing FX exposure analysis. It is a forward looking approach which indicates how prepared the project is in absorbing economic FX exposure. The models can take care on the different institutional arrangements and payment structures because they are directly linked to the financial models. The FX index reflects the annual life cycle costs and revenue structures during the whole concession period. The outcome illustrates to project sponsors and lenders the critical variables that they need to control. The CRR index provides the default probabilities on RMIs. Both models can be applied to infrastructure projects such as power, water supply, and transportation.

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α_t	-	Country reliability state
ACMV	-	Air-conditioning and mechanical ventilation
ADD_k	-	Additional investment made in year k
BOT	-	Build Operate Transfer
BP-SC	-	Bid preparation sub-committee
β	-	FX index
C^{-1}	-	Inverse of the covariance matrix
C_x	-	Covariance matrix
C	-	Concession period
CAPEX	-	Total project investment and interest cost during the construction period
CCI	-	Country change indicator Z
CCRTM	-	Country reliability transition
CDF	-	Cumulative density function
CON_q	-	Construction cost position in real terms at a given year q
CPI	-	Consumer price index
CRA_{tj}	-	Cost rates at year j
CRR	-	Country reliability risk
CRTM	-	Country rating transition matrix
D_n	-	Debt drawing in year n
DC-SC	-	Design & construction sub-committee
DEB_n	-	Outstanding debt at the end of the construction period
DEB_{tj-1}	-	Outstanding debt t at year j
DEP_j	-	Depreciation at year j
DP-SC	-	Cost plan sub-committee
DSCR	-	Debt service cover ratio
$E[X]$	-	Mean vector
$EBIT_j$	-	Net operating revenue

$\Phi^{-1}[\ ]$	-	Inverse of the cumulative density function of a standard normal distribution
$\Phi\{\ \}$	-	Probability density function of the standard normal distribution
$F(x)$	-	Original non-normal CDF evaluated at x
$f(x)$	-	Non-normal probability density ordinate at x
f_{tj}	-	Inflation rate t at year j
$f_{tj}, f_{tj+1}, f_{tj+2}$	-	Annual inflation rates
FEE	-	Foreign exchange exposure
FFF&E	-	Furniture, fixtures, fittings and equipment
FM	-	Facility management
FORM	-	First-order second-moment reliability method
FX	-	Foreign exchange
$g(x)$	-	Feasibility function
i_{tk}	-	Inflation rate on cost position t in year k
IDN	-	Indonesia
IDR	-	Indonesian rupiah
IFS	-	International Financial Statistics
IRR	-	Internal rate of return
$\lambda_{i,j}^{t}$	-	Condition that at time t the grade is r_i
L_x	-	Limit-investability surface
LCC	-	Life cycle costing
LLCR	-	Loan life cover ratio
μ	-	Mean value
μ^N	-	Normalized mean
MP-SC	-	Master plan sub-committee
M&E	-	Mechanical and electrical
MYR	-	Malaysian ringit
MYS	-	Malaysia
O&M	-	Operation and maintenance

OPC_{tj}	-	Annual operating cost position t at year j
MAC_{tj}	-	Maintenance cost position t at year j
N	-	Construction period
NPV	-	Net present value
OFM-SC	-	Operations and FM sub-committee
OTC	-	Over-the-Counter
$P_{non-investability}$	-	Probability of non-investability
P_j	-	Outstanding debt payment at year j
$P_j + I_j$	-	Principal and interest
PDF	-	Probability density functions
PHL	-	Philippines
PHP	-	Philippine Peso
PM	-	Project management
RMIs	-	Risk mitigating instruments
PPA	-	Power Purchase Agreement
PPI	-	Producer price index
PPP	-	Public Private Partnership
PRG	-	Partial risk guarantee
R	-	Correlation matrix
R_{tk}	-	Borrowing rate in year k of debt t
R_j	-	Debt service reserve account
r_{tj-1}	-	Interest rate t in year $j-1$
ROE	-	Return on equity
σ	-	Standard deviation
σ^N	-	Normalized standard deviation
S_t	-	Foreign exchange rate in domestic currency per unit of foreign currency
$S_{tj}, S_{tj+1}, S_{tj+2}$	-	Annual FX rates
SGD	-	Singapore dollar
SPC	-	Special Purpose Company
SPV	-	Special Purpose Vehicle

t	-	Cost component
T_j	-	Tax
τ	-	Income tax rate
TAR_{tj}	-	Tariffs of type t at year j
USD	-	United States dollar
WPI	-	Wholesale price index
X_j	-	Output quantity at year j
Ω^t	-	Matrix
γ	-	Allowable maximum adjustment

CHAPTER 1

Introduction

This chapter provides an introduction to the research background, objectives and the methodology. It briefly introduces the main aspects of economic foreign exchange exposure in public-private partnership projects and highlights the novelty and delineation of this research.

1.1. Background

Public-private partnership (PPP) projects have gained worldwide popularity as an opportunity to use private sector resources in terms of capital, skills and management for infrastructure development in various sectors. Figure 1-1 illustrates the market size in terms of total value and number of transactions. Western Europe has the largest value but also Asia Pacific and North America doubled the investment volume from 2007 to 2008. Barbara Samuels, Senior Advisor of the World Economic Forum, announced in the Financing for Development Initiative (2005) that PPP projects could play a key role in financing much-needed infrastructure and services in developing countries, sparking economic growth and reducing the world's poverty by up to 90 per cent.

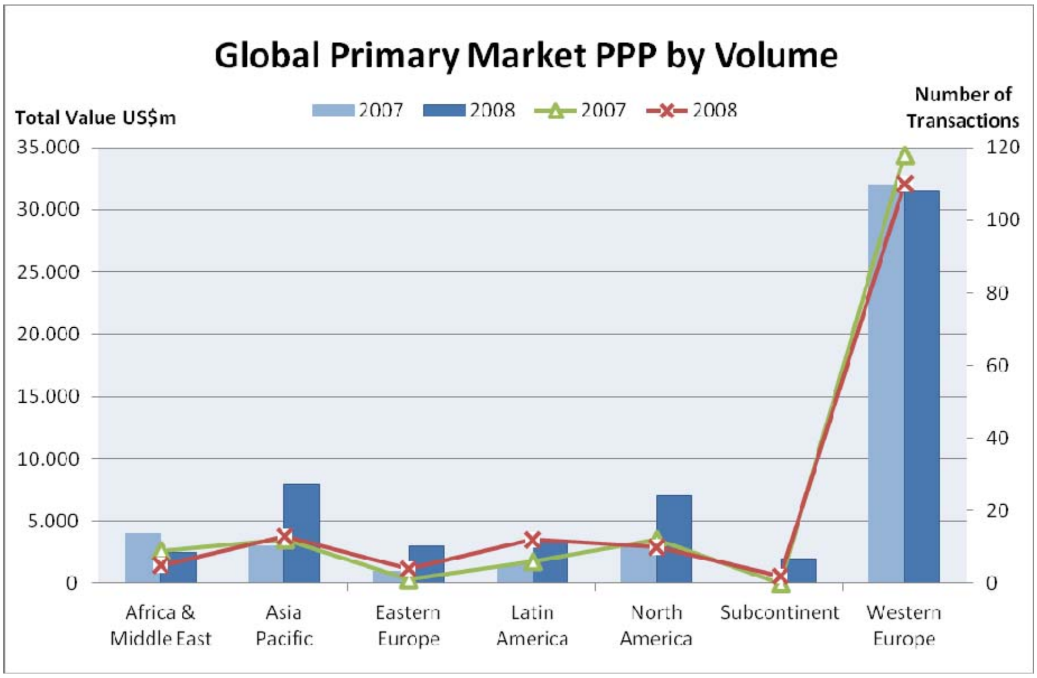

Figure 1-1: *Global PPP market by volume and number of transactions*
Source: IJ research & analysis

Investment or finance of infrastructure assets such as power, water, or roads have a long term horizon and require political stability. Developing countries such as Indonesia, Vietnam or India have the strongest growth and enormous pressure to modernize and expand the infrastructure. This demand cannot be covered by governmental funding and multilaterals. The characteristics of infrastructure as a long-term asset with high entry barriers and often regular or stable cash flows indexed to inflation rates and a low correlation to other asset classes in a portfolio makes infrastructure interesting for foreign capital. However, PPP projects must be prepared in a suitable way and will require a clear demonstration of the financial viability of the project during the concession period.

In spite of their commercial feasibility, some modern PPP projects have failed primarily due to the lack of accuracy in financial planning. This circumstance can be explained by considering the long concession period and the uniqueness of each project, as well as the uniqueness of the economic and political environment in which such an infrastructure project is realized. The purpose of this research is to investigate the economic foreign exchange (FX) exposure in PPP projects. Such exposure can be particularly relevant in the case of PPP projects, since whilst these typically generate their revenues domestically, and hence earn local currency, their financing costs and operating and maintenance costs are more typically denominated in hard currencies.

In general, project feasibility on economic FX exposure must be accomplished without the benefit of complete information. What constitutes minimum revenue and maximum cost is often defined on the basis of subjective judgements. Decisions on inflation rates, interest rates and FX rate assumptions are made under conditions of uncertainty.

Governments frequently incorporate risk mitigation instruments (RMIs) in the concessionaire contracts to compensate FX loss. However, the value of RMIs depends on the affordability and the willingness of the government to compensate unforeseen FX fluctuation in the project. Therefore, the economic FX exposure depends on the impact on cash flow positions, the applied risk mitigation instruments (RMIs) and the influence of country risks and market risks, as well as the risks inherent in the project.

The key research questions which contribute to the solution are:

i) What are the best risk mitigation strategies for economic FX exposure?
ii) How can FX exposure be quantified in PPP infrastructure projects?
iii) What are the default probabilities on applied RMIs?

The proposed methodology of the developed foreign exchange exposure (FEE) model and the country reliability risk (CRR) model have been designed to evaluate the sponsor's FX exposure by monitoring changes in the market condition. It accounts for the particular features of a project through adjustments to input data based on the specific project variables. It will also assist project sponsors in evaluating critical variables that they need to control in order to secure favourable loan terms, minimizing the loss of profit and improving the bankability of a project. The model can be applied to infrastructure projects such as power, water supply and transportation. Both models represent strategic components in the set of quantitative tools.

1.2. Research objectives

The research aims to develop a method to assess and quantify economic FX exposure in PPP projects. If the economic FX exposure exists, how is it possible to manage and control the risk? RMIs such as guarantees or tariff adjustment mechanisms can reduce economic FX exposure but their value depends on their affordability and willingness from the point of view of governments. Therefore, investors and sponsors need to assess the probability of default on applied RMIs.

The aims of this research can be achieved by the following five objectives:

i) To evaluate the best risk mitigation strategies for economic FX exposure.
ii) To aggregate probability density functions (PDFs) and correlations between market variables with impact on the project.

iii) To design an FX index which reflects uncertainties of economic FX exposure.

iv) To identify factors that indicate country reliability risk based on the affordability and willingness to compensate FX loss in the special purpose company (SPC).

v) To develop a method to aggregate these factors to a CRR index and to model default probabilities on RMI.

1.3. Proposition formulation

This research evaluates the following two propositions:

Proposition 1: "The designed FX index permits estimation of economic FX exposure in public-private partnership (PPP) infrastructure projects by considering distribution functions and correlations between the inflation, interest and FX rates."

Proposition 2: "Country risk has a significant impact on risk mitigation instruments (RMIs). The CRR index is based on signals and proxies and transferred into a conditional credit rating transition matrix to estimate default probabilities."

Proposition 1 will be proved by the developed FX exposure index. Proposition 1 is validated against a Monte Carlo simulation. The methodology is tested in case study A with application to the Malaysian, Philippine and Indonesian markets. A further case study B shows the predicted FX exposure versus the actual FX exposure.

Proposition 2 requires the development of the CRR model to estimate the value of RMIs based on signals that indicate country reliability. The proposition is tested against the sovereign ratings of foreign currency long-term debt and applied to Indonesia, the Philippines and Malaysia.

1.4. Research design and methodology

The main approaches in order to achieve the above mentioned objectives are empirical analysis such as case studies and questionnaires and theoretical model development. The development of the FEE and CRR model include logical deduction and probability theory. Figure 1-2 shows the propositions and the associated objectives for the development of the FEE model and the CRR model.

Chapter 3	Chapter 4	Chapter 5
Literature review	Proposition 1	Proposition 2
Objective 1: To evaluate the best risk mitigation strategies for economic FX exposure	Objectives 2 & 3: To quantify economic FX exposure in PPP infrastructure projects	Objectives 4 & 5: To model default probabilities on risk mitigation instruments such as tariff adjustment mechanisms and guarantees
Approach: Three questionnaire surveys were analysed and compared	Approach: Development of the foreign exchange exposure (FEE) model	Approach: Development of the country reliability risk (CRR) model

Figure 1-2: *Propositions and objectives for the FEE and CRR model*

1.4.1. Methodology framework for objective 1

The current approaches used to assess FX risk are reviewed and discussed in the literature review of chapter 3. The first objective is part of the literature review and achieved by an analysis of three questionnaire surveys. The objective is to identify the various FX risk mitigation techniques more commonly used and to investigate their perceived effectiveness. Hence, the results of three questionnaire surveys are analysed and compared regarding the perceived importance of currency risk control techniques. The first questionnaire is dealing with purely PPP projects and the second one with large construction companies, while the third examines the perspective of small- and medium-sized enterprises (SMEs). The analysis and comparison illustrates current FX risk mitigation practice, with both the advantages and disadvantages of adopting derivatives or other risk mitigation instruments.

The findings show that FX exposure is not as very well managed, both in the construction industry and elsewhere, as it might be. SMEs and SPCs remain largely dependent on bank advice as regards their hedging strategies. However, the potential benefits of relevant FX strategies in ensuring certainty of cash flows and the consequent guarantee of liquidity, can be significant. All three surveys demonstrate the significance of FX exposure to commercial success. The questionnaire analysis should enable both sponsors and contractors involved in construction, as well as SME owners/managers, to improve current practice in their FX management. Swaps and forward agreements are the most commonly used hedging techniques in PPP projects, in the construction industry more generally, less complicated instruments such as currency matching, borrowing in local currencies and forward market hedges, are applied. SMEs, whilst apparently using the full range of available derivatives, nevertheless appear to focus on forward and swap agreements.

1.4.2. Methodology framework for objectives 2 & 3

Objectives 2 and 3 are achieved by the development of the foreign exchange exposure (FEE) model. Figure 1-3 illustrates the process to develop the methodology with the aim to structure an extra tool which is linked to the financial models to achieve a high level of practicality. This requires a consistent process to evaluate FX exposure in PPP infrastructure projects. The developed FEE model provides a methodology of better understanding as well as responding to FX risk. The mathematical formulation and validation of the FEE model is derived in chapter 4. The index is based on the Hasofer-Lind reliability modelling from the engineering field of load-carrying structures with random loads and random parameters. It is a first-order second-moment reliability method which is adjusted to the characteristics of project finance with the purpose to analyse economic FX exposure in PPP infrastructure projects. The process has never been applied in project finance risk modelling before. It is an alternative method to Monte Carlo simulation with a computation time advantage and the outcome of a methodology to quantify FX exposure in project finance.

The aim of the FEE model is to reflect the uncertainties of market risks with impact on the FX exposure and the cash flow of the PPP project. Therefore, the FX index is modelled based on inflation rates, interest rates and FX rates. Exchange rates are correlated with inflation rates and interest rates and theoretically described by interest rate parity and purchasing power parity.

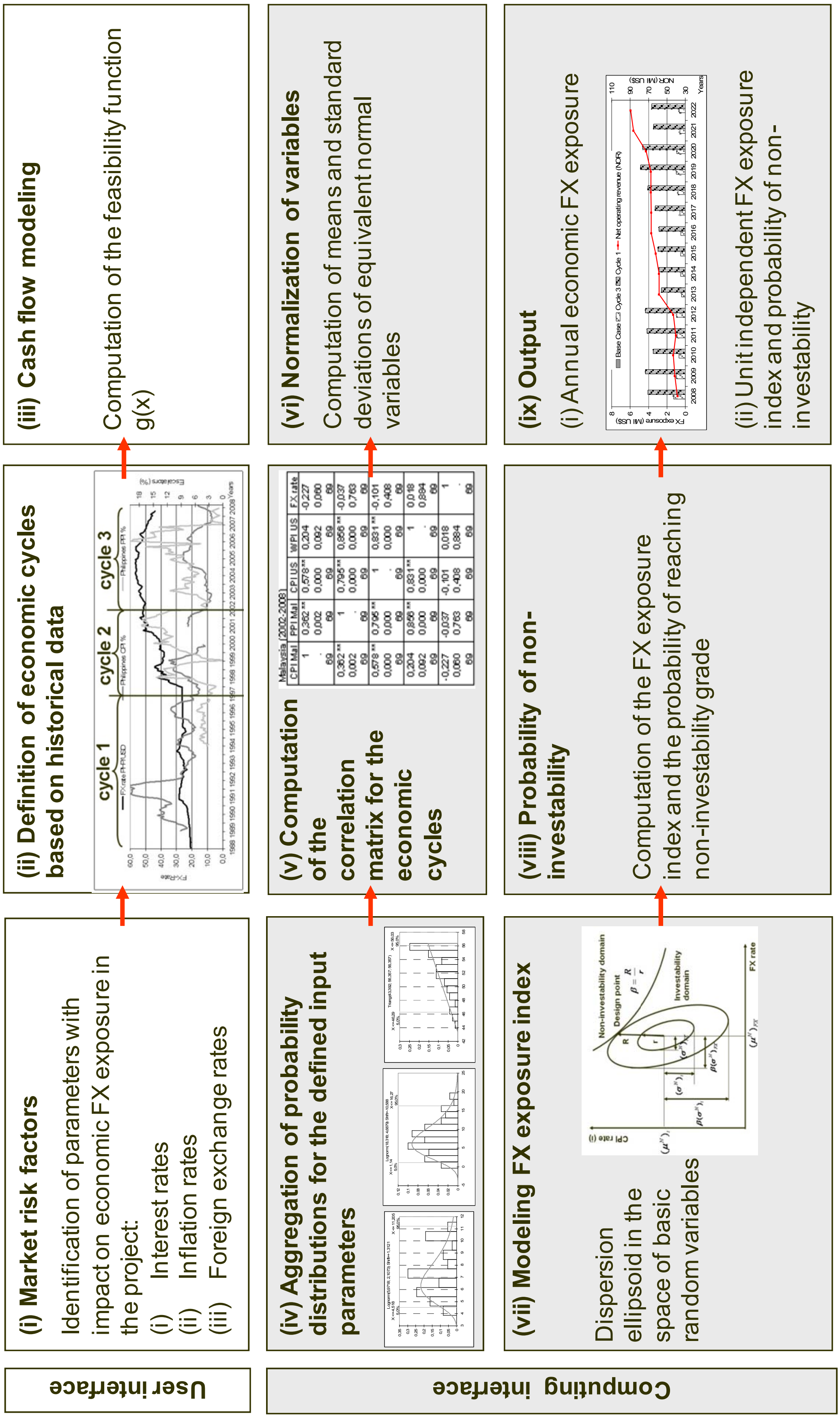

***Figure 1-3:** FEE methodology*

The FEE methodology is structured in a user interface and a computing interface (Figure 1-3). The following section will give a brief introduction of the main components in the FEE model. All formulas are derived in chapter 4. The market risk factors (box i) as input variables of the FEE model are interest rates, inflation rates and FX rates. The definition of the economic cycles (box ii) is based on historical data. Each cycle will be replicated in the future. Since the methodology is applied in Asia the analysis is based on three economic cycles indicating the period of growth in Asian markets (1989–1997), the Asian financial crises (1997–2002) and the current market situation (2002–2008).

The third box of the user interface is the link between the cash flow of the project and the FEE model. Chapter 4 shows how the net operating revenue (NOR), earnings before interest and tax (EBIT) and the total capital expenditures (CAPEX) are derived. The corresponding dividing surface on the debt perspective is called the limit investability surface. It is the probability that the project will perform its $DSCR$ requirement during the predetermined lifetime. The DSCR for the limit investability surface is computed as follows:

$$DSCR_j = \frac{EBIT_j + R_{j-1} - T_j}{P_j + I_j}$$

where $EBIT_j$ represents earnings before interest and tax, R_{j-1} stands for reserves, T_j for tax, $P_j + I_j$ for principal and interest, and the $DSCR_j$ is the minimum DSCR requirement in year j. The feasibility function g(x) is set to cero and defined as follows:

$$g(x)_j = EBIT_j + R_{j-1} - T_j - (P_j + I_j) * DSCR_j$$

The economic FX index in the computing interface is derived based on the assumptions of the user interface. First, each of the market variables will be fitted to PDFs during the defined time periods (box iv). The bivariate correlations (box v) between all input variables are obtained by the SPSS software. The Pearson correlation coefficient measures the linear association between the variables. A normalization process in box vi of variables is necessary to apply the fitted PDFs to the FORM modelling. The means and standard deviations of equivalent normal variables are computed by Rackwitz-Fiessler normal transformation with equivalent normal standard deviation

$$\sigma^N = \frac{\Phi\{\Phi^{-1}[F(x)]\}}{f(x)}$$

and equivalent normal mean

$$\mu^N = x - \sigma^N \Phi^{-1}[F(x)]$$

where x is the original non-normal variable, $\Phi^{-1}[\ ]$ is the inverse of the cumulative density function (CDF) of a standard normal distribution, $F(x)$ is the original non-normal CDF evaluated at x, $\Phi\{\ \}$ is the PDF of the standard normal distribution, and $f(x)$ is the original non-normal probability density ordinate at x.

After the normalization all variables are applied to the FORM methodology of an ellipsoid in the n-dimensional shape (box vii). The defined surface divides the n-dimensional space of variables into two sets of an investability domain and non-investability domain, as shown in Figure 1-4. The corresponding dividing surface of investability and non-investability is called the limit investability surface. Investability is defined as the minimum DSCR necessary to perform its operation and maintenance, principal and interest payments, tax and expected dividend payments during the predetermined lifetime. The limit is defined by the feasibility function g(x).

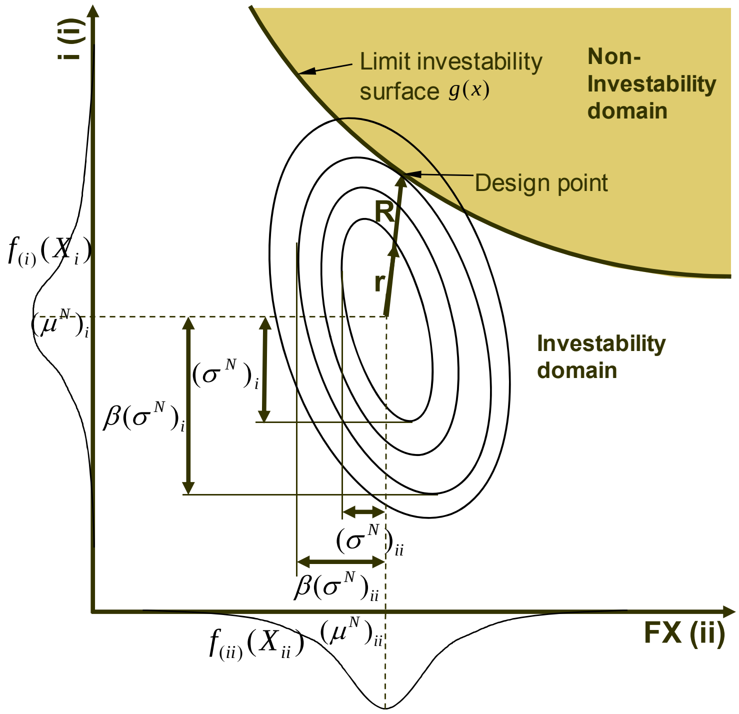

Figure 1-4: *Equivalent dispersion ellipses in the original space of the basic random variables*

Figure 1-4 shows a two-dimensional case of FX risk and inflation risk i. The FX index is the axis ratio (R/r) of the ellipse that touches the limit state surface of the non-investability surface and the one standard-deviation dispersion ellipse. The ratio is the same along any direction because of geometrical properties of the ellipsoid.

If input variables are correlated, the dispersion ellipsoid is tilted. The computation of the FX index involves eigenvalues and eigenvectors, rotation of the reference frame, and transformed space for the random variables. The Hasofer-Lind index is defined by the smallest value of this function. The matrix formulation of the Hasofer-Lind index for correlated normal random variables is:

$$\beta = \min \sqrt{\left[\frac{x-\mu}{\sigma}\right]^T [R]^{-1} \left[\frac{x-\mu}{\sigma}\right]}$$

where x represents the set of random variables, μ represents the mean value, R represents the correlation matrix, and σ represents the standard deviation. The procedure to compute β is by varying x_i to minimize the quadratic form of the ellipsoid subject to the constraint that the ellipsoid just touches the surface of the non-investability domain. The smallest ellipse or hyperellipsoid that is tangent to the non-investability domain is then equivalent to the most probable design point. Therefore, the index is equivalent to the distance from the ellipsoidal centre to the most probable point of non-investability grade (design point).

Based on the derived FX index β the probability of non-investability $P_{non-investability}$ is computed from the normal distribution of the FX index as follows (box viii):

$$P_{non-investability} = \Phi(-\beta)$$

The economic FX exposure is computed by the most likely case based on a minimum DSCR of defined economic cycles. All annual FX indices are computed with a probability of reaching non-investability. The most likely exposure is computed by the following equation:

$$FX_{\exp osure,j} = (x_{Actual\ case,j} - x_{cycle_n,j}) * \Phi(-\beta_j)$$

where x represents the net operating revenue, net cash flow or dividends, respectively.

The FEE methodology is validated versus Monte Carlo simulations based on the probability of reaching non-investability. Both methods show a maximum variation of 4% in the results of the probability of non-investability. Furthermore, the FX index is validated by a comparison of a case study in three different markets. The comparison between the three different economies is possible because the project cash flow is stated in USD. Local currency cost and revenue positions are adjusted by the exchange rates of the different markets. The annual values of internal rate of return (IRR), net present value (NPV) and equity IRR are the same in all three cases. This provides the basis to compare the economic FX exposure on the project within the three different markets.

A further case study B illustrates the estimated FX exposure by the FEE methodology versus actual FX exposure in the project. Comparing the values derived, it can be shown that the FEE methodology captures potential FX exposure.

1.4.3. Methodology framework for objectives 4 & 5

While the FEE model is focused on economic FX exposure based on market risk changes, the country reliability risk (CRR) index is designed to analyse country reliability on RMIs in PPP projects. RMI such as tariff adjustment or guarantees are often applied in PPP projects. The values of these instruments depend on the affordability and willingness of the issuers which are mostly governmental institutions. Therefore, objective 4 is to identify factors that indicate country reliability risk based on the affordability and willingness to compensate FX loss in the SPC. Default probabilities on RMI represent the result of objective 5. A CRR model is developed to aggregated the factors to an CRR index and country rating transition matrix (CRTM). The mathematical formulation and validation of the CRR model is derived in chapter 5. The following section will give a brief introduction in the methodology to evaluate reliability on RMIs.

The CRR index contains information about the willingness and feasibility of the government to exercise risk mitigation instruments if the risk should occur. The purpose of the CRR index is to generate and aggregate an opinion about the reliability of the country in performance on RMIs. All the indicators are aggregated as dimensionless proxies and translated to the CRR index. The FX risk mitigation loss probability is computed based on the CRTM and the CRR index as country change indicator as illustrated in Figure 1-5. The CRR model applies a conditional transition matrix and improves the prediction of government reliability on RMIs. The model has been designed to act as an assessment system and can be used as a monitoring tool for screening country reliability risk on RMIs. The model has a dynamic framework which requires input data based on indicators and proxies. It can be applied to support financial strategies in funding PPP infrastructure and helps investors to evaluate RMIs and prevents underestimation of the risk that a government will refuse to readjust the contract after or during a currency devaluation period.

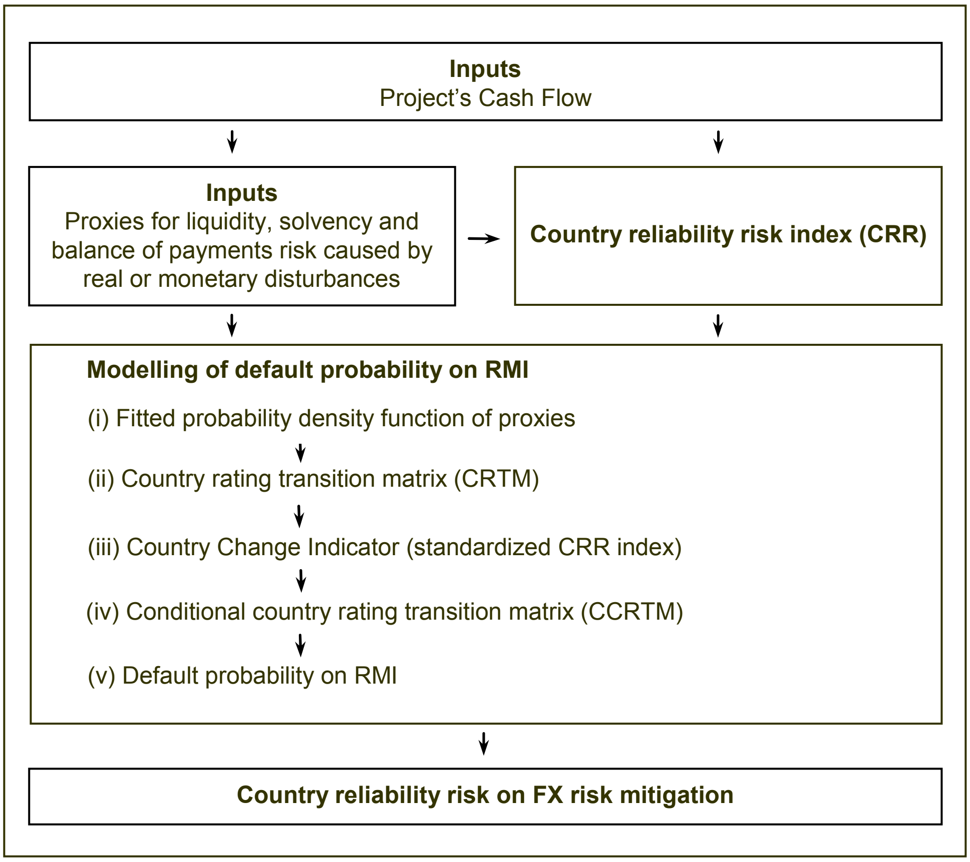

Figure 1-5: *The CRR model structure*

The CRR index is computed with six dimensionless ratios. The data are obtained from the international financial statistics database (International Monetary Fund). All the ratios are identified from the literature and tested in a regression analysis versus the foreign currency long term debt ratings.

The proxies chosen to develop the CRR index include: (i) growth of M2 (IFS line 34+35), (ii) growth of exports (IFS line 70), (iii) growth of foreign reserves (IFS line 1.D.D), (iv) M2 to foreign reserves (IFS line 34+35 and 1.D.D), (v) foreign assets to foreign liabilities (IFS line 21 and 26C), and (vi) growth in domestic debt (IFS line 32AN, 32B, 32C). Ratios (i) and (ii) are proxies for solvency risk focusing on balance of payments risk caused by monetary and real disturbances, respectively, while ratios three to six are liquidity risk proxies for debt rescheduling and financial leverage. The weights attached to the ratios of the index are the inverse of the standard deviation for each series, in order to equalize volatilities of the five components and to avoid any of them dominating the index. Each factor is expressed in the proportional rate of change in the ratios. The formulation of the aggregated index is described as follows:

$$CRR = (1/\sigma_{M2})(\frac{\Delta M2}{M2}) + (1/\sigma_R)(\frac{\Delta R}{R}) + (1/\sigma_E)(\frac{\Delta E}{E}) + (1/\sigma_{M2/FR})(\frac{\Delta(M2/FR)}{M2/FR}) +$$
$$+ (1/\sigma_{FA/FL})(\frac{\Delta(FA/FL)}{FA/FL}) - (1/\sigma_D)(\frac{\Delta D}{D})$$

where σ_{M2} is the SD of M2, σ_R is the SD of foreign reserves, σ_E is the SD of exports, $\sigma_{FA/FL}$ is the SD of foreign assets to foreign liabilities, and σ_D is the SD of debt. A low CRR index indicates a low risk in terms of country reliability and low probability of default, while a high CRR value measures a high risk in terms of country reliability and high probability of default.

In the first step the CRR index will be standardized to the country change indicator (CCI) because the probabilities of the country rating transition matrix (CRTM) are based on the standard normal distribution.

The country reliability risk grade is labelled as a vector R with elements $\{r_1, r_2, ..., r_m\}$. The grade r_m is the lowest default probability. The country reliability rating grade at time t is labelled as random variant R_t. The probability that the country reliability grade is r_j at time $t+1$ (i.e., $R_{t+1} = r_j$) on the condition that at time t the grade is r_i (i.e. $R_t = r_i$) is labelled as $\lambda^t_{i,j}$:

$$\lambda^t_{i,j} = \text{Prob}\{ R_{t+1} = r_j | R_t = r_i \}$$

The CRTM at time t, Ω^t, can thus be represented by elements of $\lambda^t_{i,j}$:

$$= \Omega^t = (\lambda^t_{i,j})_{m,m} = \begin{pmatrix} \lambda^t_{1,1} & \lambda^t_{1,2} & \cdots & \lambda^t_{1,m} \\ \lambda^t_{2,1} & \lambda^t_{2,2} & \cdots & \lambda^t_{2,m} \\ \cdots & \cdots & \cdots & \cdots \\ \lambda^t_{m,1} & \lambda^t_{m,2} & \cdots & \lambda^t_{m,m} \end{pmatrix}$$

The j column of the matrix Ω^t can also be conveniently labelled as Ω^t_j. Hitherto there has been no public transition matrix recorded for country reliability on risk mitigation instruments. Therefore the annual credit rating transition matrix in structured finance is used as proxy for the CRTM.

With the CRTM plus the country change indicator Z, it is possible to derive the conditional country reliability transition matrix (CCRTM).

$$\lambda^t_{ij} = \begin{cases} \Phi(y_j - Z_t) & j = 1 \\ \Phi(y_j - Z_t) - \Phi(y_{j-1} - Z_t) & 1 < j = m-1 \\ 1 - \Phi(y_{m-1} - Z_t) & j = m \end{cases}$$

where y is element of the CRTM and the Z-value is the standardized CRR index. The CRR index is therefore used as country change indicator and a shift of the PDF of ratings towards better or poorer country stages. As shown in Figure 1-6, a positive CRR index shifts the transition towards a better condition of country reliability, while a negative shifts the transition towards a poorer condition of country reliability.

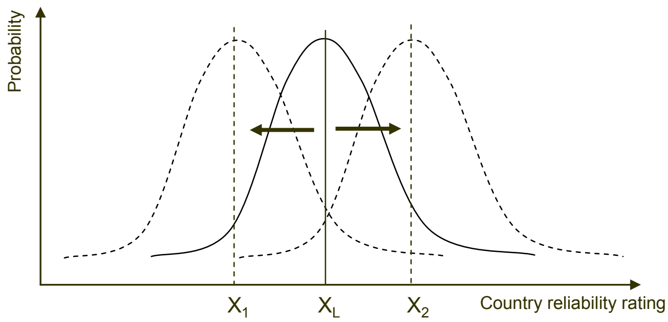

Figure 1-6: *CRR index with effect on country reliability rating transition*

The country reliability state α_t depends on the CCRTM and the distribution of the previous state vector.

$$\alpha_t = \alpha_{t-1} \bullet \Omega^{\text{t-1}} \qquad (t = 1,2,\ldots,n)$$

and

$$\alpha_t = \alpha_0 \bullet (\prod_{k=0}^{t-1} \Omega^k) \qquad (1 \le t \le n)$$

If α_0 the initial country reliability and Ω^t the CRTM are known, the country reliability can be calculated for every time period.

When the country reliability rating is at default grade at time t (i.e., $R_t = r_1$), it is regarded that it is in the state of default. The probability of occurrence of that event is hereby denoted as $P_d(t)$.

$$P_d(t) = \sum_{k=2}^{m} \Pr\text{ob}\{R_t = r_1 \mid R_{t-1} = r_k\} \times \Pr\text{ob}\{R_{t-1} = r_k\}$$

and

$$P_d(t) = \begin{cases} \alpha_0 \bullet \Omega_1^0 - p_1^0 & t = 1 \\ \alpha_{t-1} \bullet \Omega_1^{t-1} - \alpha_{t-2} \bullet \Omega_1^{t-2} & t \ge 2 \end{cases}$$

The CRR index is tested against the sovereign ratings of foreign currency long-term debt in the cases of the Philippines, Indonesia and Malaysia. However, sovereign ratings can remain constant over long time periods and do not change very often. The CRR index changes immediately if the related macroeconomic factors change. Due to the limited changes of ratings, data from Standard&Poor's (S&P), Fitch Rating and Moodys are obtained. The model is validated in a regression analysis between default probabilities computed by the CRR model versus average default probabilities of foreign currency long term debt by rating agencies.

1.5. Novelty and delineation

The proposed FEE and CRR models are new structured approaches. The FEE and CRR models are based on historical data and indicators and proxies to simulate the FX exposure and the country risks regarding the government's willingness and feasibility regarding compensation of FX loss. According to the literature review, such approaches do not yet exist. Therefore, this research contributes to the field of risk analysis and management by offering an enhanced analysis of FX risk impact.

The proposed method will avoid the limitations of previous risk assessment models by: (i) a unique mathematical process for computing economic FX exposure in PPP projects, (ii) modelling all risks based on correlation factors, (iii) modelling all input variables based on a risk distribution function which will fit the specific risk type more accurately, and (iv) using a methodology to estimate impact and probability that is dynamic and based on indicators and proxies.

1.6. Outline of the thesis

The thesis is presented in 6 chapters, as illustrated in Figure 1-7. Chapter 1 provides a brief introduction to the research questions, objectives, methodology, and propositions.

In chapter 2, the previous studies on FX risk management are reviewed. The findings are relevant to raise the issues and contribute to the design of framework and model development. Chapter 2 comprises an introduction to the characteristics of PPP projects, FX exposure in PPP projects, FX risk modelling, the Exchange market pressure index and the integration of life-cycle costing and FX risk modelling in PPP tenders.

Chapter 3 discusses potential FX risk allocation opportunities to the host country government, to offtakers, to private investors and to customers. The advantages and disadvantages of potential risk mitigation opportunities are discussed. Furthermore, the objective of this chapter is to identify hedging techniques and to investigate the effectiveness of the various hedging techniques that are commonly used in the industry. The results of three questionnaire surveys are analysed and compared regarding the importance of currency risk control techniques to sponsors and contractors in PPP projects, international construction projects and small and medium-sized enterprises. The results illustrate current FX risk hedging practice and the advantages and disadvantages of adopting derivatives or other risk mitigation instruments.

Chapter 4 introduces the CRR model and its specific components. The FX index computation methodology is developed related to the project finance modality. A case study shows the application of the FEE model in a case study of three different markets. The novelty of the FEE model is shown by delineating it against related work and practice. The computed probability of reaching non-investability is compared with the commonly used Monte Carlo simulation. Another case study is analysed to compare the computed FX exposure versus actual FX exposure.

The modelling of FX risk mitigation loss probability and the development of the CRR index are examined in chapter 5, which illustrates the concept of the FX risk mitigation loss probability development. The model is validated in three different markets.

Finally, chapter 6 illustrates the additional information aggregated from the proposed FEE and CRR model. Furthermore, the final chapter includes a conclusion and discussion of the probable extensions of the method.

Chapter 1: Introduction
- Research questions
- Objectives, Methodology, Propositions

Chapter 2: Literature review
- Risk management
- FX exposure in PPP projects
- FX risk modelling
- Exchange market pressure index
- Integration of LCC and FX risk modelling in PPP tenders

Chapter 3: Foreign exchange management and control
- FX risk allocation and mitigation
- Advantages and disadvantages of commonly used hedging techniques

Chapter 4: Foreign exchange exposure (FEE) model
- Project feasibility modelling
- FX index computation
- Application of a case study in three different markets
- Validation of the FEE model against Monte Carlo Simulation
- Case study on computed FX exposure versus actual FX exposure

Chapter 5: Modelling FX risk mitigation loss probability
- Computation of the CRR index
- Validation of the CRR index in three different markets

Chapter 6: Future work and conclusion

Figure 1-7: *The thesis structure*

CHAPTER 2

FX risk exposure in PPP projects and theoretical foundation

This chapter provides a discussion on basic macroeconomic concepts of FX rate modelling and reviews previous research on FX exposure in PPP projects. The focus in this chapter is on the risk management process of economic FX exposure modelling in PPP projects. FX risk mitigation strategies are preliminary implemented during the PPP tender stage. A case study shows how project management responds to FX risk modelling, how effective FX modelling is exercised, and how to improve current practice in FX risk management during the tender stage.

2.1. Introduction to Public-Private Partnership

Public-private partnership (PPP) projects have gained popularity worldwide as an opportunity for the public sector to enter into partnership with the private sector to use available resources in terms of capital, skills and management expertise of infrastructure development. The essence of PPP illustrates co-operation between the private sector and public sector agencies to develop, operate and maintain jointly a sustainable infrastructure project. Sovereign tasks include to develop the idea according to their own or users' needs, to structure the project, to define the procurement method, to put the project out to tender, and to supervise and control the service performance. The private sector partner finances the development and operates, manages and maintains the facilities during a concession period, usually of 25 to 30 years (Tiong, 1990b; Tiong, 1992; Tiong, 1996). During this period the concessionaire receives in return either a regular payment as service availability fee or revenues based on third-party income. As a consequence, the uncertainty in revenue concerns three key issues; the magnitude, structure, and adjustment mechanism of the tariff (Ye, 2003).

A modern PPP project involves finance, construction, operation and maintenance and is characterized by the participation of various parties with different interests (Tiong, 1992). PPP projects have been introduced as an approach to overcome the government's fiscal shortcomings as well as the difficulties in funding public projects (Ho, 2001). The success of such projects mainly depends on the ability of the project's sponsors to manage the risks associated with financing, construction and operation of the project.

A project can be financed by equity and by different tranches of senior debt or mezzanine debt. The appropriate financial structure depends on the project and the market opportunities. In general infrastructure projects have high construction costs which makes it impracticable for project sponsors to finance the project totally by equity. Additional, the project can have huge inherent risks (Tinsley, 2001). Therefore, project sponsors can prefer project financing instead of taking all the risks by using corporate financing. Since lenders are also concerned about the project risks, the successful financial close will depend on contractual arrangements and government support.

PPP projects are generally structured under the project finance modality on a non-recourse or limited recourse basis. Dailami (1999) describes the main characteristics of project finance, compared with the traditionally corporate-financed infrastructure, as a high concentration of project risks that undergoes important changes as the project comes to fruition with a relatively stable stream of cash flow that is subject to market and regulatory risks once the project is completed. This high concentration of project risks requires a careful demonstration of the project's financial viability over its entire lifespan. Equity investors and other long-term investors will be unwilling to provide the required amount of funding at competitive interest rates if the risks involved cannot be assessed properly (Levy, 1996).

An appropriate pricing and allocation of risk requires a reliable contractual structure and a reliable legal system to enforce the contractual arrangements. Therefore, an integrated, interdependent contractual structure is a key to a successful financial close. The actual financial structure, the contractual arrangements, and the government support will vary regarding the implementation strategy of the concessionaire agreement, the type of infrastructure, the economic and financial circumstances of the country, the complexity of the project and its output market. Figure 2-1 is an example of typical contractual arrangements for PPP infrastructure projects (Ye, 2001).

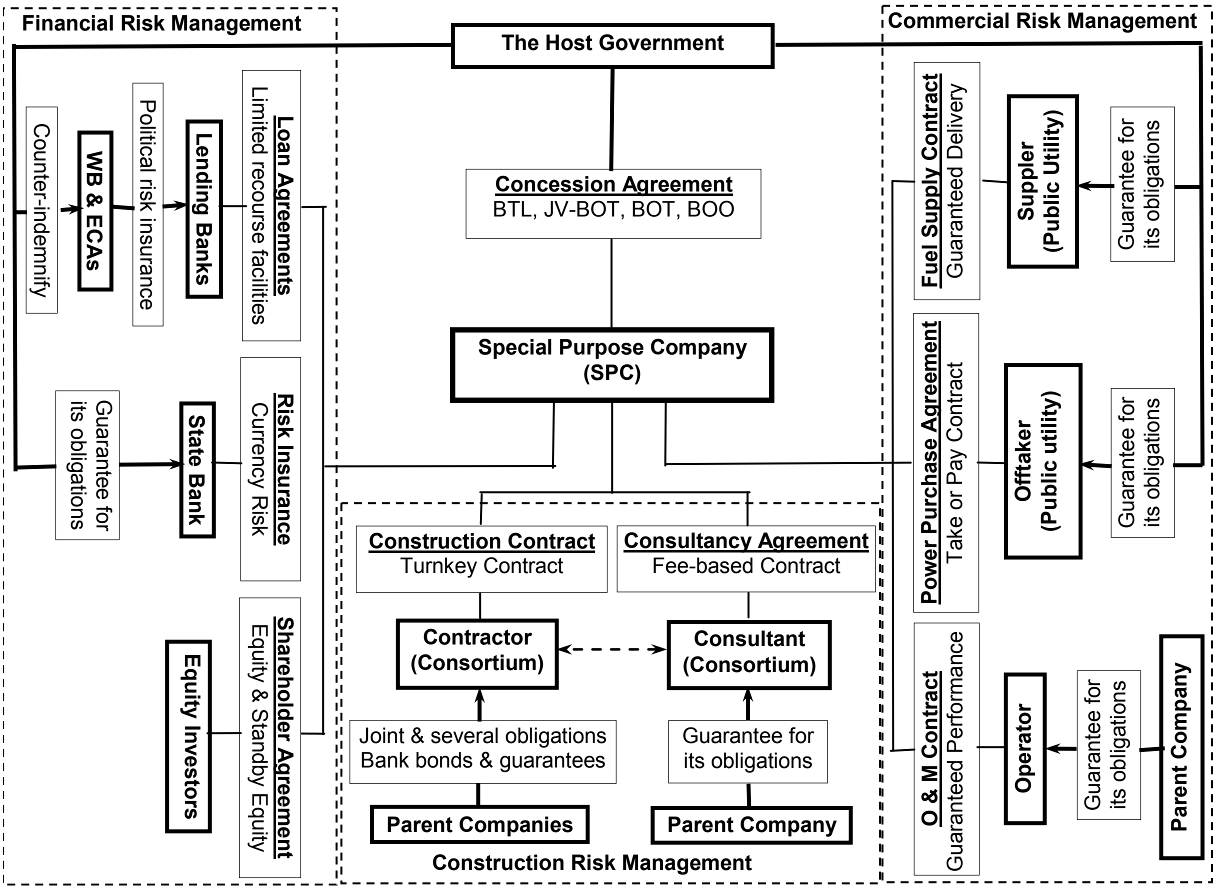

Figure 2-1: *Typical contractual arrangements to mitigate risks in PPP projects Source: Ye (2001)*

The PPP procurement is not new, especially in countries like the UK, the USA, France, Spain, Canada, Japan and Australia, and in the Middle East. The most common projects under project finance initiative (PFI) schemes include utilities, hospitals, schools, highways and bridges, army camps and barracks, airports, seaports, and housing. Each PPP project can be realized under different institutional arrangements. The organizational differentiations are known as formal, material, and functional privatization. Formal privatization is a partial transfer of ownership from a public enterprise to a shared public-private SPC. The company operates as a private company under civil law. In some cases the formal privatization is a preliminary stage for a material privatization afterwards. In this case, the material privatization is the process of transformation to a 100 per cent private enterprise with no public partner. The PPP approach under a functional privatization is the outsourcing of tasks and services with or without a temporary transfer of ownership.

The level of different tasks outsourced has a direct influence on an optimized risk allocation and the opportunity to realize efficiency and higher value for money invested.

Institutional arrangements vary in historical development, terminology, definitions, and application from country to country and from sector to sector. The legal and institutional framework, instruments and the procurement processes are country specific. However, the political and economical drivers, and consequently the general understanding, become more and more equal (Alfen, 2007).

Researchers like Alfen, Tinsley and Tiong describe the advantages of a PPP procurement compared with a public procurement as: (i) an optimized risk allocation structure, (ii) the injection of operating expertise and enhanced efficiency through appropriate sharing of tasks and responsibilities, (iii) the reduction of governmental fiscal commitment through private investment and a long-term contractual relationship, and (iv) innovations through incentive schemes like output specifications, project agreement, service levels and unitary payment mechanisms (Tinsley, 2001); (Tiong, 1996). In short, the private partner (known as the Special Purpose Company (SPC)) must reduce the project costs, increase the quality and level of service, fulfil corporate social responsibility, provide value for money, manage risks, and still make a profit over the whole life of the project.

The previous studies in PPP research cover a wide range, such as: risk identification and analysis of PPP projects (Tiong, 1990); (McCarthy, 1992); (Wood, 1995); (Merna, 1996); (He, 1996); (Wang, 1998); (Kerf, 1998); discussions on the FX risk allocation between the stakeholders (Gray, 2003); (Matsukawa, 2003); government support (Tiong, 1990); (Klein, 1997); (Dailami, 1997); risk management for PPP contracts (Merna, 1992); (Yaworsky, 1994); return analysis (Ng , 2007); critical success factors in winning PPP contracts (Tiong, 1992); (Al-Reshaid, 2005); concessionaire selection criteria (Zhang, 2004); conditions for successful privately initiated infrastructure (Keong, 1997); assessment of project viability (Russell, 1994); (Lam, 1998); (Malini, 1999); (Dailami, 2000), (Wang, 2006); project financing (Woodward, 1992); PPP projects in developing countries (Augenblick, 1990); (Platt, 1996); (Ye, 2000b); various models for PPP project evaluation (Wahdan, 1995); (Dias, 1995), and case studies on privately financed infrastructure projects (Lang, 1998); (Tzeng, 2006); (Rousseau, 1999); (Wang, 2000). Recent discussions in PPP research focus on the critical determinants of construction tendering costs (Elhag, 2005), value creation in delivery of turnkey projects (Ahola, 2008) and the responsibilities of construction project planners (Winch, 2005).

2.2. Economic FX exposure in PPP infrastructure projects

Exchange rates are determined by numerous complex factors and highly correlated to interest rates and inflation rates. Currencies are seen as political and economic asset which represents the health of the country's economy. Political instability is represented in the value of the currency. If countries perceive political and economic risk investors will move the capital to the currencies of more stable countries. Beside the political stability and economic performance FX rate movements are forced by differentials in inflation and interest rates, current account deficits, public debt and terms of trade.

Since the collapse of the Bretton Woods system in 1971 following the US Government's suspension of convertibility from dollars to gold, FX rates have become floating and significantly volatile. A world of international trade leads to a change in relative currency values. The volume increased over recent years simply because of the enhanced proportion of exports appearing in company's overall sales as foreign trade worldwide expands (Hull, 2006). Today the FX market is one of the largest and most liquid financial markets in the world. FX trading includes trading between central banks, banks, corporations, governments, individual investors, hedge funds and other institutions. According to the Bank for International Settlements, average daily turnover in global FX markets is estimated at USD 3.98 trillion. The main FX market turnovers are spot transactions, forwards, and swaps (Hull, 2006).

Countries manage their currency under different exchange rate regimes. The basic types are floating, pegged float, and fixed exchange rates (Whaley, 2006). In a floating exchange rate regime such as dollar, euro, yen or British pound the market dictates the movements. The central bank keeps the exchange rate within a target band in a pegged float currency. A fixed exchange rate regime ties the currency to another currency or a basket of currencies backed one to one by foreign reserves. Therefore central banks play a major role on the influence on the money supply in the economy. They sell and buy currencies and government securities such as bonds, notes or other debt instruments by exchanging money for the security. By buying securities they raise the money supply. The central banks will add a credit to the banks reserve and lend a portion of the money to other banks in the federal funds market. The increase of money in the banking system lowers the federal funds rate, reduces the interest rates, and devaluates the currency. If they are selling securities they will lower the money supply. By selling securities the reserves are reduced and the amount of money to lend is reduced which increases the interest rates and appreciates the currency. The central banks have to provide treasury securities as collateral for the value of the currency they print. The buying and selling is also called managed float regimes or dirty float. A dirty float looks like a free market but central banks have a measure of control. Dirty float also refers to central bank action to influence exchange rates by buying back or selling its own currency with external currency. For occasionally floating, hard currency reserves are needed (Brealey, 2000).

Before considering the implementation of a PPP project investors and lenders have to examine financial feasibility of the project. Part of the financial feasibility is the economic FX exposure. It is the extent to which the future earning power is affected by changes in the exchange rates. The FX risk can be defined as the variability in the value of a project or as an interest in the project that results from unpredictable variation in the exchange rate (Gray, 2003). Macroeconomic factors like import and export as well as natural disasters and political decision can have a significant influence on the volatility of the FX rates. In the most common context, the FX risk is the risk of exchange rate translation losses associated with any economic interest that is denominated in a foreign currency (DeRosa, 1996). Any input that is tradable even if it is not imported will have world price, so its cost, which is measured in the local currency, will inversely vary with the FX rate. The FX risk naturally has an upside and a downside. However, the experience in most developing countries has been local currency depreciation against more stable industrial country currencies (Matsukawa, 2003).

Previous research in this area has focused on alternate financing strategies and the application of PPP procurement (Schaufelberger, 2003); (Shen, 1996). Exchange rate risk management in international construction companies on borrowing and FX future hedging is presented by (Kapila, 2001). Ye (2000) contributed with an NPV-at-risk model by combining the weighted average cost of capital and dual risk-return methods. The model supports general risk investment decisions on the basis of NPV. However, the methodology gives no solution for how to quantify the annual risk values. The problem will be solved by the FEE methodology derived in this research.

An important task for lenders is to ascertain the ability of the project company to service both principal payments and interest payments. Traditional credit analysis focuses on the company's balance sheet and income statements to determine whether a borrower is generating sufficient cash flow to service its debts. Analyses of the industry, business plans, and management skills collectively provide a valuation on whether sufficient cash flows are likely to persist over the life of the outstanding liabilities. Although models for assessing credit risks have been built by some financial institutions and credit agencies, these models largely target the creditworthiness of an entire firm rather than specific projects that may be funded off-balance sheet via a SPC (Kong, 2008b).

The FX exposure in PPP projects can be viewed either from the perspective of the project as a whole or from the perspective of parties with an interest in the project, such as private investors, customers, or the host-country government. The FX exposure is defined in terms of transaction, translation and economic exposure (Bartram, 2005). Transaction exposure is the extent to which the income from individual transactions is affected by fluctuations in FX values in the short term. It covers obligations to purchase or sell at pre-agreed prices or borrowing or lending of funds in foreign currency. The translation exposure is the impact of currency exchange rate changes on the reported consolidated results of the balance sheet. The economic exposure is the extent to which the future earning power is affected by changes in the exchange rates. Consequently, it is the FX risk impact on the cash flow of the SPC.

Short-term FX exposure can be hedged in the market. However, economic FX exposure (with its focus on the long term) is more difficult to mitigate. For example, Boey (1998) stated that FX risk and political risk are both rated equal in priority by foreign lenders and equity investors, since government policies influence both FX risk mitigation opportunities and relevant instruments. Demacopoulos (1989) has described the barriers encountered in general construction projects as including: currency restrictions; capital market access restrictions; restrictive government procurement; capital and exchange controls; and government-aid programmes favouring local contractors. All such barriers, and more, are relevant for the complex nature of PPP projects because the concessionaire contract additionally includes the whole operation and maintenance period. Furthermore, PPP projects invariably require a significant investment and therefore inevitably involve more than one currency (Block, 1997).

The FX risks result from the uncertainty of foreign currency values, since the costs and revenues are often partly based on different foreign currencies (Cooley and Peyton, 1988); Gitman, 1992). Currency exposure can also arise from the mismatch of costs and revenues as driven by the contractor's operational and financial choices, with Demacopoulos (1989) arguing that FX risks exist even before a contract is signed because of FX volatility between bid and award dates. As a result the concessionaire may receive less revenue than expected or the offtaker may have to pay more than the expected amount for the service provided (Block and Hirt, 1997). Consequently, any party involved in a PPP project would be advised to assess their economic FX exposure in order to protect the resultant costs and revenues from subsequent unanticipated fluctuations.

Therefore, a commonly used practice in structured finance is to perform sensitivity analysis on the associated cash flows and to test the creditworthiness of the private sponsor. However, sensitivity analysis only shows the impact of potential FX fluctuations on financial ratios, like the debt service cover ratio (DSCR) or internal rate of return (IRR). However, sensitivity analysis does not provide the expected value of the potential FX risk exposure during the concession period.

The objective in this research is to demonstrate the application of a developed FX exposure index. The index provides additional information to investors and lenders. It is a tool to improve investment decisions and price return differentials and to justify the use and abuse of hedging. The index is designed to quantify the economic FX exposure in PPP projects. Current risk modelling focuses on each market variable separately. Banks look at FX rates and interest rates and try to mitigate the risk in the market or to allocate it to different parties. However, if one market variable changes, other variables are often correlated. In this case, market variables could have a different impact on the various cash flow positions as well as an impact on the tariff adjustment mechanisms.

To solve this problem the FX index is modelled as a system of market variables including inflation rates, interest rates and FX rates with impact on the cash flow of a project. All the variables are fitted to PDFs during a defined time period. The correlations between the variables are aggregated on defined economic cycles. As a result, the system makes it possible to quantify the dollar value of the potential FX exposure in a probabilistic view.

Since the Asian financial crises (1997), lenders and investors have been concerned with FX risk as well as convertibility and transfer risks. These can significantly affect the project's internal rate of return (IRR) and the net present value (NPV) of a special purpose company (SPC). The experience of investors is that contractual arrangements for infrastructure projects have been broken or renegotiated frequently. Furthermore, Matsukawa (2003) states that even when projects are financed on a non-recourse basis, a currency crisis in foreign markets will not only affect the SPC but will also negatively affect the investor's credit rating. The value of the foreign assets and the expected revenues decline and investors face the choice of financing losses or writing-off their investments.

Financial assets with contractually fixed cash flows and readily available market prices play a minor role in non-financial institutions (Bartram , 2005). Non-financial institutions like the SPC have current values of real assets such as O&M costs, like machinery and production facilities. Compared with the transaction exposure it is much more difficult to determine economic FX exposure, since the future cash flows from these assets are not contractually fixed and may be affected by currency movements (Bartram, 2005). Therefore a complete profile of economic FX exposure of the SPC requires an integrated approach to financial assets and real assets (Adler, 1980). Additionally, projects under PPP procurement have highly regulated tariffs and revenues capped by tariff adjustment mechanisms. As a result, international contractors have to keep track and be aware of current developments and changes in international finance. They must be able to adapt and adjust according to the different market situations. The achievement of this objective, however, must be accomplished without the benefit of complete information. What constitutes minimum revenue and maximum cost is often defined on the basis of subjective judgements. Assumptions on inflation rates, interest rates and FX rates are made under conditions of uncertainty. The adequacy or inadequacy of applied market rates may be evaluated or calibrated only in terms of past experience with similar projects or markets.

The common practice to test the feasibility of projects is through the use of risk factors on revenue and costs or by adopting conservative assumptions in the cash flow, which does not reflect the uncertainties of economic FX exposure on revenue and cost positions in the project. This method lacks the logical basis for addressing uncertainties.

Other methods, like Monte Carlo simulations, are quite complex to implement and time consuming in the simulation process. The proposed method of feasibility analysis via expanding dispersion ellipsoid is simple in the modelling methodology and rapid in the simulation time. The FEE model is developed with the purpose of quantifying economic FX exposure in the cash flow of the SPC. FX fluctuations are linked to changes in interest rates and inflation rates. Therefore, the model considers probability distributions and correlations of market variables which are linked to the cash flow. Historical cycles are applied to estimate the future economic FX exposure. Feasibility is assured in terms of the probability that a defined investability grade will be adequate to withstand economic FX exposure. All components of the quantitative model developed in this research, and their interconnections, will help to serve this purpose.

Infrastructure projects tend to have an increased exposure to FX risk (Matsukawa, 2003). The explanation can be seen in the specific structure of PPP projects. First, they generally cover a large scale of investment volume and depend on foreign loans in many developing markets. Second, infrastructure projects in many sectors have concession contracts of more than 20 years and require long-term loans to recover the investments. As a result, investors have a weak position to negotiate on the FX loss as long as the principal is not repaid and the output is not tradable in international markets. Third, the revenue and the tariffs charged to consumers are usually highly regulated. Many infrastructure projects, like power or water projects, have a market that can only support one distribution network in a given geographical area. Therefore, infrastructure projects are highly affected by political influence. Fourth, operation and maintenance costs are dollar-denominated and the output is often not tradable on international markets. However, projects with an output tradable on international markets might profit from local currency depreciation which makes the goods or services cheaper on international markets, leading to an increase in sales and revenues. Fifth, the assets are difficult to redeploy and the FX losses cannot be minimized by the exit from the investments.

The financial viability of a project depends on the relationship between risks at different levels. In the literature, from interviews, and by logical deduction, it is demonstrated that country-level risks influence both the market- and project-level risks, while the market-level risks also influence the project-level risks. Figure 2-2 illustrates how currency devaluation impacts PPP projects. Economic FX exposure on the cash flow is influenced by risk on the country, market and project level. In the case of applied RMIs, the impact of FX exposure depends additionally on the feasibility and willingness of the government to compensate the SPC for FX losses.

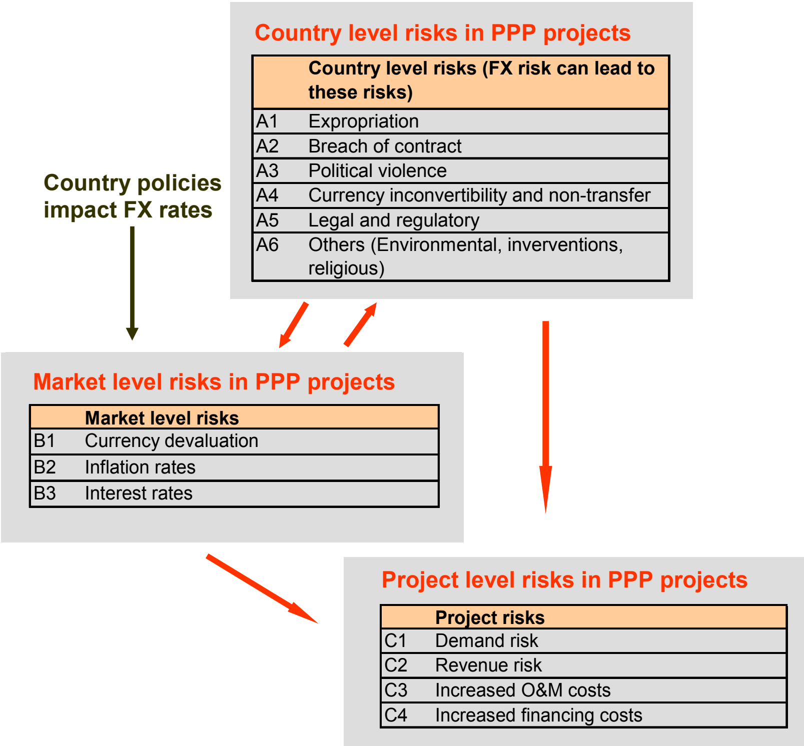

Figure 2-2: *Economic FX exposure risk factors at country, market and project level*

Each country itself requires a good understanding about the conditions related to regulatory and political risks. However, it is always possible that these risks are still too great to attract long-term investors.

2.3. Risk management in PPP projects

Literature on PPPs shows that the basic process of risk management involves the two stages of risk assessment and risk control. According to Alfen (2007), risk management may be broken down into; risk identification, risk analysis, risk prioritization and risk allocation. Risk identification requires a good understanding of the risk impact, the time of occurrence, such as short-term or long-term, as well as the frequency. In order to control these risks, the process should be expanded by risk management planning, risk resolution, and risk monitoring. Although the process of risk management has been applied in financial management and construction management, as well as operations management, there is a lack of integration of these methods into the area of PPP procurement (Ye, 2001). Figure 2-

3 explains the flow of the seven different phases in the process of risk management for PPP projects.

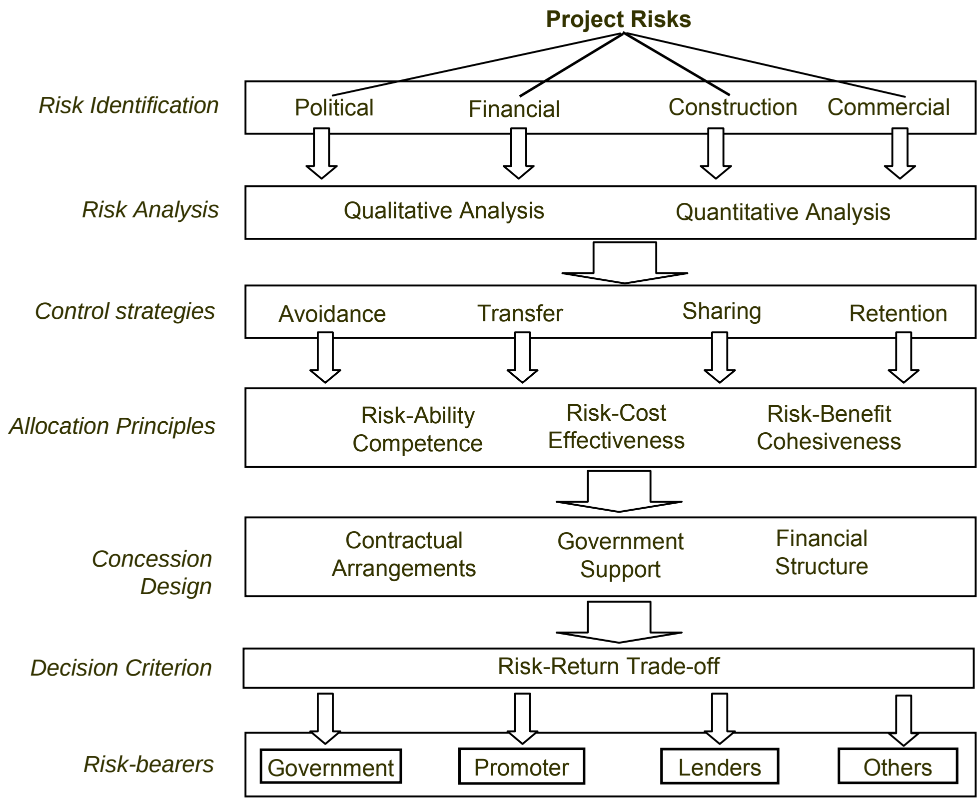

Figure 2-3: *The risk management process*

Source: Ye (2001)

The challenge in risk management is to integrate the different concerns and strategies of the key project players. According to Smith (1995), Haley (1996), Irwin (1997) and Kerf (1998), the question is: Who should bear what risks and to what extent? In the literature, attention is paid to three crucial factors; the ability to influence or control the risky, the outcomes and the ability to bear adverse results from the risk, and the incentive to bear the risk. From a common viewpoint, risk should be allocated to those who will benefit from controlling the risk under the lowest costs. Table 2-1 is a typical risk structure including risk identification, risk mitigation, risk allocation and the assignment of relevant cash flow positions.

Table 2-1: *Typical risk structure with risk identification, risk mitigation and risk allocation*

Risk analysis						
Nr.	**Risk type**	**Mitigation**	**Risk allocation**			**Reference position**
			Public	**SPV**	**Insurer**	
1.0	**Political risk**					
1.1	Expropriation, revoke, sequestration	Hunan Government Guarantee	x			Revenue
1.2	Exclusivity (i.e. not second facility)	Power purchase agreement(PPA)		x		Revenue
1.3	Changes in law	Hunan government Guarantee	x			Revenue
1.4	Delay in development approvals	Concession agreement to extend concession period	x	x		Revenue
1.5	Adverse Government action or inaction	Risk is shared	x	x		Revenue
1.6	Increase in taxes (general)	Risk is shared	x	x		Revenue
1.7	Increase in taxes (specific)	PPA to adjust tariff	x			Revenue
1.8	Political force majeure events	Hunan government Guarantee	x			Revenue
1.9	Termination of concession by Government	Government compensation	x			Revenue
1.10	Payment failure by HIPDC	Hunan Government Guarantee	x			Revenue
1.11	Reliability and creditworthiness of entities	Risk is in SPV		x		Revenue
2.0	**Construction completion risks**					
2.1	Land acquisition	Concession agreement to authorise SPV	x			Construction cost
2.2	Restriction on import equipment/ materials	Hunan Government guarantee	x			Construction cost
2.3	Provision of utilities	Utilities supply agreement	x			Construction cost
2.4	Cost overruns	External audit and advisors control		x		Construction cost
2.5	Time and quality risk	Technical advisors and external audit		x		Construction cost
2.6	Contractor default	Liquidated damage payable by contractor		x		Construction cost
2.7	Default by Concession Company	Risk is shared	x	x		Construction cost
2.8	Environmental damage-subsisting	Hunan Government need to do treatment for SPV	x			Construction cost
2.9	Environmental damage-ongoing	Environmental and technical advisors control		x		Construction cost
2.10	Protection of geological and historical objects	Hunan Government compensation for the loss caused by discovery of geological and historical objects	x			Construction cost
2.11	Force majeure	Force majeure insurance	x	x	x	Construction cost
3.0	**Operating risks related to revenue**					
3.1	Government department default	Hunan Government Guarantee	x			Revenue
3.2	Operator inability	Penalties to operator		x		Revenue
3.3	Termination of concession by Concession Company	Risk is shared	x	x		Revenue
3.4	Force majeure event	Force majeure insurance	x	x	x	Revenue
3.5	Prolonged downtime during operation	Availability Insurance		x	x	Revenue
3.0	**Operating risks related to O&M costs**					
3.5	Environmental damage-ongoing	Environmental advisor control		x		O&M cost
3.6	Labour risk	Risk is shared	x	x		O&M cost
2.3	Provision of utilities	Utilities supply agreement	x			O&M cost
3.8	Condition of facility (maintenance)	Operating insurance		x	x	O&M cost
4.0	**Market and revenue risks**					
4.1	Insufficient fare income	PPA	x	x		Revenue
4.2	Fluctuating demand of power generated	PPA	x			Revenue
4.3	Transmission failure	PPA	x			Revenue
4.4	Problem in bill collection	PPA	x			Revenue
4.5	Power theft	PPA	x			Revenue
4.6	Fluctuation of cost and availability of fuel/coal	Risk shared, PPA and Fuel supply agreement	x	x		Revenue
4.7	Government restriction on profit and tariff	Risk shared and PPA	x	x		Revenue
5.1	Inflation risk	PPA: tariff is indexed against inflation	x	x		Revenue
5.0	**Finance risks**					
5.1	Inflation risk	PPA: tariff is indexed against inflation	x	x		Revenue, together with 4.0
5.2	Foreign currency exchange rate	Risk is shared.	x	x		Foreign loan I& P dividend
5.3	Foreign currency convertibility	State Administration for Exchange Control (SAEC) support letter	x			Foreign loan I& P dividend
6.0	**Legal risks**					
6.1	Title/lease property	Risk is shared	x	x		Revenue
6.2	Ownership assets	Risk in SPV		x		Revenue
6.3	Security structure	Pass to lender				Revenue
6.4	Insolvency of Concession company	Partially pass to lender		x		Revenue
6.5	Breach of financing documents	Partially pass to lender		x		Revenue
6.6	Enforceability of security	Pass to lender		x		Revenue
6.7	Documentation/contractual risk (conflict and arbitration, applied laws)	Risk is shared	x	x		Revenue

2.3.1. Risk categorization and identification

Risks in PPP projects have been studied and categorized by researchers such as Augenblick (1990), Dias (1995b) and Walker (1995). Tinsley (2001) defined the 16 main risk categories influencing the cash flow of the Special Purpose Company (SPC) as follows: (1) supply/traffic/revenue risks, (2) market risks, (3) FX risks, (4) technical operating risks, (5) operating cost risks, (6) operating management risks, (7) environmental risks, (8) infrastructure risks, (9) force majeure risks, (10) completion risks, (11) engineering risks, (12) political risks, (13) participant risks, (14) funding/interest risks, (15) syndication risks, and (16) legal risks.

Tiong (1992) and other researchers, such as Dias (1995), have conducted several surveys and case studies on PPP projects. Their efforts are mainly focused on the bidding strategies of PPP projects, such as the critical success factors in winning PPP contracts (Tiong, 1992; Tiong, 1995; Tiong, 1996; Tiong, 1997) and the bidder's competitive advantages due to financial leverage (Tiong, 1995b). Dias (1995 analysed the optimal debt capacity and capital structures of a PPP project.

Moreover, Ye (2001) states that PPP projects usually face a gap between the risks involved in the project and the private sector's willingness to take the risks. As a key party to the concession contract, the host government is in a position to bridge this gap in order to attract private involvement in infrastructure projects. The government should ensure that the key concerns and expectations of private sector participants are adequately met. Ideally, a privately-financed infrastructure project should be self-supporting. In this case, the revenue would be sufficient to cover the total project costs without additional subsidies over the concession period. However, especially in water infrastructure projects, the cash flow revenue alone is not sufficient to compensate the costs of investment, finance, operation and maintenance, taxes, and returns during the concession period. In this case, the project requires governmental support in order to help sponsors to achieve their risk-return trade-offs.

Risks associated with privately financed infrastructure projects can be identified either by the investigation of risk events concerning cash flow positions that are exposed to the risks or by the cause-effect analysis which indicates the risks by investigating main sources and sub-sources of risks. This leads to various approaches including risk-identification check lists, expert interviews, reference cases, or contract analysis. The most common approach is a checklist of potential risks. Several checklists have been aggregated based upon previous studies, such as Perry and Hayes (1985), Tiong (1990), Smith (1995) and Wang (2000).

Wang (2004) classified all risks as: (i) country-level risks, (ii) market-level risks and (iii) project-level risks. This classification is helpful in portraying the influence between risk categories and in prioritizing the mitigation measures for each of the risks. FX exposure can be expressed within this classification with dependency on the relationship among risks at different levels. The country-level risks influence both the market- and project-level risks, while the market-level risks influence the project-level risks. Country-level risks are considered the most dominant and at the highest hierarchical level, while the project-level risks are most dormant relatively and are at the lowest hierarchical level. Figure 2-4 in the research methodology illustrates the components of the selected country-level, market-level and project-level risk. Country-level risk in general is a function of political and macroeconomic stability. It materializes when the authorities of the country expropriate property, introduce foreign currency exchange or trade restrictions, change legal and regulatory policies or introduce other rules that restrict operations, payments of dividends and interest payments.

Country-level risks with impact on currency risk are separated into insurable and non-insurable risks. The “insurable” risks are defined by the Multilateral Investment Guarantee Agency (MIGA) Convention of 1985. The “Legal, regulatory, bureaucratic risks”, and “Others” are identified based on the literature review. Expropriation is described as any legislative or administrative action by the host government which has the effect of depriving the investor of ownership or control of a substantial benefit from its investment, with the exception of non-discriminatory measures of general application. Breach of contract is any repudiation or breach by the host government where there is: (i) no recourse to a judicial or arbitral forum to determine the claim, or (ii) a decision made by such form that it is not rendered within a reasonable period of time, or (iii) a decision which cannot be enforced. Political violence is any form of war and insurrection/civil disturbance, terrorism and sabotage, strike, riots and disturbance by landowners and/or indigenous peoples. Restrictions on the transfer of currency outside the host country, or the failure of the host government to act within a reasonable period of time on an application for such a transfer attributable to the host government, are classified as risk of currency inconvertibility and transfer. Legal, regulatory, and bureaucratic risks refer to risks within the administrative processes that cannot be directly attributed to one of the above. They include the legal enforceability and execution of laws, conflict of authority, corruption, transparency, issuing of approvals and consents, change of government causing changes in law, policy, taxation, and obstruction during arbitration process. “Others” are those risks which cannot be influenced by the government directly. These include force majeure and environmental risks, environmental and trades union activism, religious fundamentalism and ethnic tension, and cultural differences.

The market-level risks are influenced by country-level risks. The relevant market-level risks can be defined as: (i) currency devaluation and the FX and convertibility risk, (ii) inflation, and (iii) interest rates.

Project-level risks are influenced by country- and market-level risks. Demand risk covers the variation from the initial demand projection. Based on the payment structure, the project will carry different levels of demand risks. The revenue risk is the failure to secure the anticipated income. The risk of increased O&M expenditures includes the additional costs incurred due to increased inflation rates and currency devaluation. Additional financing costs can accrue due to increased interest rates, FX rate fluctuations and the difficulty in converting local currency to foreign currencies.

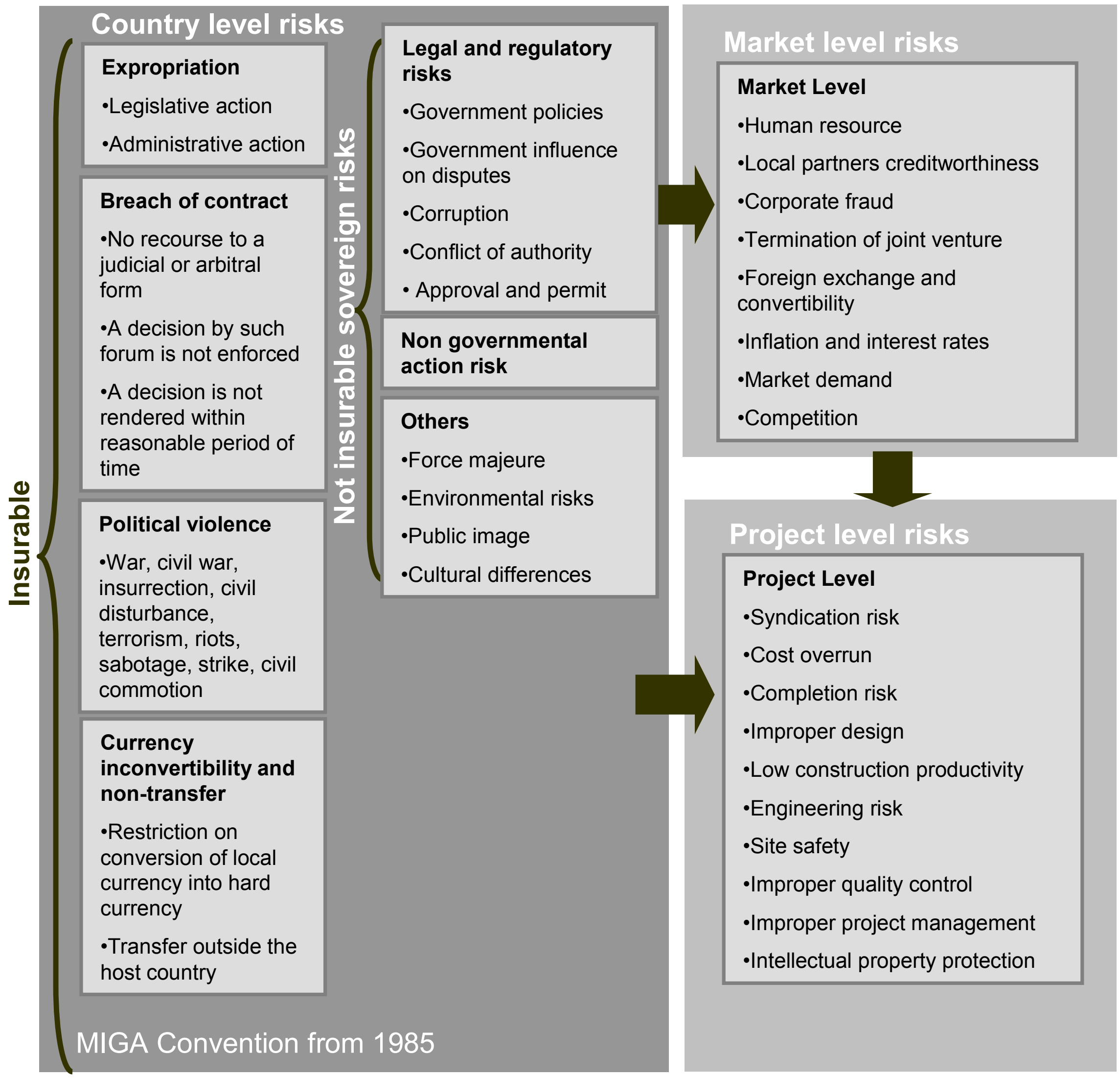

Figure 2-4: *Risk identification in country-, market- and project-level risks in PPP projects*

The risk analysis embraces qualitative and quantitative techniques. The qualitative analysis can be based on risk ratings, a quality factor analysis, opinions of experts, utility assessments, and due diligence reports. The quantitative risks analysis is founded on historical and numerical data and includes methods like statistical analysis, percentile analysis, simulations and sensitivity analysis. All these methods can be used in a complementary way to each other. The qualitative analysis can help to analyse the relationships between the risk factors, while the quantitative analysis methods can avoid errors or bias in order to reduce the wide variance in judgements.

A new approach developed by Sachs (2007) for quantifying qualitative information on risks (QQR) bridges the gap in transferring the qualitative risks into quantitative risk analysis methods. The method applies Fuzzy Set theory and captures the opinions of experts with fuzzy numbers. Accordingly, the aggregated expert opinion is converted into a specific risk profile enabling customized probability functions that allow a stochastic simulation on financial cash flows and business models.

2.3.2. Commonly used simulation technique in PPP procurement

The Australian government, in its guideline on PPP procurement, recommends a probabilistic risk assessment in PPP projects (Australia Treasury, 2008). This method is based on a discrete distribution with five different scenarios for each risk category. Each scenario requires input variables on the values of impact and the probability of occurrence. The risk value is obtained by the sum of each product:

$$Z_i = \sum_{i=1}^{N} S_i * p_i \qquad \text{with} \qquad \sum_{i=1}^{N} p_i = 1 \qquad (2.1)$$

where Zi represents the risk value, Si represents the impact of the risk, and pi represents the probability of occurrence. Figure 2-5 illustrates the discrete distribution with the probability of occurrence and the value of impact based on the inputs in Table 2-2.

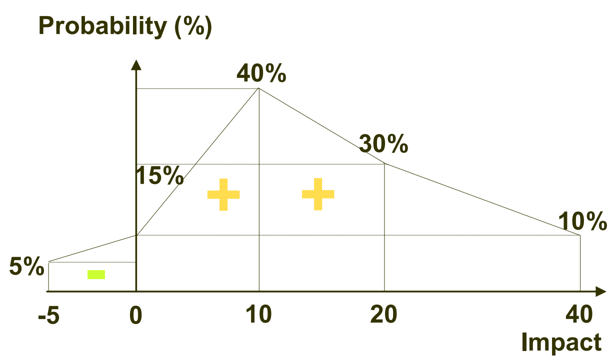

Figure 2-5: *Discrete distribution*

Table 2-2 illustrates the risk value of estimated 13.75% on a cash flow position. In this example, the risk will be retained in the quantity of 11% by the public authority and transferred to the SPC in the quantity of 2.75%. This process is repeated for each major risk and linked to the relevant cash flow positions. In conclusion, the risk modelling method simply quantifies major risks to the project and simulates the effect on the project's revenue and the internal rate of return (IRR).

Table 2-2: *Computation of the risk value*

	Impact	*Probability*	*I * P*
Positive impact	-5%	0.05	-0.25%
No influence	0%	0.15	0.00%
Minor negative impact	10%	0.40	4.00%
Reasonable negative impact	20%	0.30	6.00%
Strong negative impact	40%	0.10	4.00%
Sum		**1.00**	**13.75%**

	Risk transfer to the SPV	Retained risk by the public authority	Sum
	20%	80%	100%
Risk value on cash flow position (%)	**2.75%**	**11.00%**	

However, in a complex PPP environment, the proposed method is less than satisfactory. The limitations in the assessment process are seen in: (i) the failure to consider correlations between the risk factors, (ii) the estimation of impact and probability is very subjective and difficult to validate, and (iii) the discrete distribution does not fit for each type of risk assessed.

2.4. Exchange market pressure index

Country policies, like reduction of depreciation and policies to keep budget inflation low, will influence the FX volatility and have an impact on the market level risks. These risks can be captured by FX signals and modelled in a market pressure index. The volatilities of the FX rates would not impact on the project risk exposure if FX risk is fully mitigated by risk mitigation instruments like guarantees, liquidity facilities or tariff indexation. However, market risks can have a significant impact and add pressure to the country-level risks. If the country-level risks increase significantly, the impact on project-level risks will increase simultaneously. The risk impact could affect the feasibility and willingness of the government to exercise the agreed risk mitigation instruments. In this case, the FX loss might not be compensated in whole or in part.

The exchange market pressure (EMP) index shows the pressure on the currency based on proxies which indicate currency crises. Generally, domestic stock markets are found to be a significant indicator of currency crises (Goldstein, 2000; Granger, 2000). The most comprehensive study of indicators to examine currency crises is that of Kaminsky (1998) who reviewed the previous studies and summarized the findings as containing a large variety of 105 indicators including (i) external sector, (ii) financial sector, (iii) real sector, (iv) public finances, (v) institutional and structural variables, (vi) political variables, and (vii) contagion effects. The main indicators used in empirical work, classified by category, are listed in Table 2-3.

Table 2-3: *Indicators for currency crises*

Source: Kaminsky (1998)

	Capital account:	32	Domestic inflation
1	International reserves	33	"Shadow" exchange rate
2	Capital flows	34	Parallel market exchange rate premium
3	Short-term capital flows	35	Central exchange rate parity
4	Foreign direct investment	36	Position of the exchange rate within the official bank
5	Differential between domestic and foreign interest rates	37	M2/international reserves
	Debt profile:		**Real sector:**
6	Public foreign debt	38	Real GDP growth
7	Total foreign debt	39	Output
8	Short-term debt	40	Output gap
9	Share of debt classified by type of creditor and by interest structure	41	Employment/unemployment
10	Debt service	42	Wages
11	Foreign aid	43	Changes in stock prices
	Current account:		**Fiscal variables:**
12	Real exchange rate	44	Fiscal deficit
13	Current account balance	45	Government consumption
14	Trade balance	46	Credit to the public sector
15	Exports		**Institutional / structural factors:**
16	Imports	47	Openness
17	Terms of trade	48	Trade concentration
18	Price of exports	49	Dummies for multiple exchange rates
19	Savings	50	Exchange controls
20	Investment	51	Duration of the fixed exchange rate periods
	International variables:	52	Financial liberalization
21	Foreign real GDP growth	53	Banking crises
22	Interest rates	54	Past foreign exchange market crises
23	Price level	55	Past foreign exchange market events
	Financial liberalization:		**Political variables:**
24	Credit growth	56	Dummies for election
25	Change in the money multiplier	57	Incumbent electoral victory or loss
26	Real interest rates	58	Change of government
27	Spread between bank lending and deposit interest rates	59	Legal executive transfer
	Other financial variables:	60	Illegal executive transfer
28	Central bank credit to the banking system	61	Left-wing government
29	Gap between money demand and supply	62	A new finance minister
30	Money growth	63	Degree of political instability
31	Bond yields		

The comparison by Kaminsky (1998) of the results across the various studies in the literature did not, however, provide a clear answer about the usefulness and the significance of each of the potential indicators to currency crises. Some variables that were significant in univariate tests were not significant in multivariate tests. The variables identified to have the best track record for examining currency crises in the context of the signals include: (i) output performance, (ii) exports, (iii) deviation of the real exchange rate from trend, (iv) equity prices, and (v) the ratio of broad money to gross international reserves. In conclusion the derived results indicate that currency crises usually seem to be preceded by multiple economic and sometimes political problems with both domestic and external imbalances. The individual variables that received generous support as useful indicators of currency crises include: (i) international reserves, (ii) real exchange rate, (iii) credit growth, (iv) credit to the public sector, (v) domestic inflation, (vi) trade balance, (vii) export performance, (viii) money growth, (ix) money supply (M2)/international reserves, (x) real GDP growth, (xi) fiscal deficit, and (xii) interest rates.

To simulate the FX signals it is proposed to transfer the dependent variables into a market pressure index. Out of these twelve significant indicators, (Feridun, 2006) proposed to focus on the following three variables for further studies: (i) real exchange rate, (ii) domestic interest rates, and (iii) international reserves.

The exchange market pressure (EMP) index introduced by Kaminsky (1998) can be simulated as follows:

$$EMP = (1/\sigma_e)*(\Delta e/e) - (1/\sigma_r)*(\Delta r/r) + (1/\sigma_i)*\Delta i \tag{2.2}$$

where EMP stands for the value of the exchange market pressure index at time t,

σ_e is the standard deviation (SD) of the rate of change in the exchange rate $\frac{\Delta e_t}{e_t}$,

σ_r is the SD of the rate of change in the international reserves $\frac{\Delta r_t}{r_t}$, σ_i is the SD of the change in the nominal interest rate Δi_t, e_t are the units of US dollars in period t, r_t is the gross foreign reserve in period t, and i_t is the nominal interest rate in period t. The weights attached to the these components are the inverse of the standard deviation for each series, in order to equalize volatilities of the three components and to avoid any of them dominating the index (Kaminsky, 1998). A negative value of the index measures the appreciation pressure of the currency, while a positive value measures the depreciation pressure of the currency.

The EMP index is based on real exchange rates to avoid the issue of treating separately high-inflation episodes. The real exchange rate can be calculated as follows:

$$E_{rt}^{l/f} = E_{nt}^{l/f} * \frac{P_t^*}{P_t} \tag{2.3}$$

where P_t is the domestic consumer price index, P_t^* is the foreign consumer price index, $E_{rt}^{l/f}$ is the real exchange rate, and $E_{nt}^{l/f}$ is the nominal exchange rate.

All indicators can be obtained by the International Financial Statistics (IFS) database on a monthly frequency. Line ae (market rate) of the IMF-IFS database was used as the measure of the nominal exchange rate. Foreign assets of the monetary authorities in line 11 are used to measure FX reserves. Line 60b represents the interbank money market rate and line 64 the consumer price index.

Figures 2-6 to 2-9 illustrate the EMP index and exchange rates in Indonesia (IDN) and the Philippines (PHL). Both countries have positive peaks in 1997 indicating high currency devaluation. The higher the EMP index, the higher is the pressure of the currency to devaluate.

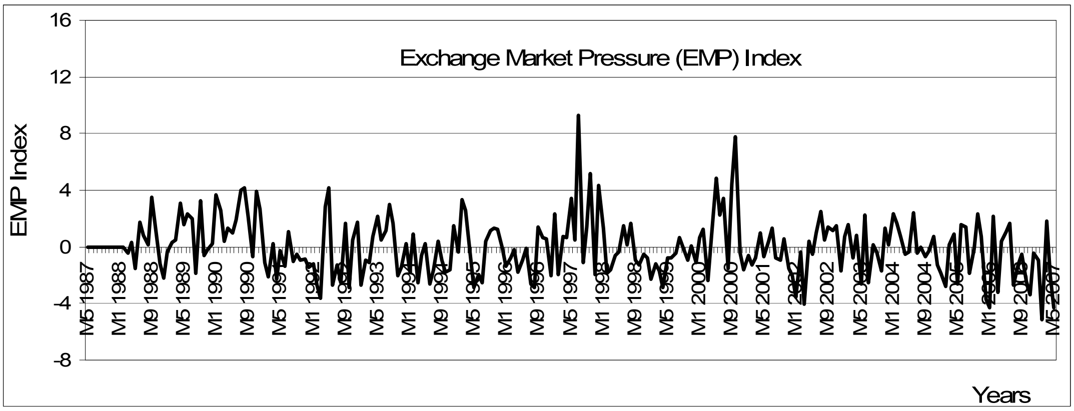

Figure 2-6: *EMP index – Philippines*

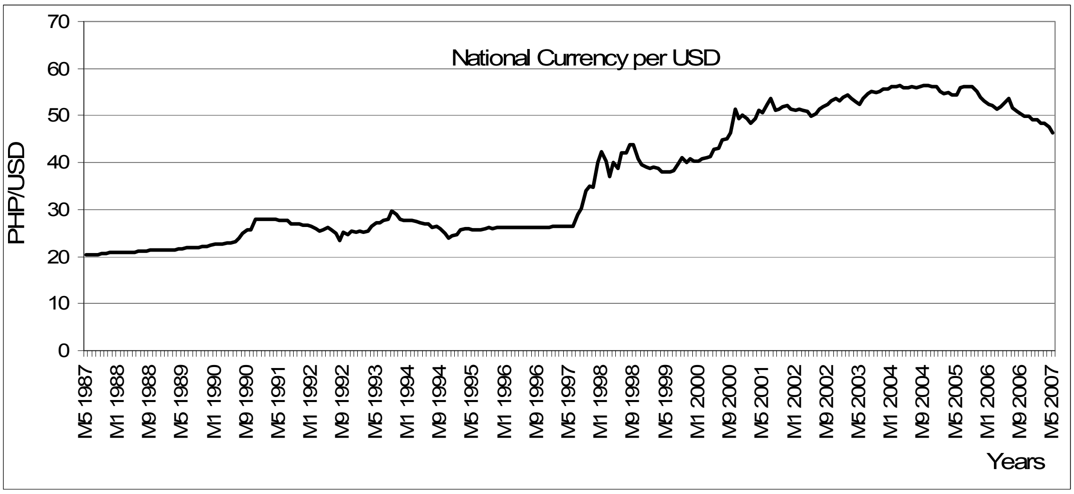

Figure 2-7: *Foreign exchange rate PHP/USD*

In Indonesia especially the EMP index indicates the high pressure on the currency from 1994 to 1996. Until 1996, the Indonesian rupiah (IDR) was strongly controlled by the Bank of Indonesia against the US dollar. In 1997 the IDR devaluated immensely during the Asian financial crises.

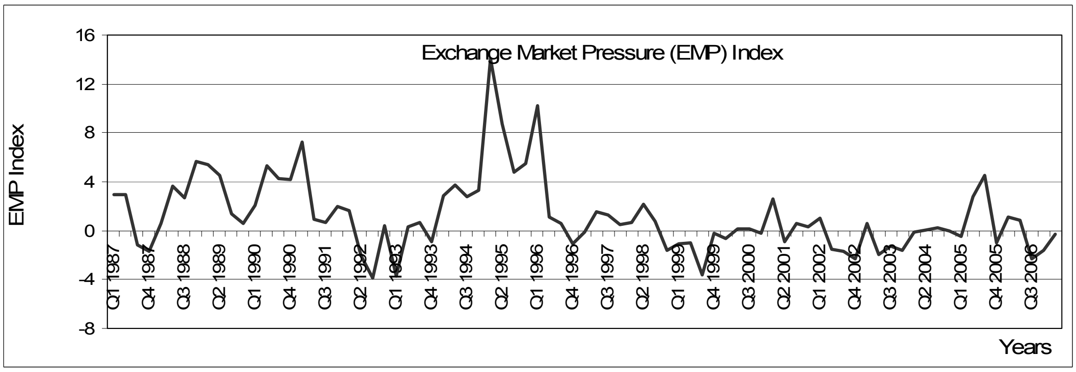

Figure 2-8: *EMP Index – Indonesia*

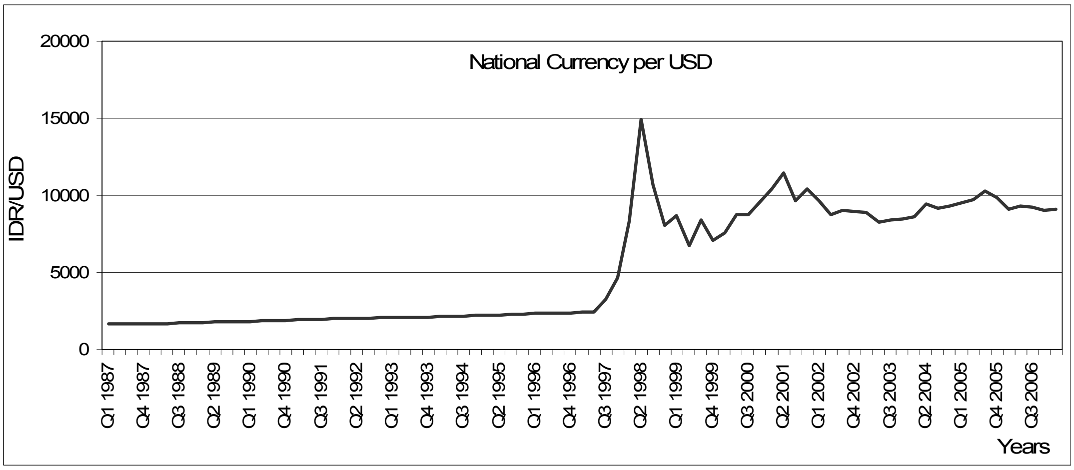

Figure 2-9: *Foreign exchange rate IDR/USD*

2.5. Forecasting FX rates and assessing real equilibrium

Research on the determinants of exchange rate volatility shows that until now no consensus has been reached in the literature. Several factors can affect exchange rates and their volatility. Many publications focus on the level of exchange rates in statistical terms like the first moment, and the implications of exchange rate volatility.

Kriljenko (2004) summarized the three principal views described in the literature as follows. First, at least over short-time horizons and for countries without high inflation, exchange rate models that include macroeconomic fundamentals do not perform better than a random walk in out-of-sample forecasting. Exchange rate volatility is simply the standard deviation of the error term. Second, macroeconomic fundamentals play an important role in explaining the behaviour of exchange rates. Some authors think that these fundamentals are important only in the long-run but have little to offer in explaining short-run movements, while others believe that macroeconomic fundamentals have explanatory power both in the long and the short run. Third, neither macroeconomic fundamentals nor the random walk model account adequately for the exchange rate behaviour at short time horizons. Rather, short-run exchange rate movements are attributed to market microstructure factors, including inventory management and information aggregation by FX dealers. However, to estimate the FX exposure and to obtain a pricing function, the value of the currency has to be modelled. The problem set requires a trend rate of growth or decline as well as a random element.

Exchange rates are determined by numerous complex factors and highly correlated to interest rates and inflation rates. The national currency is seen as a political and economic asset which represents the health of the country's economy. Political instability is represented in the value of the currency. If countries perceive political and economic risk, investors will move their capital to the currencies of more stable countries. Besides the political stability and economic performance, exchange rate movements are forced by differentials in inflation and interest rates, current account deficits, public debt and terms of trade.

Interest rates are set by the national central banks to influence inflation rates and the value of the currency. If a country has high economic growth it is likely that the central bank will raise its interest rates to the growth of inflation. If the interest rate rises, the exchange rates tend to rise. Higher interest rates inspire more foreign investment. In order to buy assets, foreign investors create greater demand for the currency which results in a currency appreciation. On the other hand, decreasing interest rates tend to depreciate the currency. This effect can be mitigated by the rate of inflation. Inflation rates are linked to purchasing power. If inflation rates are low compared with another country, the purchasing power will increase and the currency will appreciate (Eun, 2007).

The current account reflects all payments between countries for goods, services, interest and dividends. A deficit in the current account shows a country is importing more than it exports and is borrowing capital from foreign sources to compensate the deficit. Therefore, the demand for foreign currency is higher than the supply by exports. The oversupply of the national currency lowers the country's exchange rate (Eun, 2007). Equilibrium is reached if domestic goods and services are cheap enough for foreigners, and foreign assets are too expensive to generate sales for domestic interests.

Countries with large public debt encourage inflation. If inflation is high, the debt might be repaid with depreciated currency in the future. Therefore a country's debt rating is an important determinant of its exchange rate. In case a country is not able to service its deficit, the government may print money and increase the money supply. An increase in money supply causes inflation. However, despite an immense current account deficit in the US, the currency did not depreciate significantly until 2008. The pressure on the US currency by massive trade deficits has been offset by enough surplus capital from the rest of the world.

Countries like Canada, Australia, New Zealand, Japan and Germany depend on earnings through trade. Therefore the strength of their currencies depends on the trade flow through the export of various commodities. Countries such as the US and the UK have very liquid investment markets and capital flows are of far greater importance than trade flow. The terms of trade is a ratio comparing export prices and import prices. The higher the ratio, the higher is the demand for the exports, which relates to an increased demand for the country's currency.

The main parties who can cause an increase in the supply of the FX market are export companies, foreign investors, speculators and central banks. If the supply of a country's currency increases, inflation will increase and the currency should depreciate. Export companies and foreign investors can increase the supply or demand of a currency on the FX market, which leads to the decrease or increase of exchanged currency. This will cause the currency with decreased supply to appreciate in value relative to the exchanged currency. Foreign investment can be in tangible assets, stocks or bonds. Importers and foreign investors can cause increase in demand if they purchase foreign currencies, for example, to buy commodities or invest in the foreign country.

Speculators buy and sell currencies by acting on their beliefs. If investors sell a currency, the supply of it will increase, and the price of it will decrease. By believing a currency will depreciate, investors cause the depreciation to occur. On the other hand, an investor will buy a currency if the belief is that the currency will appreciate. This, in turn, results in increased demand and leads to an increased price for the currency. The central bank controls the supply of currency in a country. Central banks can use their reserves to increase the supply of money on the FX markets. Central banks can also create demand by putting their currency on the open market and using it to buy another currency. If a currency has appreciated in value too much relative to another currency, the central bank will sell some of the national currency and buy the foreign currency. This will increase the supply of the national currency on the FX market, and decrease the supply of foreign currency. As a result the national currency depreciates relative to foreign currency.

2.5.1. Modelling of FX rates

The problem set requires a trend rate of growth or decline as well as a random element. A random walk is a simple stochastic process in which the value of the risk factor equals its value in the last period plus a random number. In general, the underlying currency is assumed to follow a stochastic process either in discrete or continuous time. Continuous time processes are analytically simpler to compute, but discrete time processes are particularly useful for numerical computations.

The most common stochastic process utilized to model the change in value of a variable is the Ito process. This belongs to the Markov process which is a particular type of stochastic process where only the present value of a variable is relevant for predicting the future – the way the present has emerged from the past is irrelevant. The change in a variable x that follows an Ito process is given by

$$dx = \mu(x,t)dt + \sigma(x,t)dz \tag{2.4}$$

where μ is the drift and σ is the volatility of X and both variables are functions of x and t. The basic Wiener increment and Brownian motion process dz is represented as follows:

$$dz = \varepsilon\sqrt{dt} \tag{2.5}$$

The random variable ε follows a standard normal distribution with mean equal to zero and unitary variance. The drift term $\mu(X,t)$ is the variation term with the deviation form of the tendency or term of uncertainty. The variance term $\sigma(X,t)$ is the expectation and trend term. The FX rates are generally modelled as lognormal variables according to the following geometric Brownian motion (GBM) process:

$$dX = \mu(t)Xdt + \sigma_{FX}\, XdW_t \qquad \text{or} \qquad \frac{\Delta X}{X} = \mu\Delta t + \sigma\varepsilon\sqrt{\Delta t} \tag{2.6}$$

where $\mu(t)$ is the drift function and σ_{FX} is the FX volatility. The lognormal distribution ensures that FX rates are always positive. If x follows an Ito process and v is a function of x and t, the change in v is given by

$$dv = \left(\frac{dv}{dt} + \mu x\frac{dv}{dx} + \frac{\sigma^2 x^2}{2}\frac{d^2 v}{dx^2}\right)dt + \sigma x\frac{dv}{dx}\sqrt{dt}\,z \tag{2.7}$$

If x follows a geometric Brownian motion process $v = \ln x$, then $dv/dx = 1/x$, $d^2 v/dx^2 = -1/x^2$ and $dv/dt = 0$. Applied to Ito's Lemma, this will give:

$$d\ln x = \left(\mu - \frac{\sigma^2}{2}\right)dt + \sigma\sqrt{dt}\,z$$

and hence lead to the well known GBM which is a log-normal diffusion process, with the variance growing proportionally to the time interval. This means that the variable follows a log-normal process over time with the following parameters:

$$dt = 1: \quad x_t = x_{t-1}\exp((\mu - \frac{\sigma^2}{2}) + \sigma z) \tag{2.8}$$

$$dt = t: \quad x_t = x_0 \exp((\mu - \frac{\sigma^2}{2})t + \sigma\sqrt{t}\,z)$$

To model the FX rates, μ has to be interpreted as the expected rate of devaluation of the FX rate and σ as its volatility. The trend rate of devaluation or appreciation can be evaluated using four different approaches. The first approach assumes that the historical trend will continue. The trend rate would follow the historical appreciation or depreciation. The second approach compares the forecasts of local inflation and foreign inflation. It can be assumed that the trend rate of devaluation is the difference between the two currencies. The currency with lower inflation would be expected to appreciate against the other. The third possible approach is based on the difference in the local and foreign interest rates. Comparison of riskless rates of interest in both currencies for the appropriate duration therefore gives an estimate of the expected rate μ of depreciation in the local currency. For FX risk valuation, assuming complete markets, it is necessary to use a risk-neutral simulation. The risk-neutral simulation of a GBM uses the risk-neutral drift:

$$\mu = r_l - r_f \tag{2.9}$$

The r_l represents the local riskless interest rate and r_f is the foreign riskless interest rate. If the local rate is higher than the foreign rate, the currency is devalued and the x is expected to increase. The fourth method calibrates the drift function $\mu(t)$ by the forward FX rates. It is uniquely determined by the spot FX rate and the shape of the two currency yield curves. The FX volatility is calibrated by using the market prices of FX options (Arvanitis, 2001). Additional to the drift and volatility, the correlation between the FX rates and the spot interest rates needs to be estimated. The estimator for the drift is based on the longest time span possible. However, for the volatility the best estimator is based on as many observations as possible. Therefore, a large number of observations are important only for volatility.

2.5.2. Risks involved of speculating in currencies

The main risk categories for speculators are interest rate risk, credit risk and country risk. Financial instruments such as currency swaps, forwards, futures, and options are subject to interest rate risk. Interest rates affect the forward spreads and can create forward amount mismatches and maturity gaps. Limits on the total size are necessary to minimize the interest rate risk. The risk can be further minimized with interest rate analysis to forecast changes which may impact the outstanding gaps.

The credit risk includes replacement risk and settlement risk. Replacement risk occurs when counter parties fail to meet the terms of the contract. There is a risk that the replacement of the obligation won't be able at the same price as the contract was created. Settlement risk might happen, due to time zone differences and the time between a payment being made and the offset in another currency (Luca, 1999). Therefore, payment may be made to parties that will declare insolvency, operational problems or market liquidity constraints. The country risk refers to controls on FX activities by the government. Under political stress, governments may impose disruption in the financial system and restrict the outflow of hard currency (Luca, 1999).

2.6. Empirically founded theories in FX rates

Foreign exchange rates are potentially related to a variety of other financial and economic parameters. The four fundamental relationships with FX risk are; uncovered interest parity (UIP), relative purchasing power parity, the international Fisher effect, and the expectation theory, as shown in Figure 2-10. The theories state that interest rates, inflation and changes in the exchange rates are highly correlated. Interest rates, exchange rates and price levels form an integrated system (Kolb, 1999). According to the Fisher effect, real return on capital should be the same in different countries (Braley, 2001). Interest rate parity requires that the differences in the interest rates are equal to the differences in the forward and spot rates. This argument can only hold as long as taxes and governmental regulations are absent. According to the expectation theory, the expected change in the spot rate should equal the premium. Purchasing power parity describes the fact that the difference in inflation rates is reflected in exchange rates (Kolb, 1999). It requires that prices should be roughly equal across countries. This is particularly important for PPP projects because tariffs are normally adjusted by the local CPI rate.

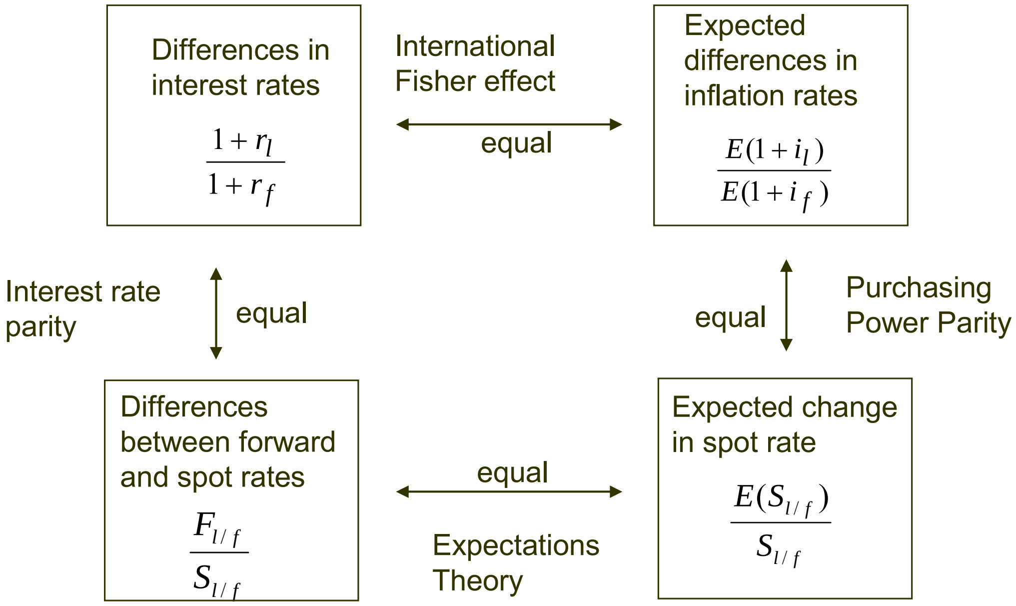

Figure 2-10: *Four fundamental relationships of FX rates*

2.6.1. Purchasing Power Parity

The principle of Absolute Purchasing Power Parity states that the exchange rate between two countries equals the price of a fixed basket of goods and services in each country. Therefore, exchange rates between two currencies are in equilibrium if the purchasing power is the same in each of the two countries (Krumnow, 1999). This means that the exchange rate between two countries is equal to the ratio of the price level of a fixed basket of goods and services in each country. However, absolute equality of price levels at the same time is never possible (Streissler, 2006a).

The principle of Relative Purchasing Power Parity states that the rate of depreciation of a currency is equal to the difference in inflation rates between the home country and a foreign country. Purchasing Power Parity relies on floating exchange rates and prices that are free to adjust according to the market conditions. It is not applicable to countries with pegged or tightly managed currency regimes, which prevent nominal exchange rates from moving towards their long-term equilibrium positions.

Relative Purchasing Power Parity is modelled as follows:

$$\frac{E(S_{l/f})}{S_{l/f}} = \frac{E(1+i_l)}{E(1+i_f)} \qquad (2.10)$$

where i_l and i_f represent the local and foreign inflation rates, and S_t is the spot exchange rate.

The expected change in the exchange rate is a function of the expected differences between the countries' inflation rates. This implies that after the exchange rate adjustment, a good should cost the same regardless of the country in which it is bought. Relative Purchasing Power Parity suggests that prices in countries vary but that they differ by the same proportional rate over time. The country with the higher rate of inflation will have a devaluating currency.

Relative Purchasing Power Parity is important for PPP projects because incremental inflation can partially offset short- and medium-term depreciation of the local currency value in the long run. If the project's revenue streams are indexed to inflation, the FX risk can be neutralized within a period of three to five years (Matsukawa, 2003). Therefore, losses from nominal depreciations can be expected to be compensated by price appreciation over time. Figure 2-11 indicates the historical Indonesian consumer price index (CPI) with the base year in 2004. The second line indicates the excess value of CPI in Indonesia versus the CPI for the USA.

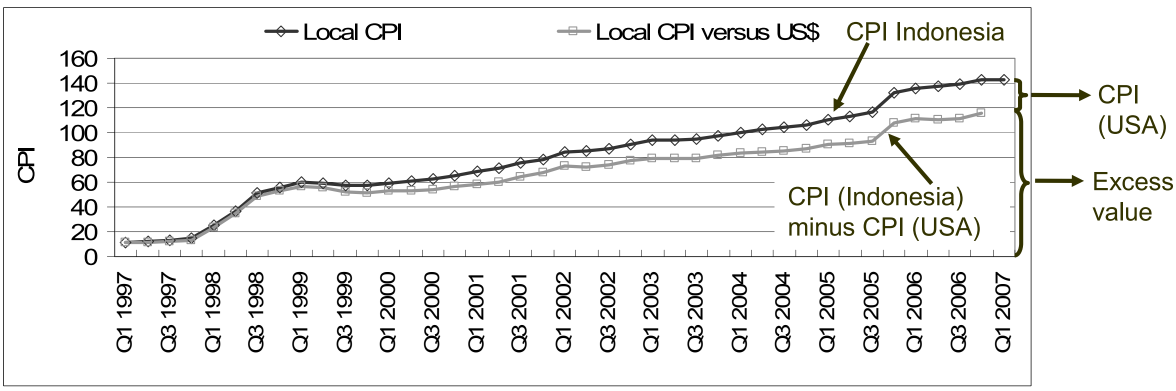

***Figure 2-11**: CPI Indonesia versus US$ (1997–2007)*

Figure 2-12 indicates the historical exchange rate in terms of IDR per US dollar. The second line shows the exchange rate presuming Purchasing Power Parity computed as:

$$\frac{\sum_{t=1}^{N} CPI}{\sum_{t=1}^{N} CPI^{*}} * f_{FX} \qquad (2.11)$$

where foreign CPI values are marked by an asterisk and f_{FX} is defined by the initial FX rate. The graph illustrates what the nominal exchange rate would have been if Purchasing Power Parity had held from the beginning of the series.

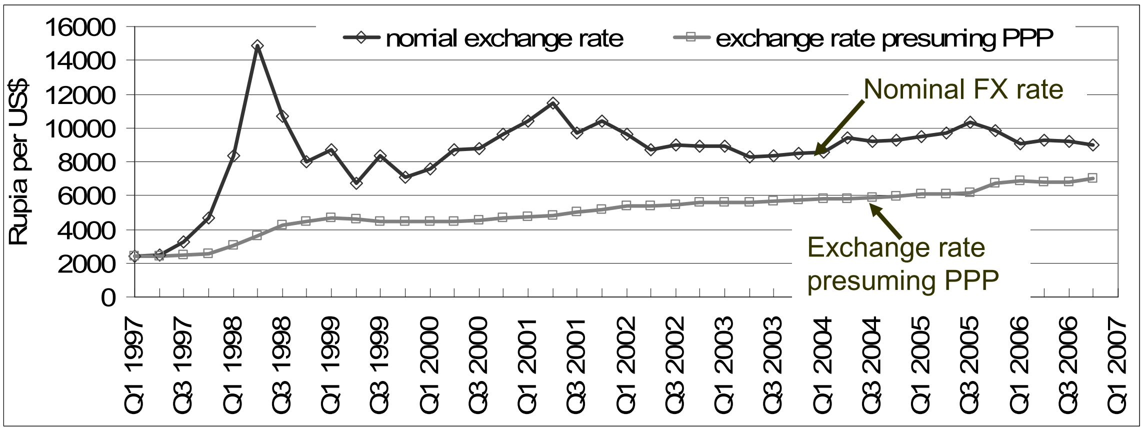

Figure 2-12: *Nominal FX rate and FX rate presuming Purchasing Power Parity*

However, it is important that the current nominal exchange rate is not significantly overvalued at the initial point. If the nominal exchange rate is overvalued initially, the consequence would be devaluation and a move towards the equilibrium exchange rate over time. In this case, there will be less rebound appreciation and the FX loss probably cannot be offset by incremental inflation. The currency can rebound to the equilibrium exchange rate only if the starting point at which the currency is valued is close to the equilibrium exchange rate. Bayoumi (2005) developed a theory-based model to estimate equilibrium exchange rates in 12 industrial countries.

2.6.2. Uncovered interest parity

The UIP hypothesis argues that changes in the interest rate differential between two countries will be compensated because the currencies of the two countries will appreciate/depreciate against each other. The theory therefore states that opportunities of arbitrage are eliminated and returns of foreign and local investments are equal (Matsukawa, 2003). In the equilibrium version, the country with the higher rate of return on capital has to appreciate by exactly the difference in the rates of return in order to equalize returns expressed in the same currency. Currencies are attached to an interest rate that is set by national central banks. If the interest rate rises, the value of a country's currency also tends to rise. Investors buy currencies from countries with high interest rates and finance these purchases with currency from countries with low interest rates. Therefore, higher interest rates induce more foreign investment and more foreign investors mean a greater demand for the currency which results in an increase in a currency's value.

The mathematical definition of UIP is:

$$\frac{1+r_l}{1+r_f} = \frac{F_{l/f}}{S_{l/f}} \qquad (2.12)$$

where S is the spot exchange rate, F is the forward exchange rate, and r_f and r_l denote the foreign and local interest rates. Equality assumes that the risk premium is zero, no transaction cost is involved, there is equal default risk over assets denominated in foreign and domestic currency, and perfect capital flow. Therefore, the hypothesis that interest rate differentials are unbiased predictors of future exchange rate movements has been almost universally rejected in empirical studies (Chin, 2005).

Streissler (2006) argues that the state of equilibrium in UIP is hardly ever reached. Sometimes the disequilibrium version of UIP is more appropriate. It yields exactly the opposite result, that the country with the higher rate of return on financial capital will attract capital from abroad, which leads to an appreciation of the currency. An increase in foreign returns could lead to appreciation due to capital inflow and a later depreciation when in equilibrium. The magnitude of this change is unspecified. Furthermore, the relevant real interest rate to be considered should be the rate after an appropriate risk premium has been deducted (Streissler, 2006). It is difficult to define an operational strategy and a specific rate of interest. There are multitudes of different and differentially moving rates of return for short and long-run interest rates, stock market returns, or returns on direct investment (Streissler, 2006). Streissler (2006) argues that the deduction of appropriate risk premiums causes serious problems for an operational definition.

Furthermore, real exchange rates and real interest rates or monetary neutrality cannot exist, simply because the relevant price levels and the relevant term structure of interest rates are variable over time (Streissler, 2005). There is no common price index to transform nominal exchange rates and nominal interest rates to real ones. Inflation-adjusted real price levels do not stay the same over time in two currency areas of different economic development levels and with different rates of economic growth. Real exchange rates change with technological change and are more volatile in developing countries. In the literature, the opposite of relative Purchasing Power Parity is frequently used. The logarithmic exchange rate change equals the negative difference of local minus foreign inflation rates. According to Streissler (2005), the theory just focuses on exports and imports of current account transactions, which constitute only a small percentage of the total balance of payments for developed countries. As PPP is a theory of the current account, only export and import price indices should be used. However, it is not clear what price indices and which interest rate within the time structure of rates should actually be chosen.

Therefore, the main problems of relative Purchasing Power Parity and UIP are that they are non-stochastic equations, implicitly assuming instant convergence to equilibrium levels. The two theories in general contradict each other if and when real interest rates differ (Streissler, 2006). Regarding relative Purchasing Power Parity, the logarithm of the discrete absolute change of real exchange rates over time should be zero. The discrete absolute change of real exchange rates equals the real interest rate between the two relevant countries by considering UIP. However the difference of real interest rates is not equal the change of real exchange rates if real interest rates differ. Appreciation and depreciation in currencies is a highly non-linear movement and can never be discovered by the use of linear econometric techniques (Streissler, 2006). The transition from one equilibrium to another would entail large jumps of exchange rates, possibly prolonged over decades if there is a slow learning process. The jump is larger the longer the new rate of return difference is expected to last (Streissler, 2006).

2.6.3. International Fisher effect

Economic growth generally inspires the possibility that the central bank will raise its interest rates to meet the growth of inflation. The higher the interest rate, the higher is the likelihood that foreign investors will invest in the country's financial market. The Fisher effect states the relationship between inflation rate and interest rate, hence the nominal interest rate adjusts to the expected inflation rate.

$$\frac{1+r_l}{1+r_f} = \frac{E(1+i_l)}{E(1+i_f)} \qquad (2.13)$$

This means that real interest rates equal the nominal interest rate minus the expected rate of inflation. According to the principle of monetary neutrality, an increase in money growth raises the rate of inflation. However, in the long run, pure monetary developments will have no effect on countries' real interest rates.

2.7. Integration of life-cycle costing and FX risk modelling in PPP tenders

The FX mitigation strategy is mostly developed during the tender period of a PPP project. Therefore, the following sections introduce the current practice of FX risk modelling in PPP projects. The focus is on how project management (PM) responds to life-cycle cost (LCC) as the essential basis for FX exposure mitigation. It is shown that the flow of information is a major success factor in developing FX risk modelling during the PPP tender stage. Furthermore, the sections try to emphasize the quality of PM to support efficient LCC and FX risk modelling. Therefore, this section will describe how the tender process is organized and how the priorities of the tender process impact FX risk modelling.

2.7.1. Project management tasks during the tender stage

Project management skills in PPP tenders have to operate at different levels and new areas like project financing, financial modelling, LCC, facility management (FM), sustainability management, venue management, events management and interpersonal relationships. Therefore, the project manager must be both a generalist and a specialist to contribute with innovative knowledge and experience. Its contribution must be both technical and business-oriented to design a commercially viable project and to meet the required bid criteria. The purpose in modern PPP tenders is to design an innovative and cost-efficient bid proposal to achieve the strategic key objectives over the time period stipulated by the client.

A dedicated team guided by (i) a steering committee and (ii) several working committees is normally established for a PPP tender. Each phase in the tender stage requires a different involvement and response of the project team led by the SPC. All the committees establish meeting frequencies which vary during the different process stages. The set up of the steering committee includes senior management representatives of all major members and is chaired by the sponsor. In most PPP projects, the lead is taken by the construction contractor or the developer, however, there are also cases where the financier or bankers are the SPC main stakeholders. The main task of the steering committee is to assess the progress of all sub-committees and to approve strategic decisions. Meetings are generally scheduled on a fortnightly basis at the beginning of the process and once a month near the submission stage. The sub-committees consist of several working committees. Each committee is led by a director and includes the categories of design, construction, operation, FM, financial and legal. The following breakdown in five sub-committees is a common structure during PPP tender preparation:

(i) Master Plan sub-committee (MP-SC) led by the master planner,

(ii) Cost Plan sub-committee (CP-SC) led by the sponsor or cost consultants,

(iii) Operations and FM sub-committee (OFM-SC) led by the FM provider and the operator,

(iv) Design & Construction sub-committee (DC-SC) led by the contractor, and

(v) Bid Preparation sub-committee (BP-SC) led by the sponsor.

PM support is extremely important in analysing and optimizing the workstream in terms of the parties responsible, cost and time. The purpose is to establish a bid submission workstream which includes the detailed bid submission requirements and responsibilities of each sub-committee and specialist team. Figure 2-13 gives an overview of the different roles and responsibilities of each sub-committee member and the different start times of their involvement. The left side of Figure 2-13 shows the dependencies and information flow between the different sub-committees. All interrelations between the members of the sub-committees depend on the flow of information and the PM actions. The right side shows deliverables by the different sub-committees in respect to the bid time period. As shown in Figure 2-13, the LCC modelling becomes a very important element for the FX exposure simulation. The LCC modelling includes the timing and amount of transactions during the project operation. It is difficult to control when clients will pay within the payment period stated in the contracts. It is also difficult to forecast operation and maintenance cycles during the whole concession period. The LCC modelling sets the time-dependent cost breakdown and cash flow and improves the accuracy of the estimations. Those assumptions are important input parameters for FX exposure modelling and financial modelling. However, FX modelling is not a tool to speculate in the financial markets to gain profits. Companies should only hedge to protect themselves from exchange rate exposure.

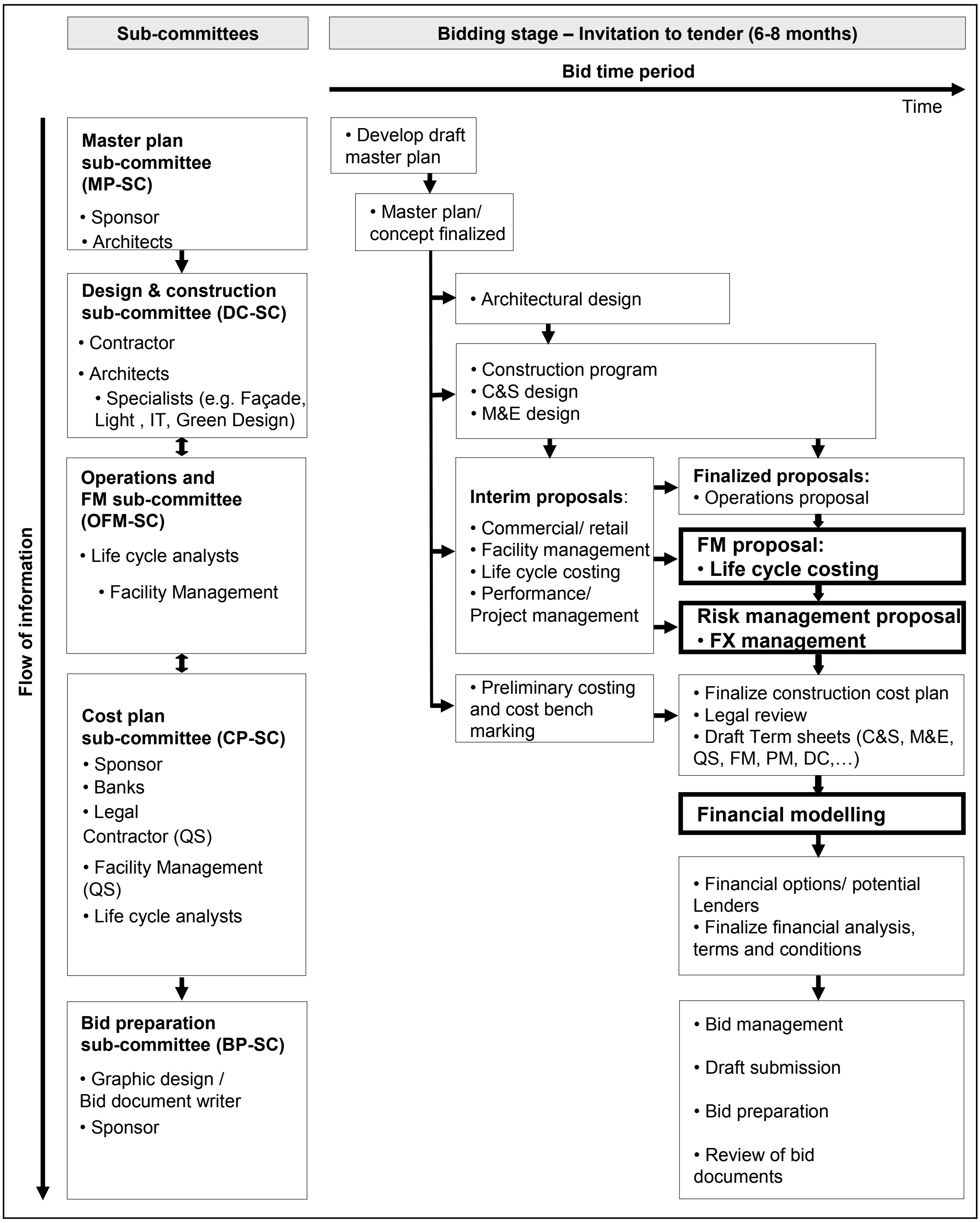

Figure 2-13: *Organization framework for PPP tenders*

Table 2-5 illustrates the contributions to the contents of the bid proposal by each party involved. All listed contents and sub-categories on the left side of Table 2-5 are categories commonly found in the tender documents. The structure illustrates the complexity and the overlapping of different parties to different contents of the bid proposal. Very critical deliverables with contributions by more than two different parties include: (i) operating strategy, (ii) major equipment, (iii) financial proposals, and (iv) financial modelling. The abbreviations refer to the sub-committees defined in Figure 2-13. PM has an important role to control the process within the organizational framework. The developed organization framework aims to provide a basis to support a strategic PM involvement to the tender process. FX risk modelling is part of the risk management proposal. However, the risk management proposal is very often not part of the bid proposal contents. It is included as contingencies or cost positions in the life-cycle programme and the financial model.

Table 2-4: *Contribution of sub-committees in an organizational framework*

	Contribution to the bid proposal from the sub-committees								
Contents of Bid Proposal	**Sponsor**	**Architects**	**Banks**	**Legal**	**Contractor**	**Facility management**	**Life cycle analysts**	**Risk modelling specialists**	**Specialists (e.g. Facade, Light, IT...)**
Strategy									
Design development plan	MP-SC	MP-SC							
Construction program					CP-SC				
Fund raising and risk mitigation	CP-SC								
Operating strategy						CP-SC	OFM-SC	OFM-SC	
Technical design									
Master plan (Facilities, Finishes)		DC-SC				CP-SC			
Construction program					DC-SC				
Lifecycle program						OFM-SC	OFM-SC		
Major equipments					DC-SC	OFM-SC			CP-SC
M&E schematic drawings					DC-SC				DC-SC
Sustainable proposals						OFM-SC			DC-SC
Management of service delivery									
Overall service delivery						OFM-SC			
Performance monitoring proposals						OFM-SC			
Project agreement markup (legal)	CP-SC			CP-SC					
Commercial proposals									
Schedules mark-up	CP-SC								
Payment mechanism mark-up	CP-SC							OFM-SC	
Heads of terms for sub-contractors	CP-SC								
Third party income proposals							CP-SC	OFM-SC	
Insurance/ utilities proposals						CP-SC			
Financial									
Financial proposals			CP-SC				CP-SC	OFM-SC	
Capital/ operating/ maintenance cost breakdown						CP-SC	CP-SC		
Financial model			CP-SC				CP-SC	OFM-SC	
Variant Bids	CP-SC								

The next section illustrates how LCC modelling is implemented in a case study of current PPP tendering in South East Asia. It is demonstrated that LCC analysis is an effective vehicle to improve the efficiency of PPP projects.

2.7.2. LCC modelling as input to structure risk mitigation instruments

LCC analysis is mainly implemented as a vehicle for decision-making during the tender period. It can also be used to analyse historical data of projects to decide how to manage an asset in the future. Both attempts are connected with decision-making processes in projects. In general the analysis and calculation of LCCs shall underline an integrated approach of the initial investment, costs for operation and maintenance and utilization of buildings or building elements. Flanagan (1987) defines the LCCs of an asset as the total cost of an asset over its operating life, including initial acquisition and subsequent running costs. Emblemsvåg (2003) states that LCC should therefore be an important way to help companies eliminate costs before they are incurred and to manage some crucial business risks related to costs, cash flow, and profitability. The relevance of the implementation of LCC analysis in a project or asset management for the optimisation of costs during the concession period mainly depends on the specific relation and the objectives of investors, owners and users of the building. According to Flanagan (1989), objectives on the one hand, such as short-term profit, long-term returns or satisfying public need, and on the other hand, the timescale, sources of capital and revenues or taxation positions of clients can vary. LCC is a tool to estimate project maintenance and replacement costs and to optimize the cash flow of a project. Major capital expenditures over the life span of the facility need to be quantified and accounted for in the LCC and profit strategy. The scheduled maintenance and major replacement costs should be covered from the unitary payments or from adequate funds like an available working capital facility.

2.7.2.1. LCC cost analysis for an educational facility in South East Asia

The case study's key objective is to develop a complex of service excellence as stated in Table 2-6. An interactive environment in a flexible, scalable and innovative development should be achieved. The project should uphold safety, sustainability and environmental responsibilities. The total construction costs are estimated to be USD 150 million with provision of accommodation supported by unitary charges and commercial revenues from on-site business. Three consortia have submitted bids for the project. The overall tender evaluation criteria are separated into the quality and the deliverability of the proposal. The quality of the proposal covers 50% of the overall rating and includes the following three sub-criteria: (1) technical (65%), (2) management (25%), and (3) commercial (10%). The deliverability covers the other 50% of the rating and includes four sub-criteria: (1) technical (50%), (2) management (10%), (3) commercial (30%) and (4) financial (10%).

Table 2-5: *Basic data of the Case Study*

Case Study - Educational facility	**Remarks**
Main facilities	- Facilities for business & services, engineering, information technologies - Training restaurants & workshops - Integrated sports & recreation facilities - Commercial outlets
Project objectives	- A complex of excellence for service quality - Provides an inspiring and interactive environment - A flexible, scalable and innovative complex - Recognizable and distinctive landmark - A complex that upholds safety, sustainability and environmental responsibilities
Capital investment	- $US 150-180 million
Concession period	- 25 years including two years construction period

The LCC analysis in the project is carried out based on the costs of construction, operation and maintenance of the project. It also includes the estimated replacement costs during the project's life cycle. All materials, components and equipment are carefully selected with regard to their fitness for purpose, appearance, operation, maintenance, and forecast replacement cost.

The life-cycle cost model consists of the following components: (i) section on the assumptions for inflation, scenarios, construction, operation and replacement costs, (ii) calculation sheets for construction, operation and replacement with real and nominal values, and (iii) calculation sheets for present values and annual values of the life-cycle costs. There were no establishments of target costing.

All costs were allocated and estimated under consideration of the time in which they would incur. The implemented consumer price index (CPI) is set at 5% in the tender documents and is much higher than the actual CPI rate. This can be explained by uncertainty of manpower costs as a major cost component for FM services. Out of 21 items, five major cost components constitute 60% of the overall operation and maintenance (O&M) expenditures. Increased O&M expenditures of nearly three times occur regularly every five years during the whole life cycle. The five items are shown in the nominal costs schedule in Figure 2-14 and include: (i) cleaning services and waste management, (ii) furniture, fixtures, fittings and equipment (FFF&E), (iii) mechanical and electrical (M&E) systems, (iv) building works including plumbing and sanitary works, and (v) security guard services.

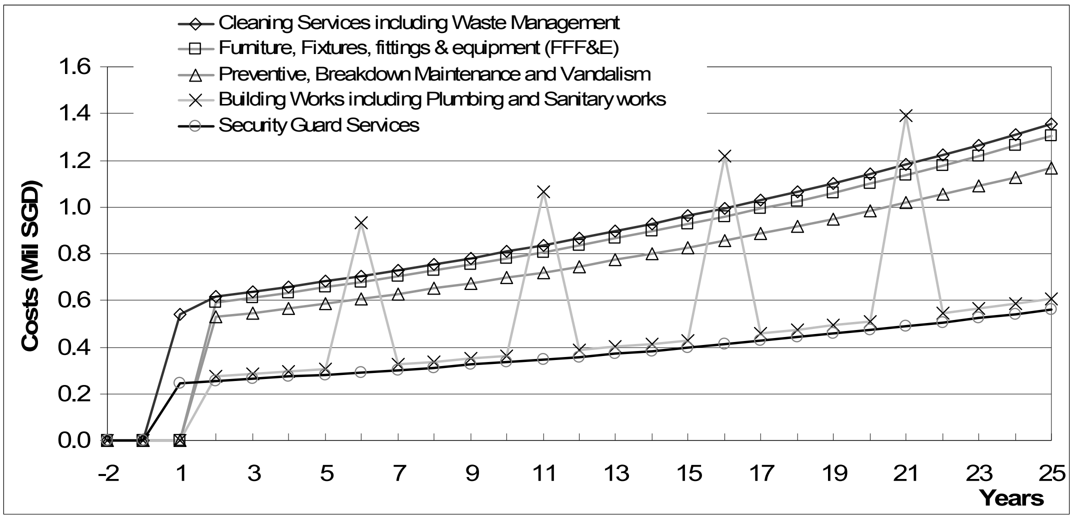

Figure 2-14: *Operational and maintenance expenditures for the five major cost components*

The amount of O&M costs will increase to nearly 75% of the total amount by adding the next two highest cost items, which are chillers of air conditioning systems and security systems. Figure 2-15 shows the nominal cost schedules of total operational and maintenance expenditures, the total costs of the five main items, plus chillers and security systems.

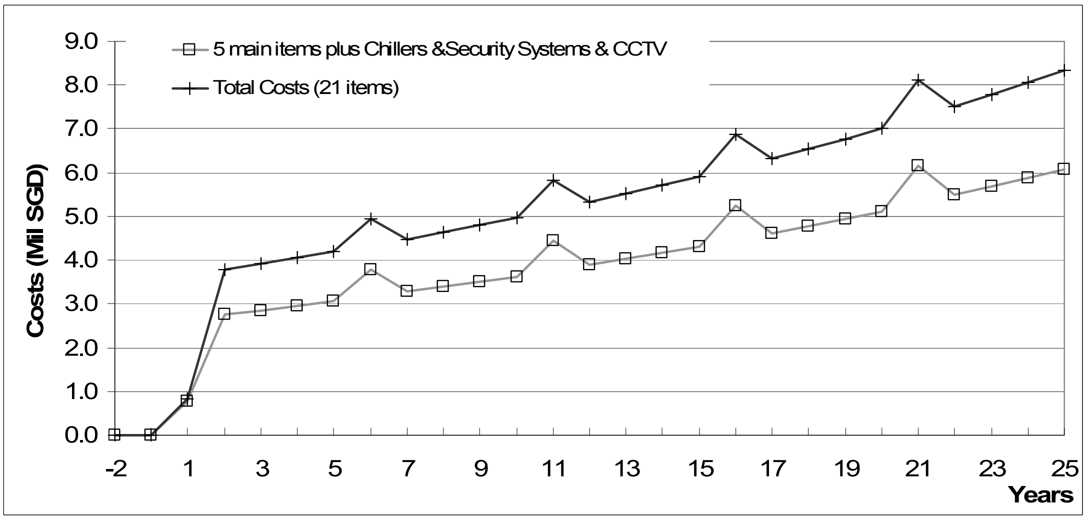

Figure 2-15: *Operational and maintenance expenditures for the seven major cost items*

Figure 2-16 illustrates a comparison between the annual unitary payment on O&M costs and the actual operating expenditures. The annual unitary payment curve is shown in three scenarios: (i) annual unitary payment in real values, (ii) annual unitary payment with escalation of 1.5% and (iii) annual unitary payment with escalation of 3%. The 1.5% adjustment intersects with the actual O&M expenditures and would be too low at the end of the operation period. A 3% adjustment is too high and results in extra profit for the SPC.

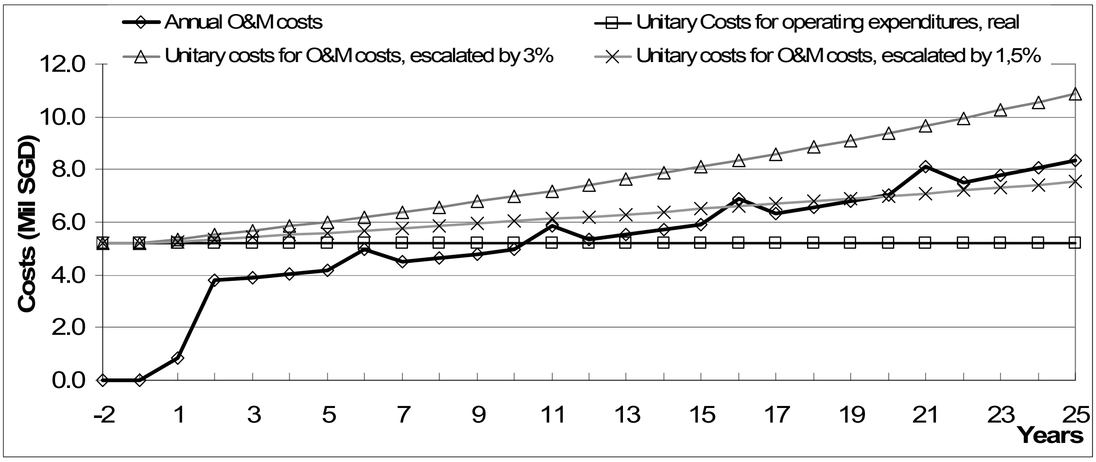

Figure 2-16: *O&M costs compared with the annual unitary payment component on O&M costs*

The regular replacement periods are defined by the projected economical lifespan. The components can be differentiated by the main components of M&E systems and building and civil engineering works. Replacements within a one- to two-year cycle include the main items of: (i) internal finishing and (ii) internal finishing exposed to vandalism. Major replacements in M&E systems and building and civil engineering works with a five-year cycle will mainly include: (i) fire protection systems, (ii) external finishing, and (iii) landscaping. Replacements in a six- to ten-year life cycle of M&E systems are expected in: (i) electrical, (ii) mechanical (iii) air-conditioning systems and (iv) specialist systems. Key building components with a 10-year replacement period are: (i) doors and windows, (ii) floor slabs and (iii) internal walls and partitions. Additionally, civil engineering works with a 10-year replacement period include: (i) service roads and car parks, (ii) fencing and gates, (iii) surface-water drains, and (iv) footpaths. Important replacements in a 15-year O&M lifecycle include the main items of M&E systems of: (i) mechanical (plumbing), (ii) fire sprinkler, hosereel, wet riser, and (iii) air conditioning or heating systems. Within a 20- to 25-year cycle, O&M components, M&E systems and building components have major replacements of: (i) specialist systems (lifts and escalators), (ii) roof, (iii) staircases, and (iv) walls (external walls and curtain walling). Furthermore, major replacements of civil engineering works are expected to (i) service roads and carparks, and (ii) surface-water drains.

The total annual O&M and replacement costs compared with the total annual unitary charge on O&M and replacement costs are shown in Figure 2-17. All three scenarios of (i) total annual operation fee in real values, (ii) total annual operation fee escalated by 1.5% and (iii) total annual operation fee escalated by 3% on O&M and replacement costs are below the actual estimated costs in years 10, 15 and 20. Therefore, working capital facilities are necessary to cover the gap during the replacement periods.

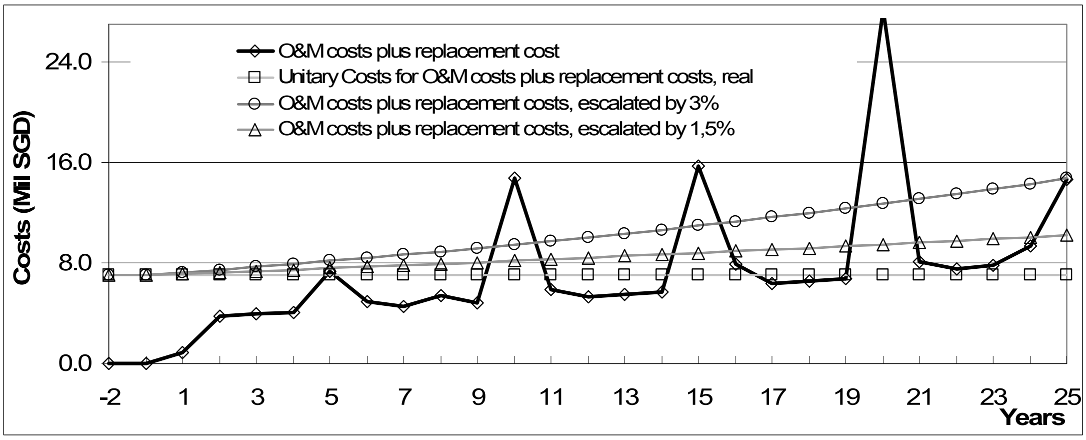

Figure 2-17: *O&M costs plus replacement costs compared with the escalated annual operation and replacement fee*

Bidders were encouraged to propose alternative, energy-efficient technologies to illustrate the significant savings that such technologies could achieve. Figure 2-18 shows the total O&M costs for the five main items plus chillers & security systems, comparing the energy costs in the base case and the energy-efficient proposal. The energy-efficient technologies have a significant impact on the O&M costs and could reduce total energy costs by 62%. To achieve this energy reduction, several improvements were implemented, such as; 6 m deep daylighting in offices, wall systems with a U-value of 0.59, double low-emissivity glazing, roof insulation of 100 mm, improved efficiency of fans and lighting, CO_2 sensors, efficient chillers of air-conditioning, and energy efficiency through floor-slab system.

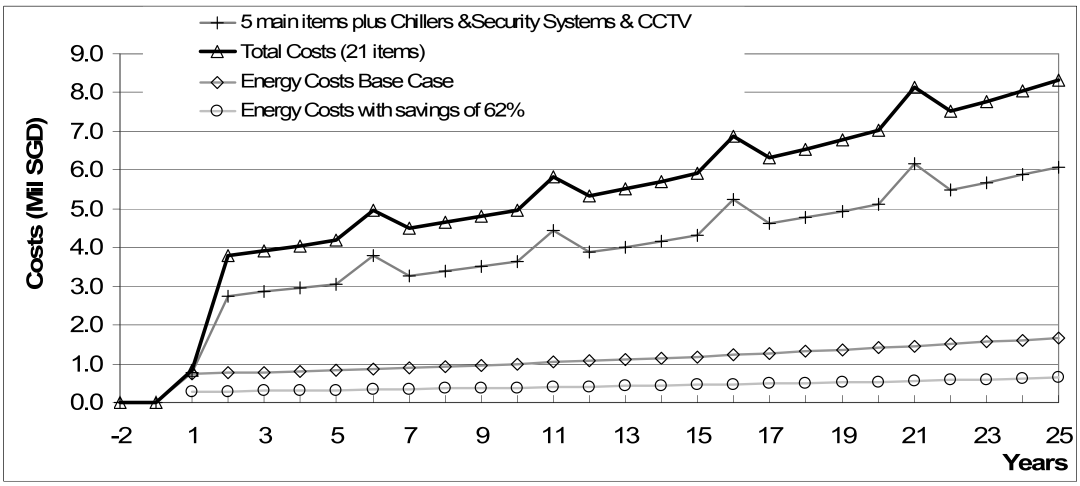

Figure 2-18: *Energy savings in relation to total O&M costs*

The ratio of energy costs to total LCC costs dropped from 0.20 to 0.075 by including energy efficient technologies, as shown in Figure 2-19.

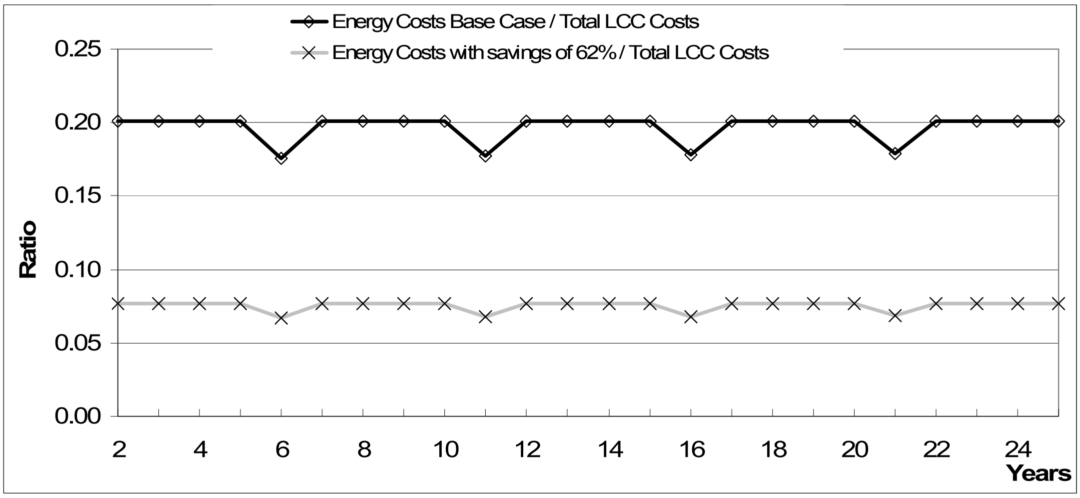

***Figure 2-19**: Ratio of energy costs to total LCC costs*

No matter in which project phase the LCC analysis is implemented, it should always be related to making decisions on new or changed requirements. Therefore, LCC can be used for various project types and the optimization of the cost structure. LCC analysis contributes as a strategic plan for the fundamentals and optimization of the PPP project during tendering. FX risk modelling can be derived with the input from the LCC analysis. The simulation depends on the LCC modelling. The next section illustrates economic FX exposure modelling in the case study.

2.7.3. Foreign exchange risk simulations

The cash flow is denominated in Singapore dollars (SGD) and exposed to euros (EUR) and United States dollars (USD). FX exposure is modelled based on the underlying assumptions of a log-normal distribution with mean value of the spot rate and 12-month volatility. All assumptions with impact on FX exposure in the project are broken down in Table 2-7. Since operational costs are mainly done by local contractors and financing can be fully provided by the local banking sector, the case study examines FX exposure mainly on construction costs and replacement costs.

Table 2-6: *FX impact on cost and revenue*

Capital Expenditure	**FX rates**		**Construction costs**	**FX rates**
Equity	SGD		Construction costs in foreign currency	EUR/SGD, USD/SGD
Subordinated Debt	SGD		**O&M costs**	
Bank Debt	SGD		Fixed Opex	SGD
Revenue			Management Fee	SGD
Capital Recovery Fee	SGD		Utility costs	SGD
Fixed Operating Fee	SGD		**Replacement costs**	
Service Fee	SGD		Fire Sprinkler, Hosereel, Wet riser etc.	EUR/SGD
Infrastructure Fee	SGD		Lifts & Escalators	EUR/SGD
Utility Fee	SGD		ACMV	USD/SGD
Variable O&M cost rate	SGD		Façade Cleaning Equipment	USD/SGD
VAT Receivable	SGD		External Wall and Façade Cladding	USD/SGD
Fianancing costs			Internal Walls and Partition	USD/SGD
SGD Bank Debt Interest	SGD		Internal Doors	USD/SGD
Subordinated Debt Interest	SGD		Furniture & ID Works	USD/SGD
Bank Debt Principal	SGD			

The FX risk parameters on EUR and USD are determined as fitted log-normal distributions. Both currencies are correlated by -0.514. The correlations and the volatilities are assessed during the period from January 2007 to January 2009. The mean value of the log-normal distribution represents the spot price in January 2009. Therefore, the FX rate on USD/SGD is modelled as $Log-N(1.5303,\ 0.0741^2)$ and the FX rates for EUR/SGD as $Log-N(1.9669,\ 0.1054^2)$. PDFs are aggregated from stochastic simulations with @risk from Palisade. Scenario analysis in conjunction with sensitivity analysis and Monte Carlo simulation will determine the most likely FX exposure on construction costs and replacement costs. Figures 2-20 to 2-23 illustrate the relative frequency of construction costs and replacement costs as nominal and discounted values. The relative frequencies are plotted on the left side of the graphs, indicating the probabilities for each value of construction cost. The right side of the graphs shows the cumulated relative frequencies. Figure 2-20 shows a 5% chance that construction costs will be below SGD 232.48 million and a 95% chance that the costs will be below SGD 243.87 million. Figure 2-20 shows a mean value of SGD 238.03 million for total nominal construction costs. The mean value of SGD 238.03 million has a 50% chance of occurrence. The total value under the 90% confidence interval shows an FX exposure of SGD 11.39 million. By using the mean value as budgeted cost, the FX exposure between mean value and 95% confidence interval shows SGD 5.84 million FX exposure on construction costs.

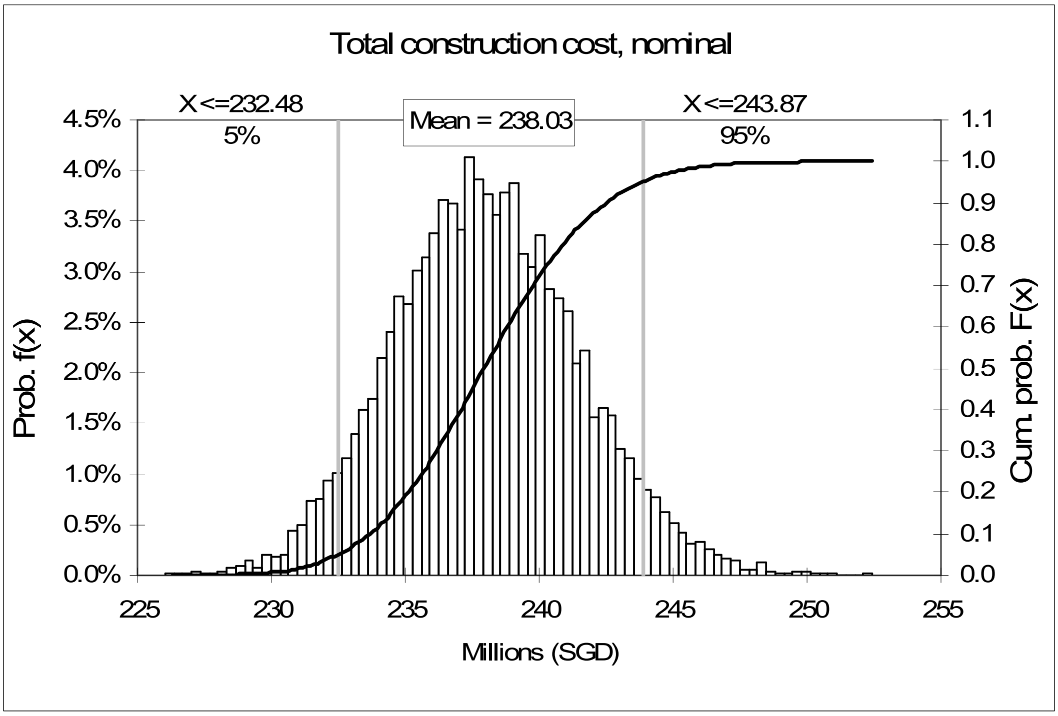

Figure 2-20: *Probability distributions on construction costs, nominal*

The FX exposure on net present value (NPV) is derived by a 6% discount rate, which was defined in the tender specifications. Compared with the nominal construction costs, the NPV is around SGD 6.6 million lower on the 5% and 95% quantile as illustrated in Figure 2-21. The case study has a two-year construction period. Therefore the discounting effect on FX exposure is very small. The total FX exposure is SGD 11.07 million within the 90% confidence interval and SGD 5.68 million between mean value and 95% confidence interval.

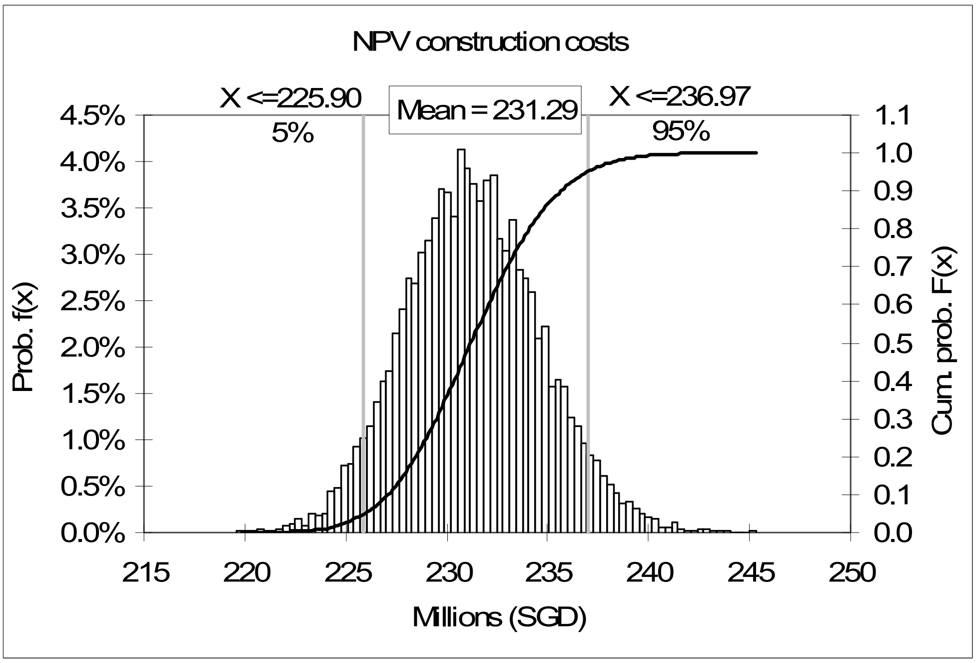

Figure 2-21: *Probability distributions on NPV construction costs*

All operational costs are denominated in SGD and cover no FX exposure. However, replacement cycles are exposed to USD and EUR. Figure 2-22 shows the FX exposure of SGD 5.48 million for replacement costs under the 90% confidence interval and SGD 2.8 million between mean value and 95% confidence interval.

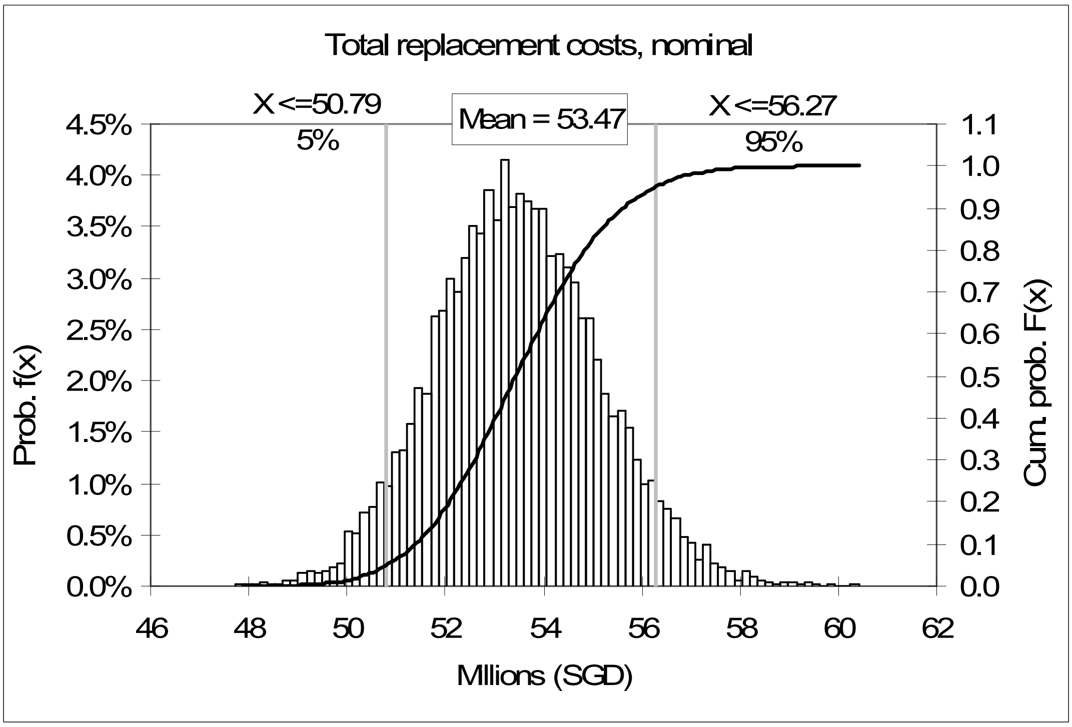

Figure 2-22: *Probability distributions on replacement costs, nominal*

The discounted values on replacement costs using the 6% discount rate are significantly reduced by SGD 31.78 million on the 5% quantile and SGD 35.1 million on the 95% quantile, as shown in Figure 2-23. The FX exposure measured on the discounted replacement costs under the 90% confidence interval are SGD 2.13 million, and SGD 1.09 million between mean value and 95% confidence interval.

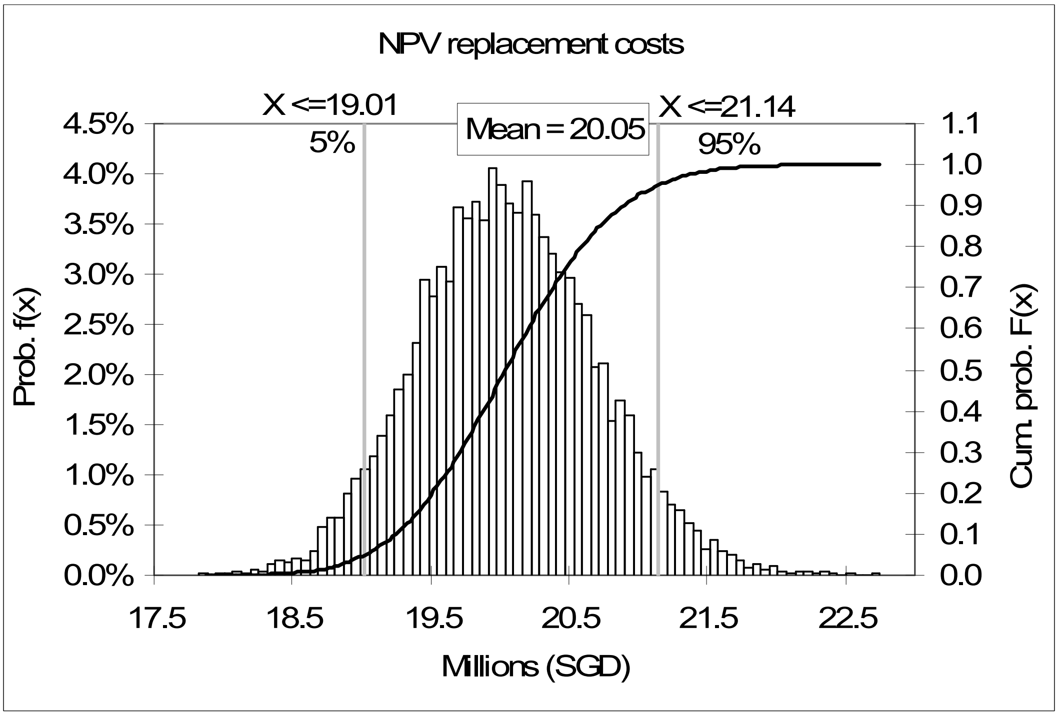

Figure 2-23: *Probability distributions on NPV replacement costs*

However, as shown in Figure 2-24, the internal rate of return (IRR) computation is not much affected by FX exposure. This can be explained by the fact that replacement costs are discounted and represent only a portion of the total LCC costs. The result would be different if the FX exposure were to have an impact on the operational costs. FX exposure affects the IRR between 11.48% to 11.95% on the 90% confidence level. This value is driven by the construction costs and the replacement costs.

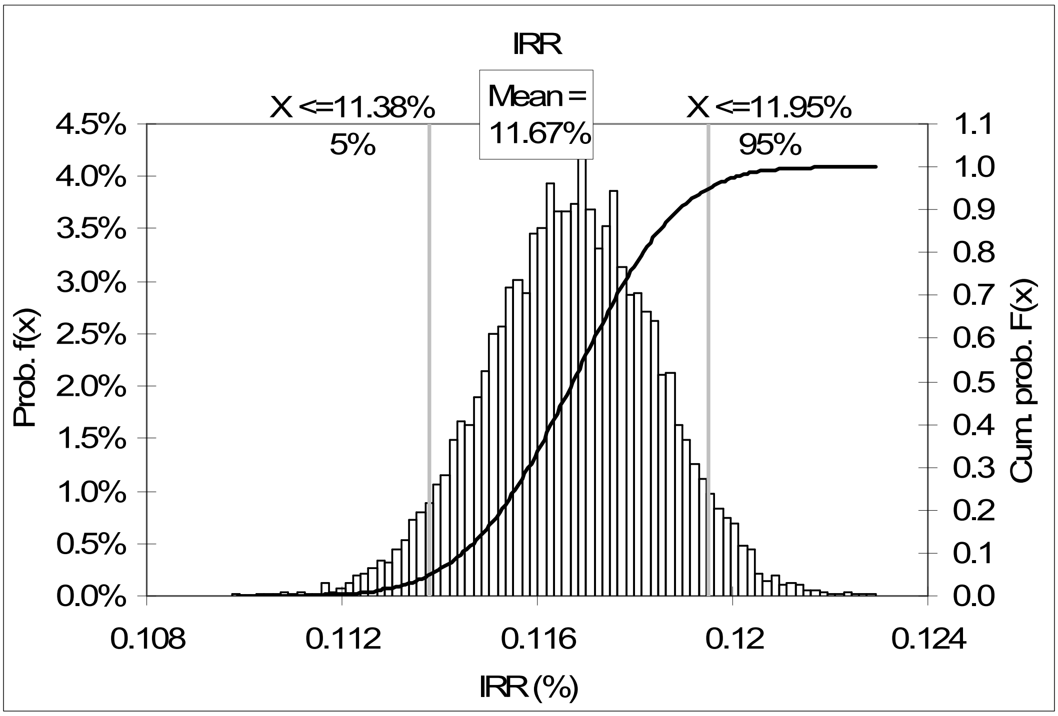

Figure 2-24: *Probability distributions for IRR*

The detailed statistics are listed in Table 2-8. The columns show the cumulative probabilities for the total FX exposure on construction and replacement costs in nominal and discounted numbers. For example, there is a 70% chance that the total construction costs nominal will not exceed SGD 239.7 million. The last column shows the detailed statistics of FX exposure on the IRR.

Table 2-7: *Detailed statistics of FX exposure in the case study*

Name	Total construction costs, nominal	Total replacement costs, nominal	NPV construction costs	NPV replacement costs	IRR
Minimum	225,419,200	47,351,560	219,039,400	17,718,850	10.94%
Maximum	253,272,000	60,685,860	246,104,000	22,875,990	12.33%
Mean	238,031,100	53,473,530	231,294,400	20,056,840	11.67%
Std Deviation	3,446,157	1,652,157	3,348,624	642,263	0.17%
5% Perc	232,492,800	50,819,160	225,912,800	19,021,100	11.39%
10% Perc	233,654,200	51,375,710	227,041,400	19,243,870	11.45%
15% Perc	234,483,500	51,776,650	227,847,200	19,396,310	11.49%
20% Perc	235,131,400	52,091,020	228,476,800	19,517,210	11.53%
25% Perc	235,670,600	52,346,220	229,000,700	19,616,410	11.56%
30% Perc	236,148,300	52,582,480	229,464,900	19,710,480	11.58%
35% Perc	236,651,100	52,807,920	229,953,500	19,797,790	11.61%
40% Perc	237,080,000	53,016,650	230,370,200	19,879,750	11.63%
45% Perc	237,501,600	53,213,540	230,779,900	19,955,240	11.65%
50% Perc	237,910,600	53,431,320	231,177,300	20,039,520	11.67%
55% Perc	238,375,500	53,638,690	231,629,000	20,124,030	11.70%
60% Perc	238,816,900	53,847,900	232,058,000	20,201,180	11.72%
65% Perc	239,284,300	54,083,820	232,512,100	20,291,880	11.74%
70% Perc	239,784,200	54,319,760	232,997,900	20,386,600	11.76%
75% Perc	240,313,900	54,566,420	233,512,600	20,481,890	11.79%
80% Perc	240,877,000	54,849,640	234,059,700	20,588,540	11.82%
85% Perc	241,632,800	55,198,300	234,794,100	20,726,300	11.85%
90% Perc	242,479,300	55,599,830	235,616,700	20,885,620	11.89%
95% Perc	243,786,400	56,245,030	236,886,800	21,135,120	11.95%

Figure 2-25 measures the sensitivity based on the beta coefficient of the total FX exposure to the impact of Euro and USD changes. The higher the coefficient the more significant is the variable in determining the total FX exposure. Figure 2-25 shows the USD as the highest variable contributing to the total FX exposure. The reason can be explained in the formulation of assumptions. The USD cost components are much higher than the EUR-denominated cost components.

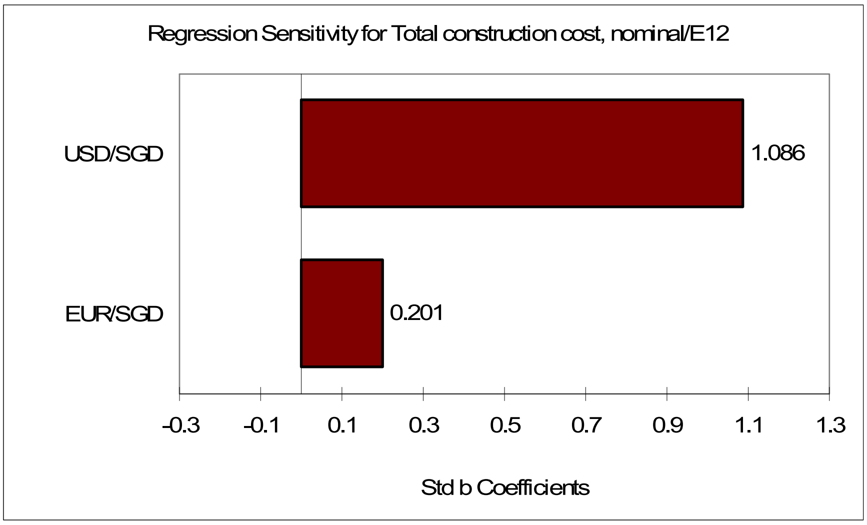

Figure 2-25: *Sensitivity of total FX exposure to the impact of Euro and USD*

The results of the case study are presented in statistics and in percentile values. The amount of economic FX exposure is significant even when the financing costs and operation costs are in SGD and only construction cost and maintenance costs are partially in USD or EUR. LCC is an important tool to derive the input variables for the FX exposure analysis. Based on the analysis, decisions can be taken on the implementation of risk mitigation instruments. In the case of setting up a contingency account for the total FX exposure, usually a 95% percentile value would be used. The expected value of FX exposure is commonly used in project selection and comparison between different alternatives.

2.7.4. Lessons learned on FX risk modelling during the PPP tender process

The case study provides several insights into how LCC and FX risk modelling can be implemented in a PPP tender process. Table 2-9 summarizes the main five lessons learned on experienced difficulties. To overcome the problems, strong PM is required. Possible improvements of PM support to overcome the difficulties are listed on the right side of the Table 2-8. The difficulty with the overall programme can be solved with effective communication between the sub-committees. Efficient PM services will happen if updates about decisions made in the process are distributed by focusing on the right parties without experiencing an overflow of information. To address tender requirements effectively, it is important to ensure no missing skills through partnerships and sub-consultants.

The LCC and FX risk modelling is based on the master plan. It is important to have a detailed master plan at the early stage. The design drawings can be developed and improved simultaneously but should not change fundamentally during the tender stage. PM support for LCC modelling is necessary if innovations require the approvals and the acceptance by the authorities and the client. There is a risk that authorities tend to deal only with the preferred or selected bidder.

The PM should identify clear standards of performance, deliveries, services and delivery or performance dates during the development of the interim proposals. Within the development of interim and finalized proposals, the PM team should monitor, track and control the performance of each involved party by providing activities lists indicating any outstanding work. This requires identifying mechanisms for performance monitoring that will relate well to the project objectives. Furthermore, the LCC modelling needs PM support if alternative energy-efficient technologies are proposed. Several risks, like unclear utility policies, require decisions by the steering committee. Major costs such as utilities, insurance, legal, general and administrative expenses, as well as taxes need to be substantiated with price quotations and if possible with market comparisons.

The risk management proposal depends on the operations and FM proposals, the LCC proposal, the finalized construction cost plans, term sheets and the financial model. It requires an integrated management process with information from FM consultants, LCC consultants and the banks. The PM task is to coordinate the process of settling the risk allocation matrices, and to comment on the assumptions and the required accuracy in the risk modelling. Without PM support the information tends to be available at the latest stage of the tender period. The parties only release information to the other consultants if the cost assumptions are very accurate. The reason is the risk of having to explain future cost increases to the steering committee if initial estimates were too low. Therefore, the PM support is necessary to include FX risk modelling in the process as soon as the interim proposals are finalized. In summary the reason for limited effort on FX risk modelling is experienced because of limited priority in the bid proposal contents and integration shortcomings of risk modelling during the tender period.

Further support of PM is necessary for the identification of national permits and approvals necessary to design, construct, operate and maintain the project. The PM team has to conduct an in-depth review of all permits and approvals needed to conform with relevant laws and regulations. In addition, the PM should ensure that government guarantees or other available credit support is in place. In many countries guarantees are used to backstop the primary credit support.

Table 2-8: *Analysis of experienced LCC and FX risk modelling difficulties during PPP tenders*

Experienced difficulties with impact on LCC and FX modelling	Impact on FX risk modelling	Impact on LCC modelling	Required project management support for successful LCC and FX risk modelling
i) Overall program			
Initial bid strategy		x	- Project management (PM) has to set overall objectives
Identify specialists gaps		x	- Ensure that the consultants are capable of achieving the objectives - Implement methodologies to secure their involvement - PM needs to identify and assign each task during the tender period
Overlapping of participation of different parties to different contents of the bid proposal	x	x	- PM needs to assign roles and responsibilities in the organization framework - PM needs to design communication channels and the information flow between the consultants - PM needs to control the performance by providing lists with outstanding work
ii) Design			
Changes in the master plan and architectural design	x	x	- Continuous changes on architectural drawings may delay the bid preparation in terms of selection of FM strategies, resource leverage and LCC and risk modelling
Life-cycle design	x	x	- Requires communication between the PM and the authorities
iii) Development of interim proposals			
Tender requirements		x	- Identify clear standards of performance, deliveries, services delivery or performance dates
Tender objectives in LCC		x	- PM needs to set clear objectives in case tender criteria are insufficient in sustainability and efficiency
Energy efficiency technologies are often not valued in the tender evaluation criteria	x	x	- Agree on methodologies and strategy
iv) FX risk modelling			
Coordination in the process of settling the risk allocation matrix as well as the comments on the assumptions and the required accuracy in the risk modelling	x	x	- PM needs to agree on methodologies, data required, and how this will be collected - Early start of identification of realistic scenarios and incorporation of significant factors in the risk model - All control measures should be stated in the operation and maintenance strategy - Set upper limit of indemnification of performance risk - The financial model and the FX risk model must be based on the same assumptions
Default risk of the SPC	x		- Protection in case of default of the SPC - Risk mitigation for operator and FM provider
Optimize capital expenditures	x	x	- Major capital expenditures over the life of the facility need to be quantified and accounted in the LCC model
Environmental sustainability and responsibility		x	- Implement sustainable development objectives into design, construction and operation such as efficient use of utilities and logistics - Implement controlling and management systems
v) Permissions and approvals			
Identify all local and national permits and approvals		x	- PM needs to update on internal agreements included in the tender documents
Government guarantees or other available credit support is in place	x	x	- In-depth review of all permits and approvals regarding the reliability and the violation of laws and regulations

2.7.5. Summary

A successful LCC and FX risk modelling during a PPP tender process requires assessing the roles and responsibilities to all consultants involved, a clear definition of the workstream including the flow of information and a strong PM involvement. LCC and FX risk modelling must be implemented in the PPP tender process. The derived organizational framework illustrates the contribution by each party involved. It shows how the flow of information will contribute to LCC modelling which is the basis for input variables of the FX risk modelling. A case study of a current PPP project in South East Asia is used for illustration. The same case study is used to illustrate economic FX exposure in the project. The priorities during the tender process, from lessons learned and solutions delivered on shortcomings in the organization of the tender process and the flow of information are discussed.

CHAPTER 3

FX management and control

This chapter discusses potential FX risk allocation opportunities to the involved parties in PPP projects. The advantages and disadvantages of potential risk mitigation opportunities are discussed. The objective of this chapter is to identify hedging techniques and to investigate the effectiveness of the various hedging techniques that are commonly used in the industry. The results of three questionnaire surveys are analysed and compared regarding the importance of currency risk control techniques to sponsors and contractors in PPP projects, international construction projects and small and medium-sized enterprises. The results illustrate current FX risk hedging practice and the advantages and disadvantages of adopting derivatives or other risk mitigation instruments.

3.1. FX risk allocation opportunities

The standard advice on allocating risks is to assign them to the party best able to manage the risk at the lowest costs. The risk exposure depends on the risk analysis assessing the risk effectively and it depends on the negotiation strategy to lower shareholders' risk exposure. The allocated risk position will be translated into the concessionaire agreement. Additional risk mitigation instruments (RMIs), such as guarantees, assurances, agreements, indemnities or financial products, can be adopted to mitigate the FX risk exposure.

However, the problem with the FX risk, and the reason for its perennial concern to investors, is that it is neither under the control of any of the parties, nor is it clear which party can manage it best (Matsukawa, 2003). The adequate approach to mitigate or allocate the FX risk for each project will be determined by the specific project structure and the sector and national circumstances.

Furthermore, Tinsley (2000) states that extra caution is needed as the phrases "risk allocation" or risk "mitigation" may give the impression that the risk in question has been settled. Based on his experience in previous PPP projects, the risks were never clearly allocated and each party had to worry further about the risks. To solve the problem of risk allocation, it is essential to understand the risk exposure properly. However, the assessment and the understanding of the FX risk exposure during the concession period of 15 to 30 years requires a flexible structure and one that is capable of learning.

Matsukawa (2003) describes the reasons for sharing the FX risk exposure among the project's stakeholders as follows: (i) the government has the incentive to signal its policy objectives (ii) the equity sponsors have the incentive to mitigate the project's FX exposure, and (iii) the consumers are encouraged to make demand-side responses through price signals

The investment appetite of investors and lenders depends partially on the FX exposure within the project. If a government is interested in improving the infrastructure and living conditions in the country, the risk profile has to be structured in a way that achieves confidence by investors and lenders. Investors can choose in which country, sector or project they will invest. If the FX risk is too great for investors, the government must bear the risk as the last resort. To attract private sector investors, host governments often provide financial support packages. These supports may take various forms, such as: (i) comfort letter, (ii) capital contribution (equity/debt/subordinated debt participation), (iii) preferential tax treatment, (iv) grant/subsidy, and (v) guarantees. A government's obligation to provide support can be defined in laws, decrees, statutes, licences, concessions, contracts or other legally binding documents (Dailami, 1997).

The following three parties can bear the risk of exchange rate movements in the first instance: (i) the host country government, (ii) private investors, and (iii) customers. The following section analyses which party stands to gain from unexpected increases of local currency appreciation or lose from unexpectedly large declines.

3.1.1. FX risk allocation to the host country government

The host country government can be differentiated by three categories: (i) national government, (ii) local government, and (iii) contracting authority. Based on the type of infrastructure, the relevant sub-category of the national government will influence currency volatility by its macroeconomic policies and undertakings regarding exchange rate policies. Governments can influence exchange rates through monetary and fiscal policies as well as through foreign currency market interventions. They can influence the underlying source of risk by reducing the rate of depreciation or maintain currency volatility by keeping budget deficits small and inflation low. Local governments are often responsible for contractual fulfilments like compensation payments and tariff adjustments. The contracting authority is generally organized as a state-owned company and operates as the offtaker of the infrastructure output.

The government is responsible for macroeconomic policies that mainly determine changes in exchange rates. The ability to use policies to influence exchange rates is a strong reason to allocate the FX risk fully to the host government. In addition, the government has an informational advantage compared with all the other stakeholders. A government has the necessary information of its own future policy intentions and can use policy instruments to influence exchange rates. However, contingent claims due to foreign currency devaluation may be payable at a time when the government is least able to manage the risk. Therefore, investors still have the uncertainty about: (i) the policy that a government will adopt in response to an external shock, (ii) the policies that may be adopted by future governments, (iii) the willingness of the public authority to compensate regarding contractual arrangements, (iv) the insolvency of the offtaker, (v) the delay in compensation payments, and (vi) the delay in tariff adjustment or other agreed risk mitigation instruments.

Matsukawa (2003) states that the allocation of exchange rate risk to the government is often illusory because governments do not respond to financial incentives the way firms or individuals do. Furthermore, investors have a weak position to negotiate in the FX loss even if the FX risk was allocated to the public authority. The asset is difficult to redeploy as long as the principal is not repaid and the output is not tradable in international markets. The revenue and the tariffs charged to consumers are highly regulated and with high political influence, and the offtaker could be less concerned that the project is able to meet its fixed costs. On the other hand, most infrastructure PPP projects are monopolies. In most cases, a given geographical area can only support one distribution network.

Investors can choose the country, sector, and project in which they invest. If the FX risk is too great for investors, the government must bear the risk as the last resort. In general, foreign currency lenders will always require FX risk protection. Several mechanisms can be provided at the national level if long-term local debt is not available and derivative markets do not exist to mitigate the FX risk exposure. The most common RMIs are: (i) fixed exchange rate, (ii) public sector lending in local currency, (iii) local lending by multilateral agencies, (iv) local currency fund schemes, (v) exchange rate guarantees, (vi) partial credit guarantees, (vii) partial risk guarantees and political risk insurances, (viii) local currency guarantee facilities, (ix) tariff adjustment mechanisms, and (x) compensation payments. All mechanisms should be developed to avoid moral hazard of the various parties.

3.1.1.1. Fixed exchange rates

In theory a fixed exchange rate system would protect project participants of the host country from currency devaluation. However, the problem occurs if nominal exchange rates are dramatically different from market-determined rates. If a country is forced to abandon a fixed exchange rate system, the real exchange rate would immediately devaluate. According to Matsukawa (2003), the magnitude of devaluation is typically much greater than the volatility associated with floating or managed float systems. Furthermore, the period for which the FX risk is maintained and the period of stability are much shorter than the project finance loan durations.

3.1.1.2. Public sector lending

Public sector lending in local currency is an alternative approach to finance loans which may be made either directly or indirectly through state-owned financial institutions. These loans could be used to leverage private investment when the loan from the government is subordinated to the private loans.

Alternatively governments could borrow from donors to finance infrastructure projects and lend the funds to projects at a higher interest rate. As suggested by Matsukawa (2003), the spread between foreign currency fixed-interest rate loan and the local currency loan on-lending rate can be used to provide partial cover against devaluation risk. However, it is essential that the spread will be sufficient to cover the losses in case of severe currency depreciation.

3.1.2. Local bank market development

According to Outreville (1990), the governments of many developing countries historically held the view that the financial systems cannot serve their countries' development needs adequately. Therefore, on the one hand, the financing needs exceed local market capacity, and on the other hand, the development of local capital markets in emerging markets that would absorb the financing needs of infrastructure projects is far beyond what governments' budgets can afford. In the long run it seems essential to promote local bank market development and to establish long-term governmental bonds for infrastructure finance. In a structured finance transaction the local market opportunities should be explored and integrated.

Furthermore, empirical work illustrates the close ties between financial and economic development (Goldsmith, 1969) and (McKinnon, 1973). The hypothesis that financial development is crucial for successful economic growth seems to be accepted in the field of economic development. Accordingly, during the past 30 years, developing countries have made efforts to change the structure of these financial systems. However, the development of a bank market offering long-term loans in the local currency typically requires that banks will be able to finance themselves on a long-term basis in local currency. Funding of local banks by long-term financing in dollars, simply transfers the FX risk from the borrower back to the lender.

3.1.2.1. Local lending by Multilateral Agencies

International Finance Corporation and the World Bank support the establishment of local currency guarantee facilities. GuarantCo is a global facility providing partial guarantees to eligible borrowers without the requirement of sovereign government counter-guarantees. Local currency fund schemes are provided, for example, by the Infrastructure Finance Corporation of South Africa and the Infrastructure Development Finance Company of India. The funds provide additional security for lenders and diversify the project risks.

Governments provide initial capitalization from reserve funds and issue bonds in the capital market. They lend the bonds to infrastructure projects and use the reserve funds in securing bond debt service payments (Matsukawa, 2003).

Multilateral agencies (MLA) also seek opportunities to make local currency loans to infrastructure projects. The motivation is to prevent financial crises in order to reduce currency mismatch in projects (ADB, 2007). According to Sheppard (2003), local and foreign currency financing are not mutually exclusive and even a small tranche of local currency debt may improve the sustainability of a project in currency crises. Local currency loans are most likely to be available in currencies where cross-currency swaps can be established to hedge the FX exposure of the MLA. Implementing local currency financing has catalytic effects in triggering the capital market development in developing countries by offering diversification opportunities for investors (ADB, 2007). However, local currency lending often has much higher interest costs compared with the interest rates on foreign loans. In some countries local currency lending is only possible with permission from government authorities, which requires a stable political situation.

3.1.2.2. Guarantees

Exchange rate guarantees are mostly provided by governments and can protect lenders, sponsors, offtakers and consumers from cost increases caused by currency devaluation. They are provided in case it is not possible to hedge FX risk in the local capital market or long-term local currency financing is not available. Exchange rate guarantees expose the government to one single risk and not to several risks as if the government is financing the project itself. The guarantee can mitigate the risk of government interventions to restrict currency convertibility and transfer. Government guarantees can also be written on the principal repayment of foreign currency loans. Past experience during the Asian financial crises showed that government exchange rate guarantees have not been very sustainable for infrastructure projects. If currency devaluation occurs, the guarantee will put an additional burden on the host government's FX reserves and hence increases the costs for the host country (Matsukawa, 2003). It affects the government's creditworthiness and therefore it is mandatory for the host government to understand and hedge its own risk exposure (Matsukawa, 2003). Some private agencies have begun to offer short-term exchange rate guarantees for protection against exchange rate devaluation. The guarantee locks in a certain currency exchange rate and is structured like a put option.

Partial credit guarantees (PCG) facilitate financing especially in situations where the borrower can access the local credit market but cannot realize sufficiently long tenures (Matsukawa, 2003). Through the possibility of funding the project in local currency, the FX risk exposure is indirectly mitigated. The guarantee can be used to cover later maturity payments or a certain amount of debt service payments over the duration of the credit. This can be applicable if the lenders expect temporary interruptions in the project's ability to service its debt obligations if funds are not matched. Additionally, PCG may be structured as a put option as take-out financing. The lender has the option to sell the loan to the guarantor at an earlier date (Matsukawa, 2003). The take-out financing is structured as a loan based on trigger events other than debt service defaults. This is different from a guarantee which is called upon in case of default.

Partial risk guarantees (PRG) can be applied in structured finance transactions in order to mobilize long-term local currency funding. Institutions like the Asian Development Bank (ADB), International Bank for Reconstruction and Development (IBRD), International Development Association (IDA), Multilateral Investment Guarantee Agency (MIGA), and the International Finance Corporation (IFC) offer several different guarantees to mitigate sovereign and non-sovereign risks (World Bank, 2006). The multilateral guarantees function as a deterrent against government actions that may adversely affect investments for large infrastructure projects (World Bank, 2006). The guarantee is supportive especially when local currency commercial creditors are willing to carry commercial project risks but are hesitant about the uncertainty in the political and regulatory environment (Matsukawa, 2003). PRG can also be used to guarantee the performance of regulatory agreements. These guarantees cover protection against currency inconvertibility and transfer coverage which offers protection against the inability to convert revenues and loan proceeds from local currency to hard currency and assures the possibility of transferring earnings out of the host country (Wagner, 1999). The guarantee protects the project company against active and passive blockage of currency. Active blockage means that the host government releases a law which prevents conversion or transfer of currency. Passive blockage is present if the host government causes excessive delay in converting or transferring the currency because procedures are slowed down and hindered (Wagner, 1999). The duration for a PRG can be from three to 15 years (World Bank, 2006). Depending on the project conditions and the nature of the project guarantee, arrangements are also extendable up to 20 years (World Bank, 2006). However, PRGs only guarantee the availability of foreign currency and do not provide coverage against currency devaluation. MIGA is offering PRG only in its member countries. PRGs are not available for all non-member countries.

Multilateral institutions usually provide loans denominated in hard currency but have now started to follow a new approach and provide guarantees of project debt denominated in local currency (Haddon, 2004). In case of default in repayments which is covered by a local currency guarantee, the guarantor pays the lender in local or hard currency. Therefore, the lender has the guarantee that local or hard currency will be available even in case of a default (Haddon, 2004). The local currency guarantee enables the SPC to obtain local-currency financing that otherwise would not be available.

3.1.3. FX risk allocation to the offtaker

Offtakers are the buyers of the goods produced by the infrastructure and are often government-owned companies. Therefore, they have an essential role in the FX risk allocation. The mismatch between local currency revenue and hard currency obligations is often solved by payments of hard currency to the SPC. In this case, the SPC is paid by the offtaker in hard currency which is adjusted by the actual exchange rate on a regular basis. Investors now depend on the solvency of the offtaker. To secure the solvency of the offtaker, they often have a counter-guarantee from the government's ministry of finance (MOF). The remaining risk to the investors is therefore: (i) the willingness of the offtaker to pay for the contractual payments during periods of currency devaluation, (ii) the willingness of the offtaker to adjust tariffs or to pay compensation payments, (iii) the feasibility of the offtaker making the contractual payments during periods of currency devaluation, and (iv) the risk that similar guarantees will be provided to other infrastructure projects, which will increase the government's overall risk exposure and make all guarantees less creditworthy by the possibility of multiple calls.

3.1.4. FX risk allocation to private investors

In PPP projects investors take some risks they can control, like construction risks, and some risks they can partly control, like commercial risks. As discussed in previous chapters, private investors cannot influence the risk of currency devaluation. In PPP projects, private investors can be distinguished as: (i) investors and sponsors, (ii) the special purpose company, and (iii) private shareholders.

In most PPP infrastructure projects, investors face economic FX exposure from capital expenditure in contrast to those in which funding is available to meet that expenditure. Additionally, economic FX exposure arises from revenue mismatches with the currency of tariff revenues being different from O&M costs and financing costs.

The most cost-effective measure is to structure a natural hedge to mitigate exchange risk in the project. In this case, the exchange rate is hedged by matching the revenues and expenses of the project.

Diversification of shareholdings and assets could be seen as one risk mitigation strategy for investors. As long as exchange rates have a negative correlation, firms can stabilize their operating cash flows by diversifying their project portfolio (Eun, 2007). Potential volatility is then reduced by the fact that not all asset classes move up or down in value at the same time or at the same rate. Therefore, it reduces the risk exposure of the entire portfolio held, but does not necessarily reduce the returns from the individual projects it comprises. However, the opportunity to diversify FX risk by owning a basket of assets denominated in different currencies is very limited, since there are few, if any, multinationals active in PPP infrastructure sectors that are large enough, and have a broad enough range of investment opportunities, such as to benefit in this way (Matsukawa, 2003).

A different perspective on the FX risk exposure can be shown by shareholders as random investors investing in the world's capital markets, they are able to diversify shareholdings. The statement assumes that the shareholders have access to information regarding the nature and size of the risks to which the SPC is exposed. This is very often not the case. Additionally, it would involve high transaction costs for commissions and margins.

For investors, the most common financial instruments to protect the project cash flow against changes in FX rates, are future and forward contracts, options, and swaps.

Derivatives can be categorized into standardized contracts and un-standardized contracts. Standardized contracts are traded on exchanges such as the Chicago Merchantile Exchange and the Chicago Board of Trade; are settled through a clearing house; and are highly regulated. Un-standardized derivatives are traded over-the-counter (OTC). These are custom-tailored products and their settlement terms are negotiated privately between the parties involved in the transaction. OTC derivatives can be fitted exactly to the counterparty's needs (Loader, 2005), and accordingly have the advantage of meeting the specific hedging requirements of the given risk exposure.

3.1.4.1. Futures and Forwards

FX future contracts are binding agreements to sell or buy a predetermined amount of a currency for an agreed price at a stated future date (Loader, 2005). Futures are standardized derivatives with relatively low transaction costs and a large trading volume (Hull, 2006). Futures are settled through a clearinghouse. The clearinghouse is the intermediary for the futures contract arrangements and acts as a guarantor to assure that the parties involved fulfil their obligations under the agreement (Hull, 2006). The price for a futures contract depends on the prevailing spot price and the cost of continuing to the contract expiration date. Prices are settled market-to-market, meaning gains and losses are posted every day (Whaley, 2006).

A currency forward contract is a customized product where a firm agrees to sell (or buy) foreign currency at a rate specified at the time of the transaction (Kapila, 2001). Forward contracts are very similar to futures contracts, but they are OTC-traded. All contract terms are individually arranged and tailor-made. When a forward contract is settled, the price for the arrangement is set so that the value of the contract equals zero (Jarrow, 1996). Since the contracts are not settled through a clearinghouse, forward contracts involve counterparty risk (Winstone, 1995).

In a fixed forward contract, the exchange of currency occurs on the day it expires. The buyer of an option-dated forward has the option to choose when to perform the contract. The only obligation is the delivery of the entire contracted amount before the expiry date.

One reason for the absence of these products in emerging markets is the minimum requirement of a country investment grade rating. Furthermore, in many currencies it is difficult to arrange a settlement for more than a two-year maturity (Coyle, 2000). Since forwards are OTC-traded, it is possible to arrange a longer maturity, but this results in unbearably high hedging costs. For this reason, forwards are predominantly used for short-term hedging and need to be rearranged after expiration (DeCovny, 1991).

Stort-term forward contracts are available in upper-middle income countries such as Chile, Malaysia and Mexico, and East European countries, in lower-middle-income countries such as China, the Philippines, South Africa and Thailand, and in low-income countries like India or Indonesia.

3.1.4.2. Swaps

Currency swaps are a favourite risk management tool to hedge FX risk. Since swap agreements can be customized, they provide a convenient mechanism for fixing an exchange rate for a long period of time and hence can be used as a significant hedge against exchange rate fluctuations in PPP projects (Strong, 2005). A currency swap agreement can convert a loan obligation from one currency to another. It can be structured as a series of forward contracts lined up on a schedule and available for longer maturities (Claessens, 1993).

Since swaps are private arrangements, they do not involve a safeguard to guarantee for the swap transaction. According to this, the parties involved have to pay attention to the creditworthiness of their counterparty (Johnson, 1999), otherwise the risk of counterparty default can arise. Figure 3-1 illustrates a plain vanilla foreign currency swap. The two principal amounts will be set equal with the spot exchange rate and exchanged between the parties. During certain intervals the parties will exchange interest payment on the principal amount. At the end of the swap contract the parties re-exchange the original principal amounts.

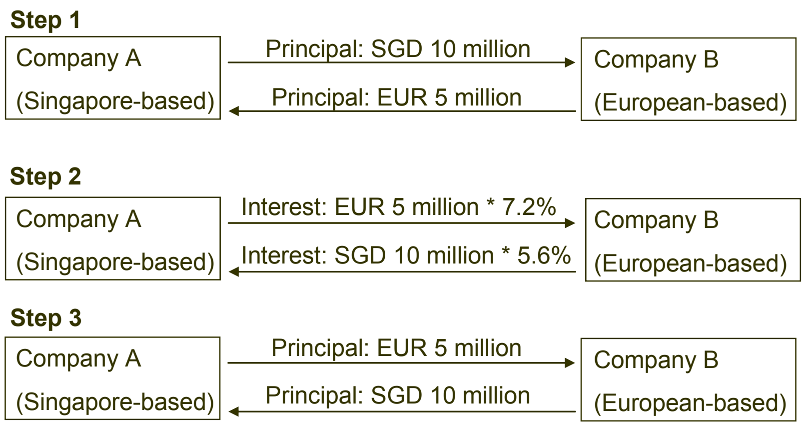

***Figure 3-1:** Plain vanilla FX swap*

In project finance deals, the swap structure seems to have a great disadvantage regarding its flexibility. A financial restructuring during the concession period can cause prohibitive costs of breaking a swap arrangement.

3.1.4.3. Options

A currency option may be defined as a contract between two parties – a buyer and a seller – whereby the buyer of the option has the right but not the obligation to buy or sell a specified currency at a specified exchange rate, at or before a specified date, from the seller of the option (Mydin, 2002). The contract arrangement is asymmetric because one party has the right to complete the transaction within a certain time period or to deny the contract completion if it is not profitable, while the option seller has no choice. The seller has an obligation in the event the right is exercised by the buyer (Mydin, 2002). His only reward is the premium he receives for selling the option (Winstone, 1995).

Options are ideal hedging tools when the amount and timing of the exposure is uncertain. Options are in general divided into call options and put options. Call options give the buyer the right to buy a specified currency at a specified exchange rate, at or before a specified date, put options give the buyer the right to sell a specified currency at a specified exchange rate, at or before a specified date (Kolb, 1999). Five factors contribute to the valuation of a currency option: (i) the spot exchange rate, (ii) the market level of option volatility, (iii) the foreign interest rate, (vi) the domestic interest rate, and (v) the time to expiration. The value of the call and put option can be described as follows:

$$C_T = Max[0, S_T - K];\ C \geq 0;\quad P_T = Max[0, K - S_T];\ P \geq 0;\quad \tau = (T - t) \qquad (3.1)$$

where C is the value of the call option, P is the value of the put option, K is the option strike, S is the spot exchange rate, τ the time remaining to maturity, T is the date of investment, and t is the current time. Put and call options can be distinguished between American and European conventions. With an American option the owner has the right to exercise the option at any time. European options can only be exercised at their expiration (Strong, 2005). In general the right conveyed by the option only lasts for a fixed period of time. After expiration of the option, the right expires as well.

Long calls are used if the risk is an upward trend in price and long puts are used if the risk is in a downward trend in price. A premium has to be paid to the seller of the option for providing the right to exercise the option. If the SPC buys an option to protect its cash flow against FX devaluation, the greatest loss will be the premium of the option (Strong, 2005). In contrast, the price of the underlying asset can go up to any level, so the profit for the option is unlimited. On the other side, writing a call or put option has unlimited risk. In general, options are more flexible than forwards and futures, but mostly more expensive, too.

3.1.4.4. Tariff adjustment mechanisms

Interest rate risk, inflation rate risk and FX risk can be partially passed on to the consumers by tariff indexation. PPP projects generally involve a mechanism to adjust tariffs on a periodical basis (Matsukawa, 2003). Payment mechanisms vary from user payment structures with transferred demand risk to availability payments based on the performance of the operator. Both structures include tariffs which are adjusted through indices over time. Therefore, tariff adjustments should be made on a frequent basis to reflect cost changes as soon as they occur. Otherwise a lag of currency depreciation and tariff adjustment can cause losses for the investors (Matsukawa, 2003). Very often tariffs cannot be adjusted as fast as rates might change. Especially in payment mechanisms based on user payments, the implemented tariff index should be calculated in such a way as to protect consumers from excessive price volatility. Tariff indexation becomes commercially and politically unsustainable as soon as exchange rates, inflation rates and interest rates are subject to excessively high volatility. In this case, tariffs could increase to a very high level and therefore make the infrastructure unaffordable for the customers. Figure 3-2 illustrates a possible payment mechanism with indexation to the FX risk and the consumer price index (CPI).

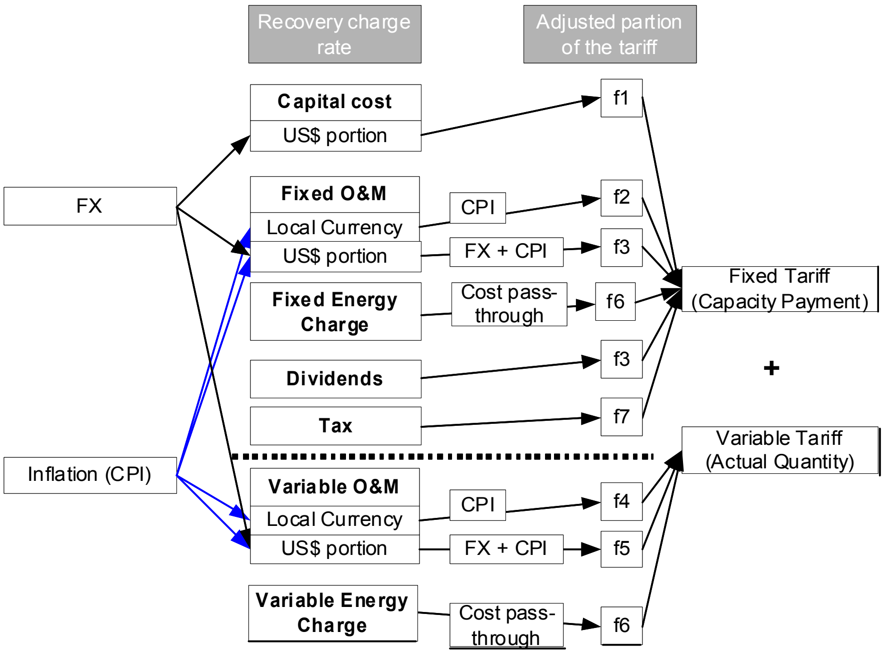

Figure 3-2: *Payment mechanism*

As a general principle, investors are better protected by frequent tariff adjustments to reflect cost changes. In some PPP projects the distributor can only increase tariffs annually as an extraordinary price adjustment. Some countries prevent indexation to exchange rates or inflation, fearing that it undermines the government's macroeconomic policies. In general, input costs that depend on the exchange rates can be treated as a pass-through, so that customers pay the actual costs. According to Gray (2003), over the long term the effect on prices will be similar whether tariffs are linked to local inflation or to exchange rates.

3.1.4.5. FX liquidity facility

FX liquidity facilities are similar to stand-by facilities, such as subordinated, revolving loans that are included in the financial structure. They enable the project to service its foreign currency debt in periods of currency devaluation with the side effect that bonds can receive an international investment grade rating. According to Baietti (2005), it is preferable to use a liquidity facility to offset temporary shortfalls in debt-service payment obligations rather than sparking a sharp rise in tariff rates which is unsustainable. Tariffs can be increased gradually to recover the funds that have been drawn from the facility. Therefore, the strategy minimizes the impact of currency devaluation on the project's cash flow and hence reduces price increases for the end-users of the infrastructure facility. They are generally provided by a third party or funded in separate escrow accounts to support the project (Matsukawa, 2003). If the FX liquidity facility is designed as a stand-by facility it is only exposed to the FX risks. Undrawn amounts can earn a commitment fee, and drawn amounts will incur interest during the time that draws are outstanding.

However, the mechanism of storing a portion of the revenues in an escrow account makes the liquidity facility typically costly. The liquidity facility should step in as soon as tariff adjustment is not sufficient to cover a devaluation of the currency and hence the project cannot cover its debt obligations. Debt obligations will be repaid with future revenues over a period of years. However, a liquidity facility can only be repaid by future cash flows if the current nominal exchange rate is not significantly overvalued. Furthermore, the theory of Purchasing Power Parity relies on floating exchange rates and prices that are free to respond to market conditions.

3.1.5. FX risk allocation to customers

If the FX risk is allocated to customers who are numerous and diverse, the risk can be thinly spread over many individuals. The question is whether customers are able to bear the risk at lower cost compared with other parties and whether they would suffer significantly in currency crises. One argument by practitioners is that customers should bear the risk because they must ultimately pay the costs of the service and they would not suffer significantly. Furthermore, if the risk is allocated to the customers they will probably receive better quality and better value. When the FX risk is allocated to investors, the possible negative consequences could be the interruption of services, impaired supply in quality, or the suspension or postponement of investment programmes. However, Matsukawa (2003) argues that the expenditure on energy and water supply by poor households is often in the region of 20% of household income. In this situation, customers would suffer significantly from tariff adjustments during periods of currency devaluation.

If customers pay the full cost of supply including the FX cost, one hypothesis could be that the price signal encourages efficient demand-side responses. However, poor customers have limited potential to reduce consumption below a minimum that is necessary for basic needs. Furthermore, in macroeconomic crises, when the exchange rate has fallen, their ability to pay higher tariffs seems to be very low. In addition, cheaper sources of supply are not perfect substitutes in water or power infrastructure. Piped water could only be substituted by unprotected water and the switching of electric power to gas would involve high cost of substitution. In conclusion, customers have no good natural hedges against the risk of currency fluctuations. There is little realistic opportunity to acquire hedges or to diversify away the risk.

3.1.6. Risk mitigation opportunities at the project level

Shareholders are able to diversify the country-specific FX rate risk and are seen as potentially eligible to bear the FX risk. However, without mechanisms to mitigate the FX risk, a very likely situation could be that projects (i) will not benefit from any foreign equity investment, and (ii) will not attract foreign commercial lending. In this case, equity investors will expect at least partial protection from the FX risk. The degree of the FX risk exposure can differ in: (i) fully hedged or mitigated currency risk, (ii) partly hedged or mitigated currency risk, (iii) hedging of the principal payments but not of the interest payments, and (iv) hedging of the hard currency risk but not the local currency exposure.

In developed financial markets, the FX risk can be mitigated by an appropriate hedging strategy. These hedging strategies differ but the commonly used methods to mitigate currency risks are: (i) forward contracts, futures contracts or currency swaps, (ii) currency options, and (iii) back-to-back loans.
Beside the governmental mechanisms, the following mechanisms can be used by investors to mitigate the FX risk exposure: (i) diversified shareholdings, (ii) diversified assets, (iii) matching funding and operating currencies, (iv) outsourcing the FX risk to a third party, (v) greater reliance on local equity, (vi) greater use of local currency debt, (vii) local currency bonds, (viii) hedging the risks with

derivatives, (ix) hedging the risk in financial markets, and (x) hedging the risk in the equity market.

Unfortunately, most emerging markets only offer some of these mechanisms and mostly with inadequate maturity terms or volumes. In this case, private investors and sponsors still have the problem that they cannot influence currency devaluation risk and have little opportunity to diversify the FX risk exposure. Local financial markets in emerging countries are mostly not liquid, and not deep. The maturities of loans are too short and no, or incomplete, hedging instruments are available. The missing opportunity to hedge weak currencies effectively in the long term creates a situation that risk exposure is unacceptable for investors and lenders. The additional lack of regulatory transparency often does not provide much confidence in other risk mitigation instruments available.

One option is to consider partly local lending to decrease the FX exposure in the project. According to Sheppard (2003), local and foreign currency financing are not mutually exclusive and even a small tranche of local currency debt may improve the sustainability of a project in a currency crisis.

A project can be financed totally by equity or by debt, or a combination of both. This raises the question what financial structure is appropriate for a given project. Since an infrastructure project is usually capital intensive, it is impractical for project sponsors to finance the project totally by equity. On the other hand, lenders have options between senior debt and mezzanine debt. Recognizing that the project has huge inherent risks, project sponsors are not prepared to take all the risks by using corporate financing. Thus, a possible solution is to finance the project using mezzanine capital. Since lenders are also concerned about the project risks, the successful financial close will depend on contractual arrangements and government support. However, as discussed in previous chapters, a non-recourse project finance structure might require FX risk mitigation for investors.

3.2. Advantages and disadvantages of commonly used hedging techniques in Public Private Partnerships

International trade leads to a change in relative currency values and, as a natural consequence, subsequently to FX risk exposure (Ross, 2000). Companies' exposure to FX risk will also be likely to have increased over recent years simply because of the enhanced proportion of exports appearing in their overall sales as foreign trade worldwide expands (Jorion, 1990). It has been suggested that hedging FX risk can contribute to minimizing overall FX exposure (Loderer and Pichler, 2000) and increase firm value (Stulz, 1984) in such circumstances.

The argument for not hedging FX exposure was initially developed by Modigliani and Miller (1958). These renowned authorities argued that the shareholder can manage relevant exposure themselves through diversification of their portfolio and that the additional cost of hedging would lower the individual firm's value. However, at their time of writing (now half a century ago), the greater proportion of corporate equity was owned by individuals and who, qua shareholders, might typically be expected to lack the requisite detailed knowledge regarding hedging opportunities to act contrary to as Modigliani and Miller suggested. Currently, investment managers doubtless do have an informational advantage over individuals, so the situation now of institutional shareholders owning, in all of the developed world countries, the majority of corporate equity (the UK figure has been estimated variously at 75-90%), means the relevant expertise is now there. With the additional information now available to them, institutional shareholders are able to hedge efficiently, which results in the Modigliani and Miller contention perhaps no longer holding. Not surprisingly, therefore, researchers such as Eun and Resnick (2007) have established that hedging can provide important protection by limiting the possibility of financial repercussions on the business.

During the last several years various methods for managing FX exposure have been developed. So a money market hedge, for example, would denominate the debt in the currency to which it is exposed – it is an on-balance sheet protection instrument to manage long-run exposure (Loderer, 2000). Alternatively, derivatives such as forwards, swaps, currency options and futures can all be used to hedge FX exposure.

The next sections analyse three questionnaire surveys regarding FX research conducted by Nanyang Technological University (NTU). The objective is to identify the various FX risk mitigation techniques more commonly used and to investigate both their perceived effectiveness and the factors of concern in using them.

Survey One is an international enquiry via email where a total of 50 questionnaires was received from the 500 contacts approached. Of these respondents, 48% are from the financial sector, 36% are investors, 36% act as consultants and 14% are contractors. Some respondents act in more than one capacity, so the total exceeds 100%. Since 38% of survey participants declared themselves not exposed to FX risk and could consequently not comment upon it, 31 valid responses are used for the purpose of subsequent analysis. The survey focuses purely on PPP projects with anticipated FX exposure during the relevant concession, the main concern then being to mitigate economic FX exposure during the whole concessionary period.

Survey Two focuses purely on international large-scale construction projects, hence involving the participating companies in short-term FX exposure relating to costs and revenues during the construction period. The survey includes 25 valid responses (two results having been rejected as spurious) from the 284 mailed out (so a useable response rate of 8.8%), from construction contractors and developers having a portfolio of large-scale overseas projects.

Survey Three includes 50 valid responses from 150 questionnaires and presented a questionnaire-based survey exploring the FX risk hedging behaviour employed by SMEs in the Singaporean market. The size of the companies surveyed varied from 50 to 250 employees. Since Singapore has a strong reliance on international trade, most of the companies surveyed consequently face economic FX exposure.

Surveys One and Two had the poorest response rates. However, in a mail survey of randomly selected respondents, without pre- or post-mailing contact, response rates can be less than 15% (Malhotra and Birks, 2007). In Survey Three the response rate was increased by two follow-up calls to 33%. Surveys with more than 30 responses are statistically significant. However the accuracy depends on the population and the variance in responses from the population. Since the aim is to identify the various FX risk mitigation techniques more commonly used and to investigate their perceived effectiveness, a very high accuracy is not required. The results of all three surveys would be approximately 95% certain of +/-15% accuracy.

In the subsequent sections, findings regarding a number of significant topics will be discussed.

3.2.1. Revenue or expenses denominated in foreign currency

All three surveys test the ultimate impact of FX exposure on the object company. Figure 3-3 is extracted from Survey One and illustrates the impact of FX exposure on project success, here distinguishing between projects in “developing” and “developed” countries as defined by the United Nations Statistics Division.

Hence, were the project to be located in the developing countries, 54% of the respondents rate the resultant FX risk as being from “critical” to “extremely critical,” whereas only 30% rank FX risk as being in these two categories if located in the developed economies. This observed difference probably results from the comparative availability of a variety of risk mitigation instruments.

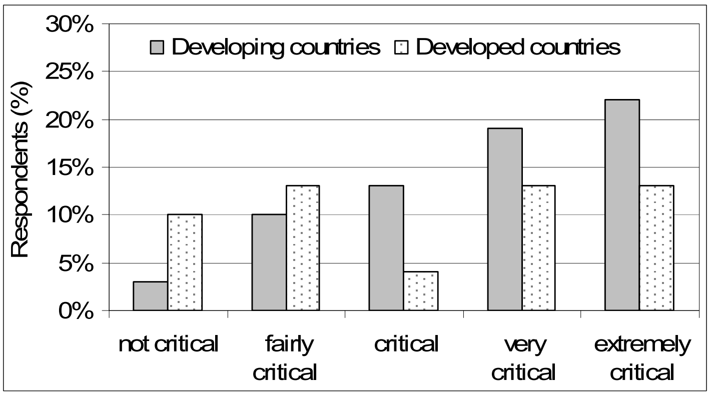

Figure 3-3: *The impact of FX exposure to the project success*

Survey Two sought to test if overseas project involvement automatically means a very high FX risk exposure for the object company. The results indicate that 30% of the respondents "strongly agree" and 52% "agree" with the contention, as illustrated in Figure 3-4. However, 18% of respondents are able to mitigate their FX exposure and hence disagree with the statement's relevance to their own position. Since the total is 100% it is obvious there is no strong disagreement recorded with the proposal.

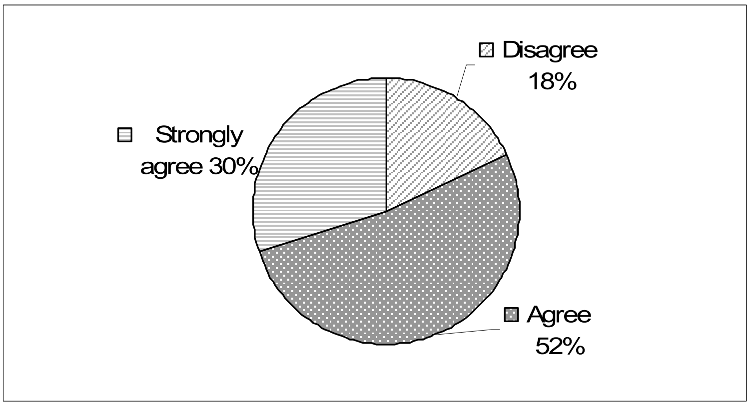

Figure 3-4: *FX exposure in oversee construction projects*

Survey Three assesses the level of importance placed on FX risk exposure compared to other operational risks that companies can face. Figure 3-5 provides a general indication that 50% of respondents rank FX risk as "equally important" to these other risks with another 15% viewing the risk as "more important" when compared to other operational risks faced by the company.

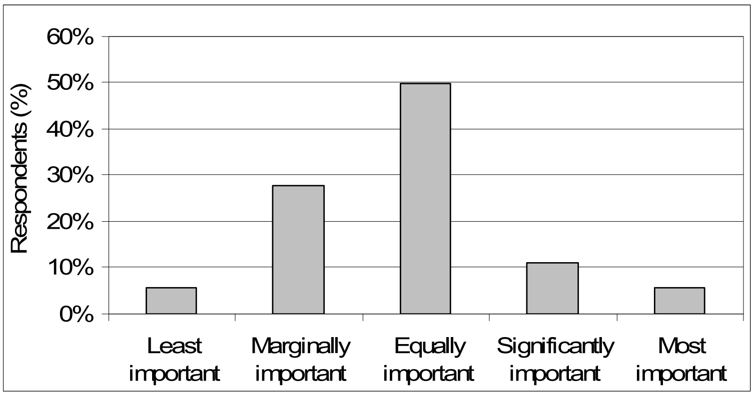

Figure 3-5: *The degree of importance of FX exposure compared to other company risks*

Survey Three additionally measures the impact of FX exposure on the expenses and revenues of the company. Figure 3-6 analyses the responses received and indicates that, for the greater number of respondents (i.e. revenue, 50%; expenses, 68%), FX exposure is perceived to be 20% or less.

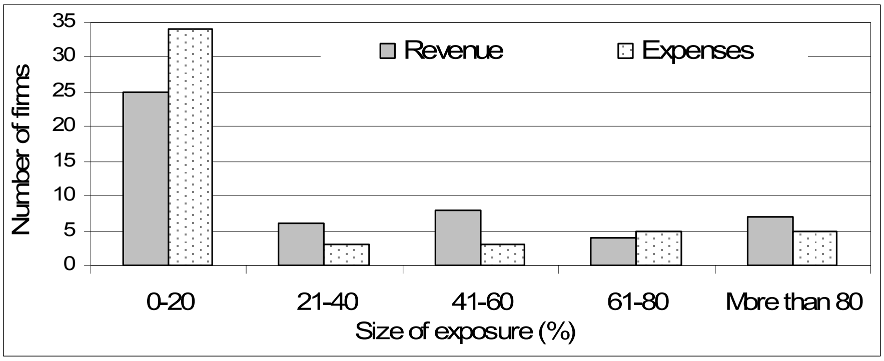

Figure 3-6: *The proportion of revenue and expenses denominated in foreign currency*

Thus, all three surveys indicate possession of too small a hedging position as, not surprisingly, being a strong reason for companies not to hedge their FX exposure. Even so, Survey One indicates that 47% of respondents possess projects with a loan amount of, in total, over 50 million US dollars exposed to FX risk, as illustrated in Figure 3-7.

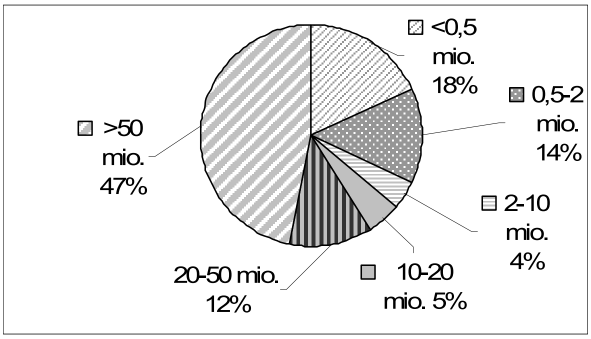

Figure 3-7: *The percentage of loan amount exposed to FX risk (in US$ million)*

3.2.2. Practice of FX risk management

Mitigation of FX risk is important in ensuring stable cash flows, and Survey Two reveals that 74% of firms practise FX risk management. As indicated in Figure 3-8, 40% of this proportion always attempts to manage FX risk; a further 55% will usually do so.

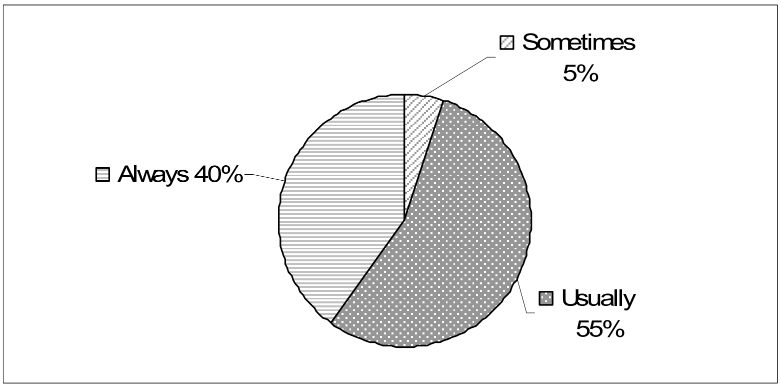

Figure 3-8: *The frequency of risk management amongst those companies that do so*

Survey Three indicates that 36% of respondents hedge their FX exposure. This result is surprisingly low. However, SMEs, by their very nature are small and would therefore likely be considered to lack the degree of FX exposure mitigation expertise available to larger enterprises. This contention is supported by Berkman et al. (1997), who found 53% of large firms (market equity value greater than US$250 million) using derivatives and 36% of small firms (market equity value less than US$50 million) doing so.

Figure 3-9 illustrates the proportion of those hedging regarding revenue or expenses denominated in foreign currency. It suggests that, the smaller the exposure, the more likely it is that hedging will occur. Further, the histogram indicates that, with increasing FX exposure, it is more likely that hedging exposure on expenses will occur compared to revenues.

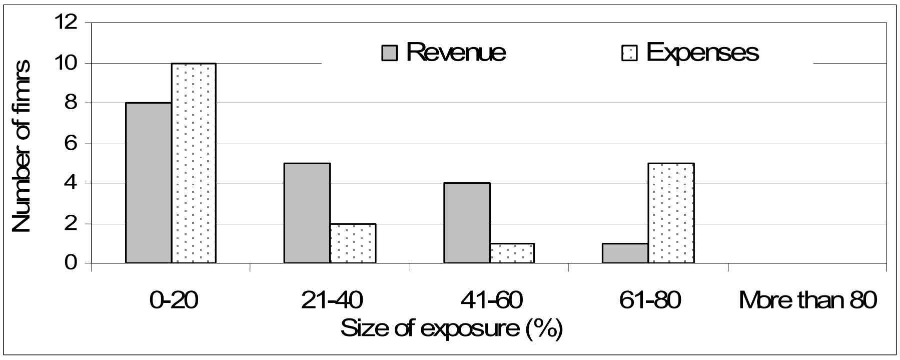

Figure 3-9: *The proportion of those hedging with revenue and expenses denominated in foreign currency*

3.2.3. Reasons for not hedging FX exposure

Survey One establishes the main reason for not hedging as being that the amount of FX exposure is considered too small to bother with in developed countries, although a clear difference emerges in the developing country case, as indicated in Figure 3-10. Alternatively, consideration of shareholder interests might well prevent hedging strategies; or the cost of hedging might simply be deemed too high. Further reasons applicable to developing economies only are: the necessary knowledge about hedging instruments is simply not available; or suitable hedging or other financial instruments simply do not exist.

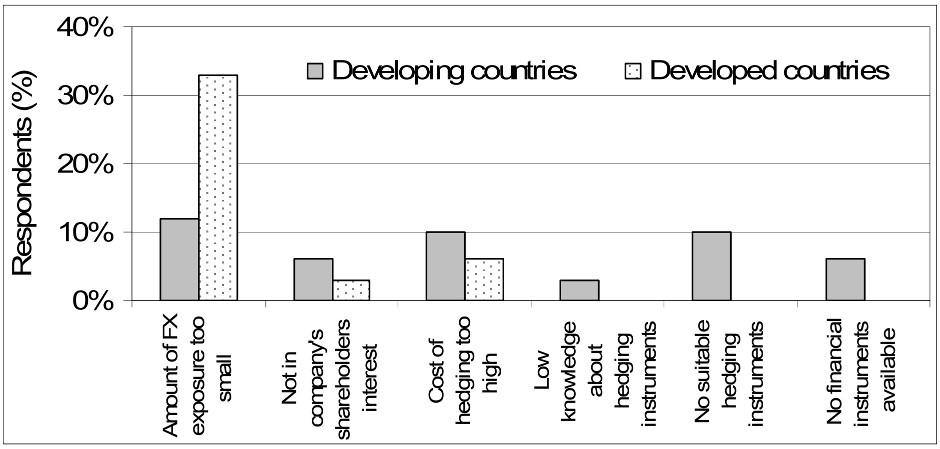

Figure 3-10: *Reasons for not hedging FX exposure*

The responses in Survey Two indicate that construction company managers feel they need to manage FX risk but that there is no necessity for them to employ relevant staff, such as business or finance professionals, who are specifically trained in this area. Only 48% of respondents have employees specialised in the relevant skills; whilst 24% of respondents indicate a lack of FX risk mitigation expertise, and 29% consider they lack assistance and support from financial institutions, in their attempts to reduce their exposure. 'Other' problems cited by 38% of respondents include: regulatory restrictions; the high cost of hedging; and parent company controls (the total here summing to more than 100% because some of the respondents chose more than one option). Furthermore, it is deemed difficult to control basis risk in ensuring the timing and amount of transactions during project execution. In other words, it is difficult to control when clients will pay even when this is within the payment period stated in the contract.

Survey Three delivers similar results regarding the size of hedging contracts negotiated as Survey One, as Figure 3-11 demonstrates. Thus, if revenues and expenses are denominated in the same currency, the effects of FX rate movements are deemed to be offset. Similarly, gains and losses can be offset if currencies are correlated. However, FX exposure modelling is difficult, especially if several currencies with correlations are relevant to the company, and in such a case the size of FX exposure then becomes difficult to determine. However, in contrast to Survey One, in the present (hence Survey Three) case, none of the respondents feel the cost of hedging to be so high as to deter them from engaging in the activity. This observed difference may be explainable by the time duration of the hedging tools utilised. Thus PPP projects have much longer time periods compared to SMEs and therefore significantly higher hedging costs. Only 4% of respondents indicate a lack of appropriate products constitutes a deterrent in their attempts to mitigate their FX risk. (As elsewhere, the ability given respondents to select more than one reason explains why the total adds to more than 100%.) Further aspects of derivative practices and policies have been studied by Mian (1996) and Geczy et al. (1997). Both enquiries showed that disclosure aspects of derivatives have a potential impact on a company's use of derivatives.

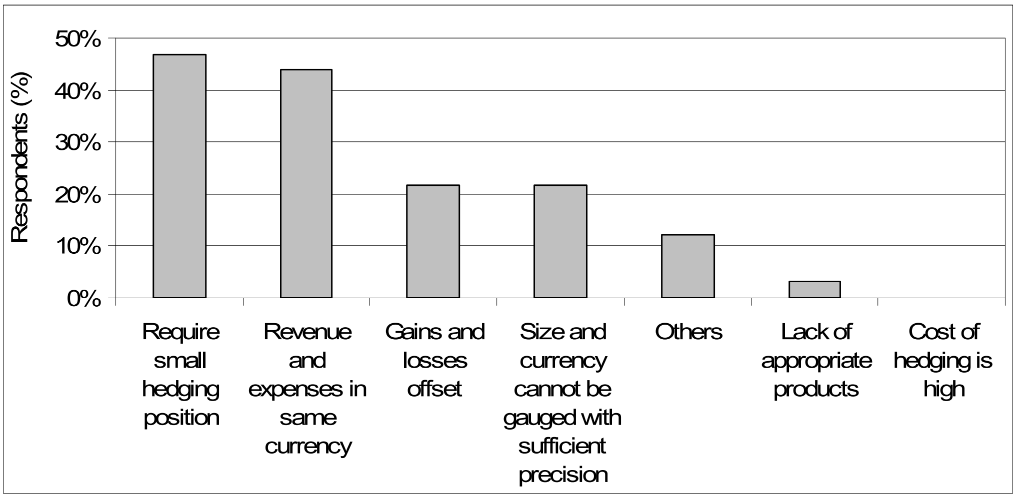

Figure 3-11: *Reasons for not mitigating FX exposure*

3.2.4. Usage of hedging instruments

Survey One tested attitudes regarding the most suitable hedging instruments that can be utilised. In this context, Figure 3-12 illustrates that currency swaps and forward agreements are identified as the most appropriate vehicles amongst the available techniques.

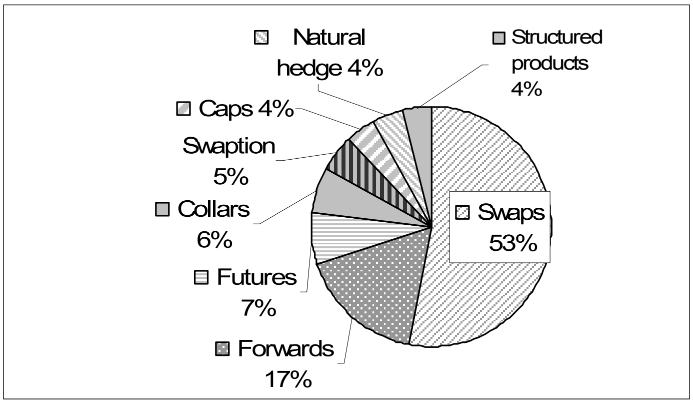

Figure 3-12: *Most suitable hedging instruments*

It is obvious from the presentation that the majority (53%) of respondents use swap arrangements, whilst the second largest group (17%) use forward contracts, to hedge their FX risk. Both are simple in execution and hence not surprisingly frequently used in practice. Furthermore, forward market hedges and currency swaps are low cost instruments when compared with the 'option' alternative, which in addition to involving high cost, are additionally both more sophisticated and require enhanced knowledge of the relevant procedures. As is evident from the pie chart, alternative possibilities such as caps, swaptions, collars and structured products are implemented by only a minority of respondents.

Somewhat surprisingly, futures appear to be used by only a small number (7%) of the survey respondents, who tend, rather, to hedge their position by using financial derivatives. Lioui (1997) found that forwards and futures give identical results in hedging effectiveness in terms of volatility minimization but forwards consist of an additional interest rate risk. Therefore, prices between forwards and futures should differ if interest rates are stochastic (Cox et al., 1981; Richard and Sundaresan, 1981; Duffie and Stanton, 1992). If interest rates are positively correlated with futures prices, futures will generate gains when interest rates are increasing; but generally, when futures prices are positively correlated with interest rates, futures will be more expensive than forwards. Conversely, when futures prices are negatively correlated with interest rates, forward contracts will be more expensive. Another reason for the observed unpopularity of futures could be that forward contracts, representing an agreement to exchange currencies at a future date although at a price established today, are simple in both utilization and implementation. Furthermore, forward agreements are OTC derivates, which are written by banks. They are tailored contracts regarding both amount and maturity date, and require a good credit standing with a bank. This could be the reason why forward market hedges are deemed more suitable than futures contracts.

PPP projects often utilise several risk mitigation instruments provided by the relevant government. Thus Survey One, for example, demonstrates (as in Figure 11) that FX risk can be mitigated via local currency loans in the case of 35% of the questionnaire's respondents followed, in order of popularity, by tariff adjustment formulas, guarantees and portfolio diversification. Furthermore, this survey reveals that 24% of its respondents have no governmental support such as to mitigate their FX risk exposure.

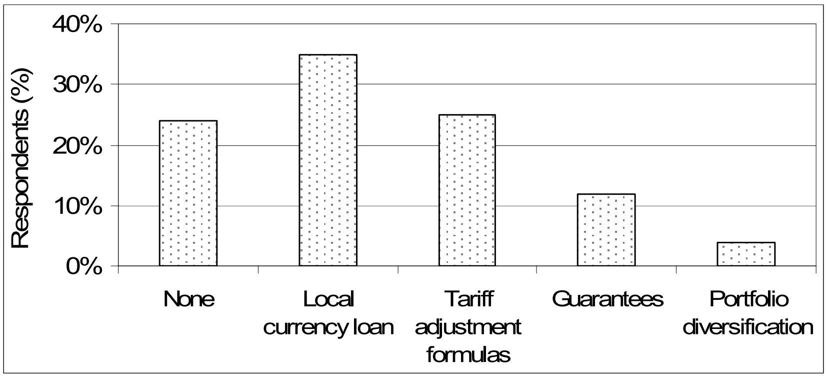

Figure 3-13: *Risk mitigation instruments provided by the government*

Somewhat interestingly, however, Survey Two delivered a different perspective on hedging techniques when applied in a (non-PPP) construction project context. The questionnaire in the object case tested the frequency of usage of possible FX hedging instruments in terms of being either "always" or "usually" used. Figure 3-14 illustrates currency matching, borrowing in local currency and forward market hedging to, sequentially, be the most important instruments to reduce FX exposure as always utilised by international construction companies.

The matching of currency mainly involves the balancing of currency receivables against currency payables. But whilst borrowing in local currency eliminates FX exposure, it is often associated with a higher price in terms of interest cost.

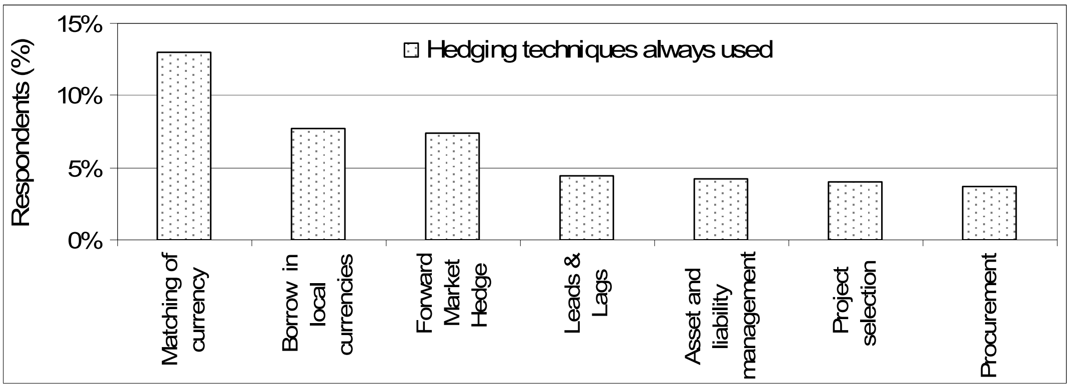

Figure 3-14: *Ranking of hedging techniques which are always applied*

By way of explanation at this point, "asset and liability management" means the maximizing of asset positions in strong currencies, and liability positions in weak currencies; and "project selection" refers to targeting projects in countries where the exchange rate regarding the local currency is stable. Another alternative to mitigate FX exposure is to change the source countries for such as materials and equipment according to exchange rate fluctuations. Thus, if it becomes more expensive to import from a certain country, companies may change their sourcing to another country if this provides a more advantageous exchange rate.

The ranking of usually used hedging instruments revealed from Survey One (shown in Figure 3-15) is similar to the "always applied" hedging instruments presentation of Figure 3-14. Hence, respondents rank matching of currency as their most favoured risk mitigation instrument, followed (sequentially) by: borrowing in local currencies; asset and liability management; and forward market hedging.

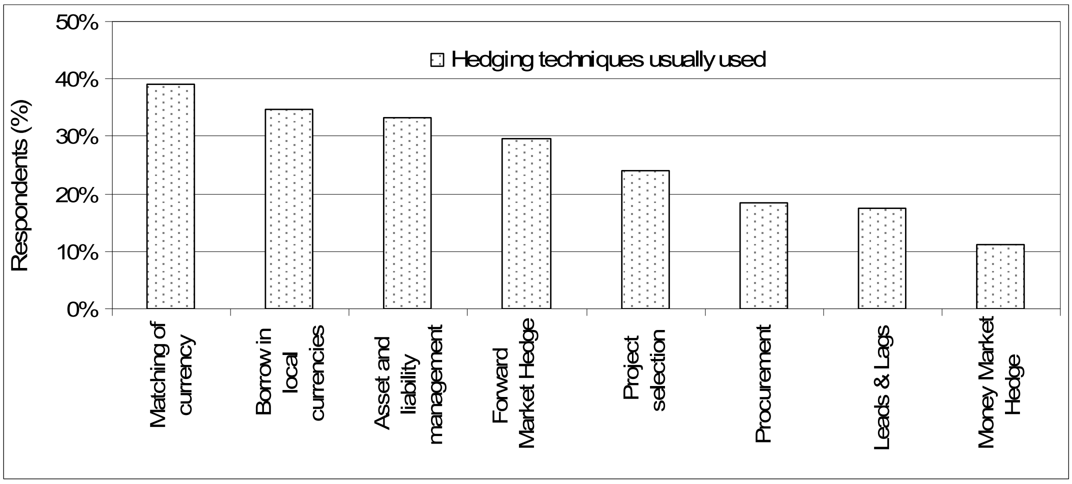

Figure 3-15: *Ranking of hedging techniques which are usually applied*

Somewhat surprisingly, Survey Two provides no mention of the use of the futures and swap markets, although this finding does, nevertheless, support the limited use of futures identified in Survey One. The reason could possibly be the aspect of less flexibility in the case of futures; additionally, they tend to be of smaller monetary amounts when compared to forward agreements; and, finally, futures are exchange-traded derivatives and only available in the major currencies. They are standardized and mature on a limited number of specific dates each year.

Currency swaps (which are temporary exchanges of money between two parties), appear to be relatively unpopular in construction projects. Survey Two shows that 60% of the respondents use local bank borrowing and internal working capital to finance their overseas projects. The duration of the available FX exposure mitigation instruments is much shorter than the life of a typical PPP project and in such a situation internal working capital enables businesses to manage their capital requirements internally through such things as advanced payments from clients in order to (at least partially) cover the construction costs incurred.

Survey Three, via Figure 3-12, provides an interestingly different perspective on the usage of derivative products compared to Surveys One and Two since it establishes forward agreements to be the most favoured hedging instrument amongst SMEs (the results being based on the 3-16 respondents who actually hedge their FX exposure).

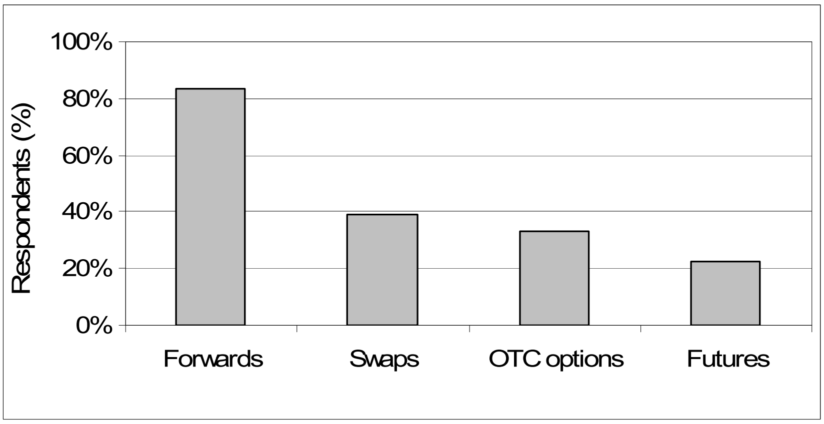

Figure 3-16: *The most common instruments used to hedge FX exposure*

This is, nevertheless, a similar result to that produced by previous research (Grant and Marshall, 1997, Bodnar et al., 1998; Marshall and Bansal, 2000). Additionally, a study by Phillips (1995) found that 63% of its respondents used derivative contracts, derivative securities, or both. The reasons for using derivatives, by all respondents, was for purposes of financial risk management (some 71%), while nearly 67% of firms used them in conjunction with obtaining funding and 21% for investment purposes. However, the survey presented the view of derivative practices only amongst treasury professionals, so might not be comparable with presently-reported findings.

The SMEs approached in Survey Three also applied swaps ─ subsequently found to be the most common aid to structured finance (as previously revealed by Survey One). However, OTC options and futures would appear to have very limited application in PPP projects and construction projects. Both instruments require access to a trading environment, which makes the process of hedging complex. As opposed to the situation faced by construction and special purpose companies, SMEs might well find access to this necessary trading environment convenient and therefore make use of the relevant instrument.

3.2.5. The perceived effectiveness of risk mitigation instruments

Previous studies have tested for the most important objectives in hedging policies (Nance et al., 1993, Bodnar et al, 1996, Mallin et al., 2001). Nance et al. (1993) found that the focus on stability of reported earnings is inconsistent with the widely held view of focusing on the cash flow benefits of hedging; whilst Mallin et al. (2001) showed that firms worry most (53%) about the fluctuations in accounting earnings. The second most important factor (38%) is the objective of minimizing fluctuations in economic internal cash flow. Only 6% of firms cited managing the market value of the firm as their most important hedging strategy; and only 3% mentioned hedging to manage balance sheet ratios.

To now complete the findings, the three surveys tested the perception of derivatives' effectiveness in hedging FX exposure. Such effectiveness is found to be largely dependent on the project's location, as shown in Figure 3-17.

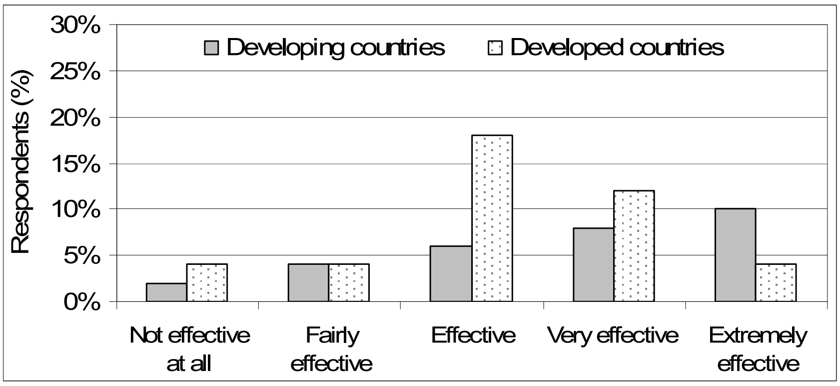

Figure 3-17: *The effectiveness of derivatives as hedging strategy*

In Survey One, 18% of respondents with projects in developed countries rate hedging instruments as "effective" and 12% as "very effective". The relative popularity between developed and developing countries is different, however, moving in completely different directions. Thus, in the developing country case, the 6% that view hedging instruments as "effective" increases to 10% that find them "extremely effective"; in the developed country situation, the figures reduce from 18% to only 4% respectively. This rating potentially indicates a need to enhance the availability of derivatives to protect projects carried out in developing countries from potential FX exposure. It may also indicate that, in the developed country case, their better developed financial markets make available more effective mechanisms to reduce FX exposure, and that, in any event, would be expected to be less extreme.

Figure 3-18 illustrates the perceived effectiveness of guarantees in mitigating FX exposure. From this it can be observed that respondents having projects in the developed countries rate effectiveness in this case much lower than in the case of derivatives (as previously presented in Figure 3-17).

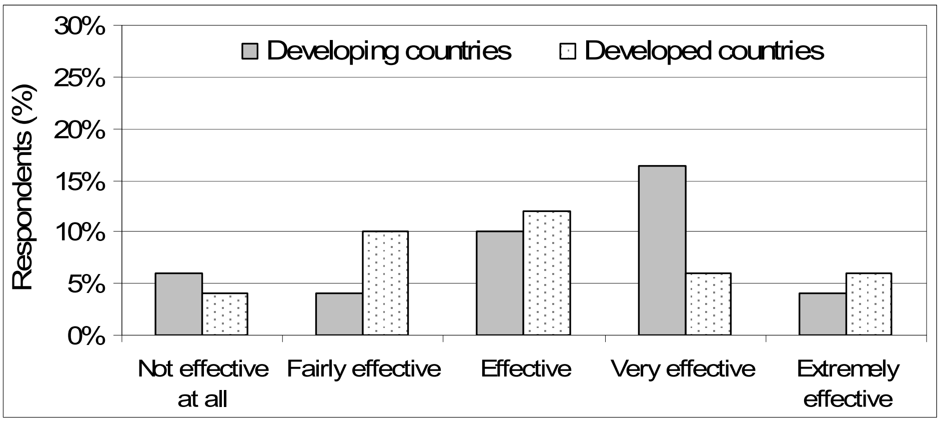

Figure 3-18: *The effectiveness of guarantees in FX risk mitigation*

From Figure 3-18 it may be observed that, in the developing country case, the greatest number of respondents rate guarantees as "effective," although only marginally ahead of their being merely "fairly effective." Contrarily, in the developed country case, the most popular rating is "very effective." However, since guarantees regarding FX exposure come in a variety of forms, Figure 16 can only give a general indication of the effectiveness of guarantees to mitigate FX exposure.

As shown in Figure 3-19, tariff indexation is rated as being "effective" by the highest proportion of respondents having projects in the developed countries, and as "equally effective" or "very effective" in the developing country case. In neither case, however, is tariff indexation found to be of much use (hence being "not effective at all" or merely "fairly" so), by a significant proportion of respondents.

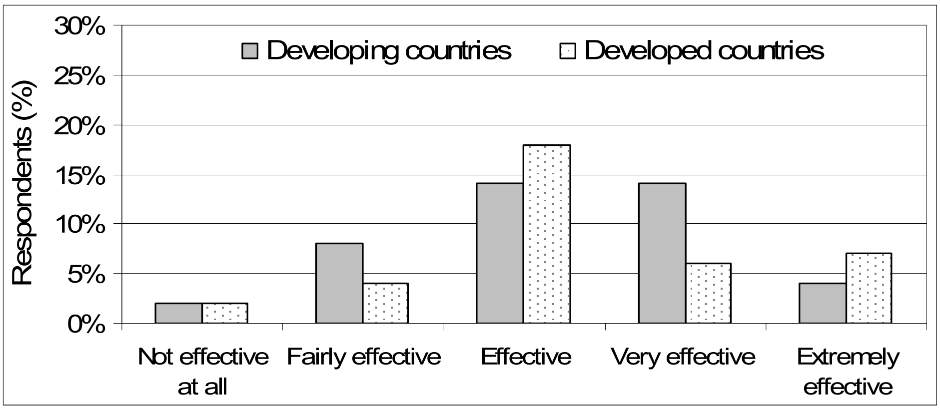

Figure 3-19: *The effectiveness of tariff indexation as FX risk mitigation*

In contrast to local currency loans, tariff indexation instruments are highly influenced by the political risk evident in some countries. As a consequence, respondents, as a whole, are more inclined in Survey One to rate the usefulness of local currency loans as "extremely effective" in both developing and developed countries. This preference is illustrated in Figure 3-20, regarding which it should be noted no respondents rate local guarantee loans as being either "not effective at all" or only "fairly effective."

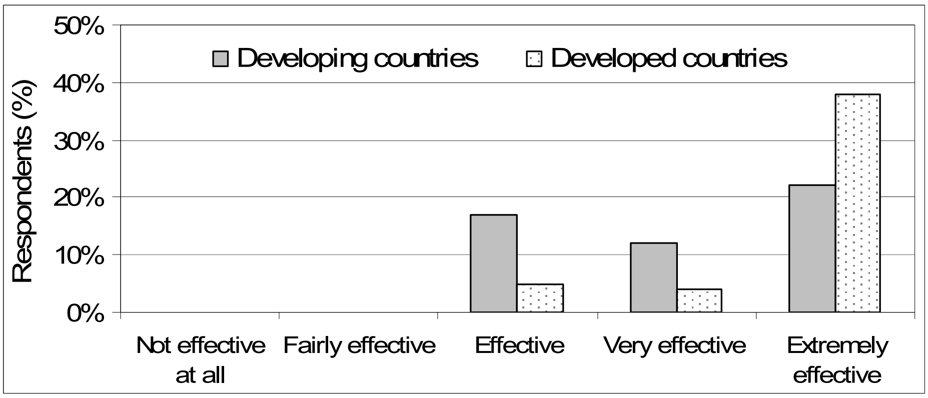

Figure 3-20: *The effectiveness of local currency loans as FX risk mitigation*

Survey One further demonstrates, as illustrated in Figure 3-21, that portfolio diversification is rated as either "fairly effective" or "effective" by the largest proportion of responding participants having projects in both developed and developing countries.

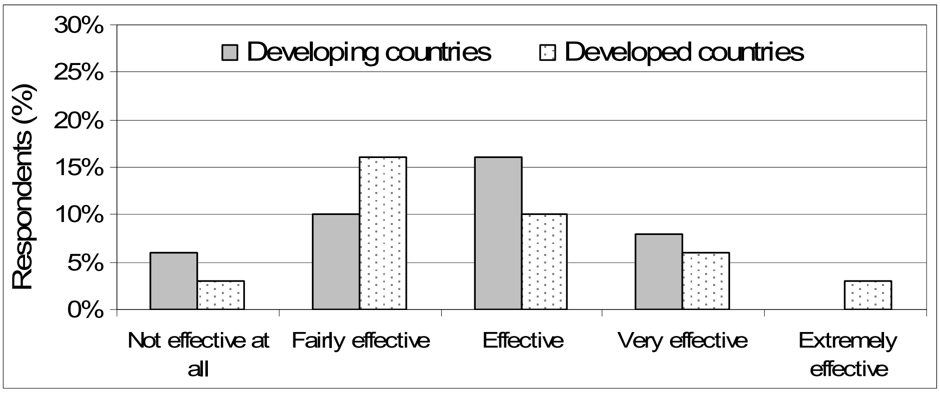

Figure 3-21: *The effectiveness of portfolio diversification as FX risk mitigation*

However, the perception of usefulness is relatively low, it can be observed, virtually ‘across the board’. This low perception of usefulness could well be a result of respondents having previously achieving negative correlation between currencies, since FX exposure is only reduced by the fact that not all asset classes move up or down in value at the same time, or at the same rate when they do. However, the opportunity to diversify the FX risk by owning a basket of assets denominated in different currencies is very limited in project finance - there are few multinationals active in PPP projects large enough, and that have a broad enough range of investment opportunities, to diverse their portfolio (Matsukawa et al., 2003).

3.2.6. Knowledge of hedging instruments

As shown in the earlier sections of the analysis, FX risk mitigation depends upon knowledge that appears to be limited in the construction industry case. Illustratively, however, Survey Three observes the current level of knowledge regarding hedging techniques prevalent in SMEs, and in this case, whilst the majority of respondents is found to have knowledge about the most commonly used hedging tools such as forwards and swaps, something like 40% have no knowledge of OTC options, futures, or exchange traded options. This is consistent with the studies by Mallin et al. (2001) and Bodnar (1996) who identified the lack of knowledge about derivatives as the third most important factor concerning derivative users. Figure 20 illustrates the research findings (which again can obviously sum to more than 100% where respondents have knowledge of more than one instrument).

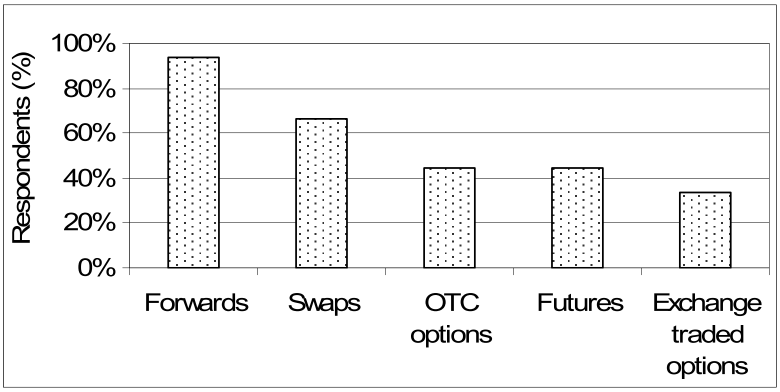

Figure 3-22: *Knowledge of hedging instruments*

Interestingly, Survey Three also tested the level of dependence ("usefulness") that its survey respondents placed on bank advice. Besides the reliance placed on such knowledge in the context of hedging strategies, SMEs appear additionally quite dependent on bank advice as regards their FX exposure, as illustrated in Figure 3-23.

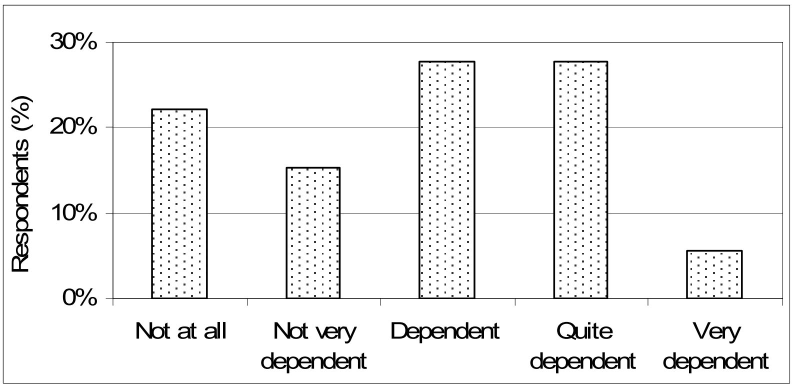

Figure 3-23: *The level of dependency on bank advice*

The main bank services for ameliorating FX exposure utilised in Survey Three are illustrated in Figure 3-24, which illustrates the extent of the use of the available 'products' in the FX domain, with the presented responses indicating respondents' multiple use of the facilities on offer.

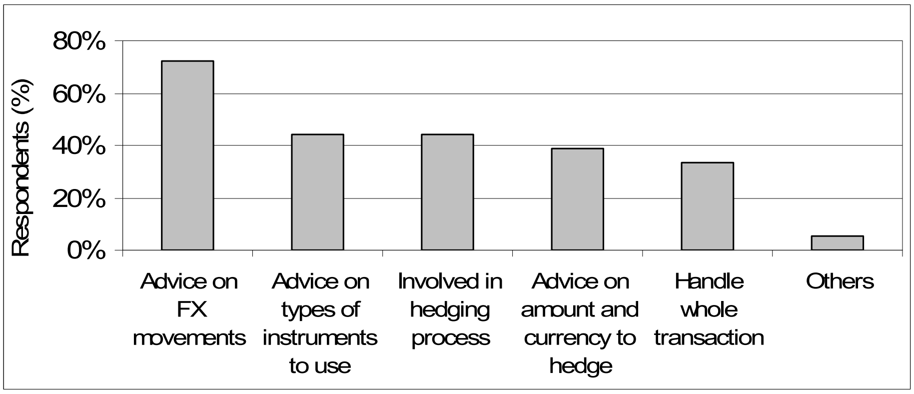

Figure 3-24: *Expectation of type of bank advice received*

Furthermore, the histogram shows a preference for banks to provide various types of advice rather than actually handle and manage the whole hedging process/transaction.

3.3. Summary

The present analysis of three questionnaire surveys has suggested that those engaged in PPP projects, construction companies and SMEs having a Singaporean base, are exposed to a degree of FX exposure, although for different reasons. However, the analysis also demonstrates that FX exposure is not as very well managed, both in the construction industry and elsewhere, as it might be. Because of the sophisticated processes involved in mitigating FX exposure in practice, such as SMEs remain largely dependent on bank advice as regards their hedging strategies. However, the potential benefits of relevant FX strategies in ensuring certainty of cash flows and the consequent guarantee of liquidity can be significant. All three surveys demonstrate the significance of FX exposure to commercial success. So whilst the surveys' findings illustrate that swaps and forward agreements are the most commonly used hedging techniques in PPP projects, in the construction industry more generally, less complicated instruments such as currency matching, borrowing in local currencies and forward market hedges, are applied. SMEs, whilst apparently using the full range of available derivatives, nevertheless appear to focus on forward and swap agreements.

However in emerging markets FX hedging tools and financial instruments are often not available or with too short durations for the hedging requirements of PPP projects. The decision to hedge FX risk in the financial markets depends on the amount of risk exposure. If the FX exposure is too small the costs for implementing hedging strategies are greater than the benefits from hedging. Additional, the hedging strategies also depend on how competitors hedge their exposure (Eun, 2007). If the SPC has higher costs because of hedging it would be less competitive. Furthermore, companies must justify the cost of hedging strategies to other executives within the SPC and to shareholders.

CHAPTER 4

Development of the FX exposure index

This chapter presents the design and methodology of the FX exposure index. In this context the chapter aims to establish a quantitative model to analyse economic FX exposure in PPP infrastructure projects. Firstly, the FX index terminology will be introduced, which is borrowed from the engineering field of load-carrying structures. Secondly, the methodology is adjusted to the characteristics of project finance. A PPP power project in South East Asia is used as a case study to illustrate the techniques and outputs of the proposed FX exposure model.

4.1. Project feasibility modelling methodology

A first-order second-moment reliability method based on the Hasofer-Lind reliability index is undertaken to reflect the uncertainties of market risks with impact on the cash flow of the PPP project. This terminology is borrowed from the engineering field of load-carrying structures and adapted to the characteristics of project finance. The application of the second-moment reliability methodology in quantifying FX exposure in project finance has several advantages compared with Monte Carlo simulation and the methodology provided by the Australian treasury (Australia Treasury, 2008). The trend shows that the Monte Carlo simulation takes much more computation time if the dependencies between the variables increase. This computational time advantage becomes very significant when comparing several economic cycles. Furthermore, the FEE methodology can be modelled as an extra tool which is linked to the financial models. The methodology is able to consider PDFs, correlations between the variables and to compute an FX index. The FX index is modelled via an expanding dispersion ellipsoid. The second-moment reliability index was first defined by Hasofer (1974). The index has been further treated by Rackwitz (1978), Ditlevsen (1981), Shinozuka (1983), Ang (1984), Madsen (1986) and Tichy (1993). Low (1997a, 2004, 2007) presented a practical procedure of efficient feasibility evaluation for correlated non-normal variables with respect to the Hasofer-Lind index and first-order reliability method (FORM).

The following section focuses on the implementation of the model framework in PPP procurement. The computation of the FX index is derived from the FEE model. It is linked to the cash flow of the project by defined market variables. This allows the FX model to consider project specifics like different institutional arrangements and payment structures. All variables influence the cost and revenue structure and therefore the non-investability domain. Each project has different output quantity, technical requirements, different cost positions and financial assumptions. These details are modelled in financial models with input sheets and computation sheets. Input sheets include details such as output quantity, involved costs and revenues. Computation sheets include modelling of income tax, profit and loss statement, balance sheet, and the cash flow as well as detailed modelling of funding drawdown, sources and uses of funds, and debt repayment.

Figure 4-1 illustrates the process to develop the cash flow modelling characteristics and the FX index computation in the FEE model. All boxes will be listed and described in greater details during the next sections.

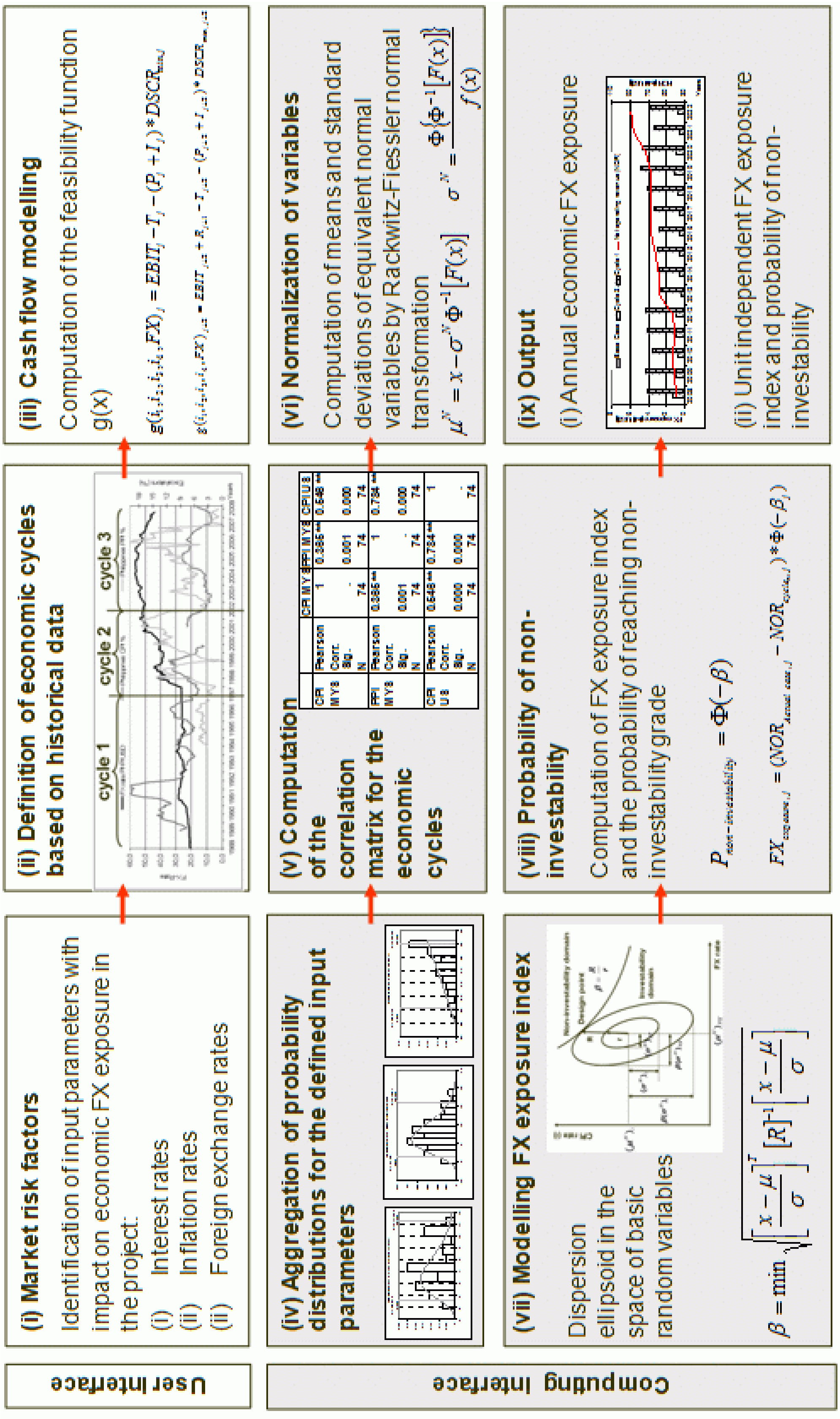

Figure 4-1: *Model flow chart*

4.2. Market risk factors

The FX index is modelled in terms of n input variables $x_1, x_2, \ldots x_n$ representing market risks. The input variables describe inflation, interest and FX rates with impact on the cash flow of the project. All variables form the ellipsoid in the n-dimensional shape. A defined surface divides the n-dimensional space of variables into two sets of an investability domain and non-investability domain, as shown in Figure 4-2. The limit is described in terms of a minimum DSCR requirement defined by the feasibility function g(x). One set contains points in the model which are below a certain minimum DSCR requirement and one set for which the points behave above a DSCR requirement.

Figure 4-2 shows a two-dimensional case of FX risk and inflation risk i. The FX index is the axis ratio (R/r) of the ellipse that touches the limit state surface of the non-investability surface and the one standard-deviation dispersion ellipse. The ratio is the same along any direction because of geometrical properties of the ellipsoid. The corresponding dividing surface of investability and non-investability is called the limit investability surface. Investability is defined as the minimum debt service cover ratio (DSCR) necessary to perform its operation and maintenance, principal and interest payments, tax and expected dividend payments during the predetermined lifetime.

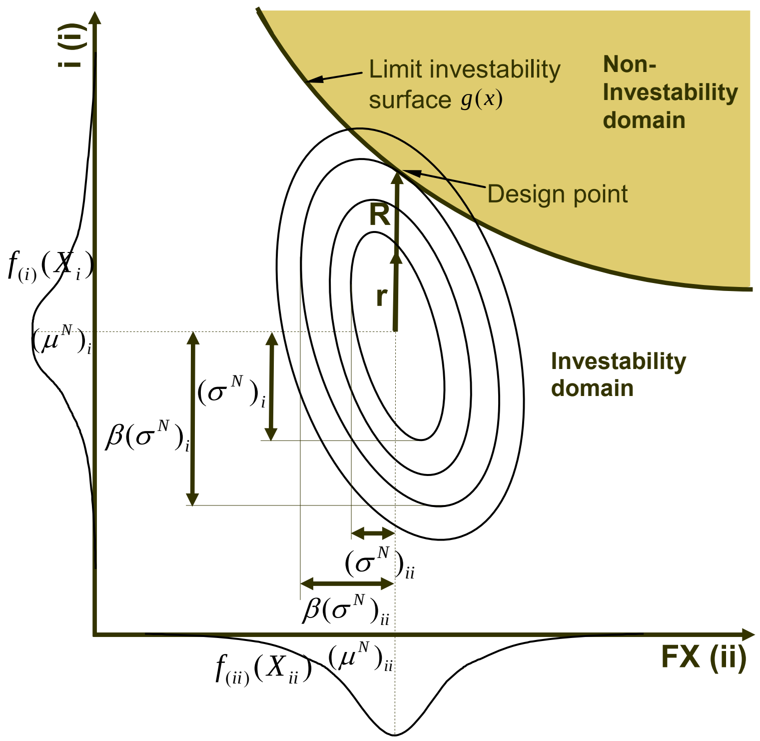

Figure 4-2: *Equivalent dispersion ellipses in the original space of the basic random variables*

Each axis of the ellipsoid is parallel to a corresponding coordinate axis in the one-standard-deviation dispersion ellipsoid if the variables are uncorrelated. The dispersion ellipsoid is tilted by consideration of correlation assumptions between the escalators.

4.3. Definition of economic cycles based on historical data

The analysis in the case studies is based on three economic cycles: (i) 1989–1997, (ii) 1997–2002, and (iii) 2002–2008, indicating the period of growth in Asian markets, the Asian financial crises and the current market situation respectively. Figure 4-3 illustrates the project-linked escalators and FX rates on the local market and on the US market.

Alternatively, the variables can be fitted to the whole cycle from 1989 to 2008. In this case, the distributions fit very well to normal or log-normal distributions because of the large amount of data. Instead of specific economic cycles, the variables will be set to upper and lower boundary conditions. However, the disadvantages of this method are higher standard deviations and correlations which cannot reflect the behaviour between the different cycles. The accuracy can be increased in the short term by minimizing the time duration. The estimation is always based on the replication of the last cycles.

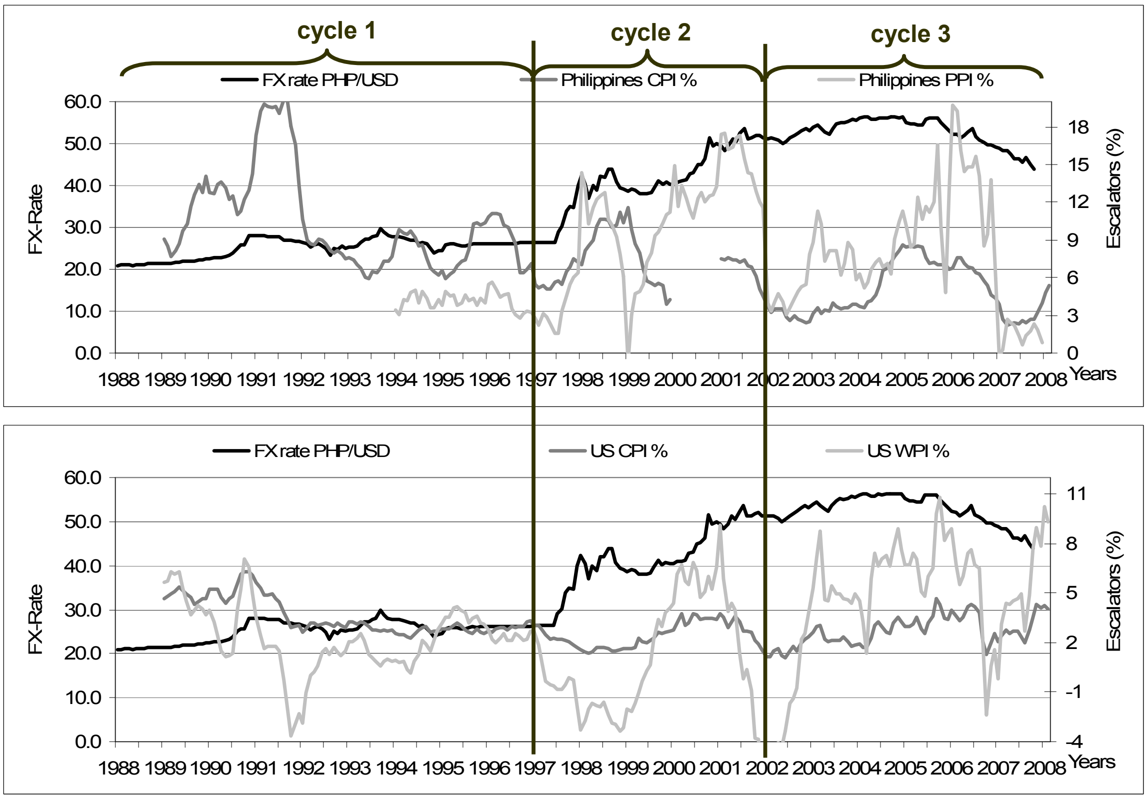

Figure 4-3: *FX rate and escalators applied on the case study in the Philippines*

Each of the variables will be fitted to PDFs in each time period. The fitted PDFs of the CPI rates USA are shown as example in Figure 4-4. The software @Risk is used to generate the PDFs.

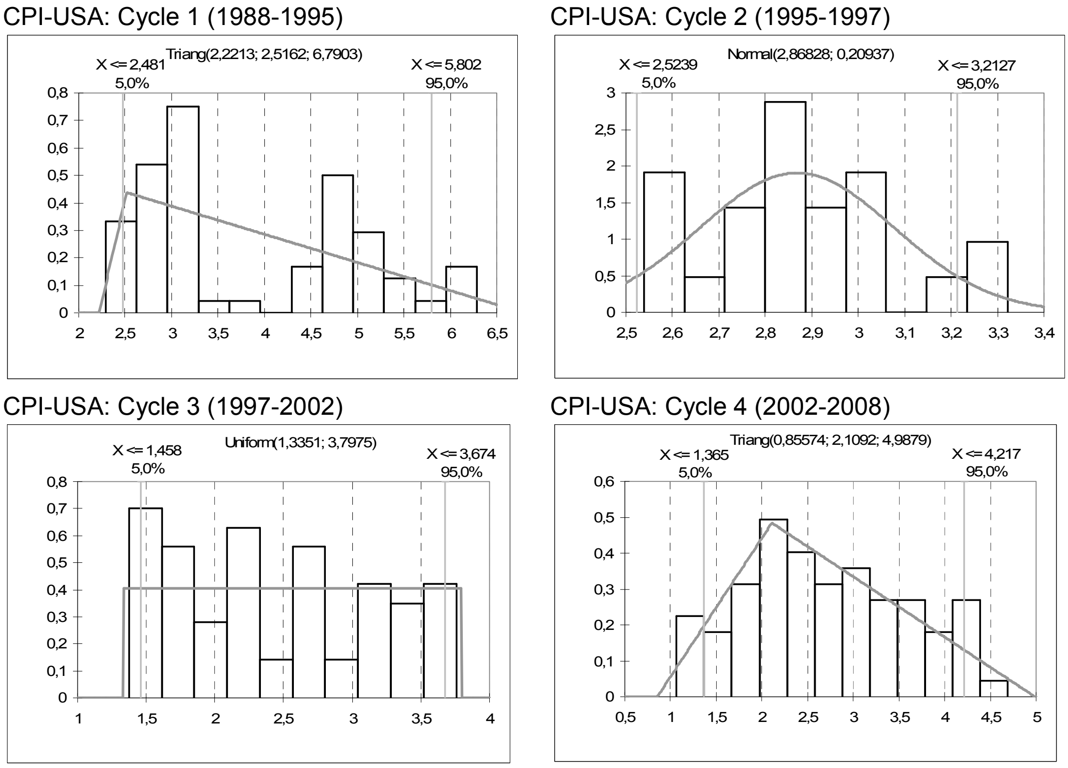

Figure 4-4: *Fitted probability density functions*

4.4. Cash flow modelling

The following assumptions are applied in modelling the project feasibility on FX exposure in cash flows:

i) Debt repayment depends on the financial performance of the project without recourse to the project sponsor or its parent company;

ii) Depreciation is applied to both initial investments and any additional investments made during the concession period;

iii) The priority for use of any cash in any period is as follows: (1) operating and maintenance costs, (2) interest payments, (3) income tax, (4) principal repayment, (5) reserves and (6) dividends.

The first step in modelling net operating revenue (NOR) or the earnings before interest and tax (EBIT) is to determine the total capital expenditures, CAPEX.

$$CAPEX_n = \sum_{t=1}^{u} CON_{tq} \prod_{k=q}^{n} (1+i_{tk}) * (1+R_{tk}) * S_{tk} \qquad \begin{matrix} n = 0,\ldots,C \\ t = 1,..,u \end{matrix} \qquad (4.1)$$

where CON_q is the construction cost position in real terms at a given year q, i_{tk} is the inflation rate on cost position t in year k, R_{tk} is the borrowing rate in year k on cost component t, and S_t is the FX rate in domestic currency per unit of foreign currency. The equity capital requirement in year n can be modelled as:

$$EQT_n = CAPEX_n - \sum_{t=1}^{u} D_{tn} \qquad \begin{matrix} n = 0,\ldots,C \\ t = 1,..,u \end{matrix} \qquad (4.2)$$

where D_n is the debt drawing in year n. The outstanding debt DEB_n at the end of the construction period is estimated by:

$$DEB_n = \sum_{n=0}^{c} D_{tn} \prod_{k=n}^{c} (1+R_{tk}) * S_{tk} \qquad \begin{matrix} n = 0,\ldots,C \\ t = 1,..,u \end{matrix} \qquad (4.3)$$

where R_{tk} is the borrowing rate in year k of debt t. The operating revenues REV_j generated by the project are simply computed by the actual dispatch, and the tariff rates:

$$REV_j = X_j \sum_{t=1}^{u} CRA_{tj} * TAR_{tj} * S_{tj} \qquad \begin{matrix} j = C+1,\ldots,N \\ t = 1,..,u \end{matrix} \qquad (4.4)$$

where X_j represents the quantity at year j, CRA_{tj} represents cost rates at year j, TAR_{tj} represents tariffs of type t at year j, and S_{tj} is the FX rate in domestic currency per unit of foreign currency in year j. The CRA_{tj} are defined on major cost positions. Generally this includes fixed O&M costs, variable O&M costs, service fee rate and an additional fuel cost rate in utility projects. Wibowo (2004) formulates the general setting of tariff indexation TAR_{tj} as follows:

$$TAR_{tj} = \begin{cases} TAR_{tj-1} & Y_x \le j < Y_{x+1} \\ \min\left[y; TAR_{tj-1} * \dfrac{\prod_{j=C+1}^{Y_{x+1}} (1+f_{tj})}{\prod_{j=C+1}^{Y_x} (1+f_{tj})} \right] & j = Y_{x+1} \end{cases} \qquad \begin{matrix} j = C+1,\ldots,N \\ t = 1,\ldots,u \end{matrix} \qquad (4.5)$$

where TAR_{tj} represents the tariff at year j of category t, f_{tj} represents the inflation rate t at year j , and γ represents the allowable maximum adjustment if a price cap system is applied. Y_x represents the year at which the xth adjustment will be applied. The annual operating cost OPC_j and maintenance cost MAC_j with inflation rate t at year j can be modelled as follows:

$$OPC_j = \sum_{t=1}^{u} OPC_{tj} * \prod_{j=C+1}^{j} (1+f_{tj}) * S_{tj} \qquad \begin{matrix} j = C+1,\ldots,N \\ t = 1,..,u \end{matrix} \qquad (4.6)$$

$$MAC_j = \sum_{t=1}^{u} MAC_{tj} * \prod_{j=C+1}^{j} (1+f_{tj}) * S_{tj} \qquad \begin{matrix} j = C+1,\ldots,N \\ t = 1,..,u \end{matrix} \qquad (4.7)$$

where OPC_{tj} and MAC_{tj} stands for each cost position t at year j. The earnings before interest and tax $EBIT_j$ in year j are computed by subtracting operating cost OPC_j and maintenance cost MAC_j from operating revenue:

$$EBIT_j = REV_j - \sum OPC_j - MAC_j \qquad (4.8)$$

Interest and tax payments are ranked highest in the payment claim. The available operating profit must be first used for interest payments and income tax. The interest payment is dependent on the available $EBIT_j$. If the $EBIT_j$ is less than the interest payment obligation, the creditor receives what remains. The unpaid interest payment will be accounted in the following year's debt balance calculations. The interest rate I_j can mathematically be written as:

$$I_j = \min(EBIT_j; r_{tj-1} * DEB_{tj-1}) \qquad j = C+1,..., N \qquad (4.9)$$

where r_{tj-1} is the interest rate t in year $j-1$ and DEB_{tj-1} represents the outstanding debt t at year j. Wibowo (2004) simplified the depreciation calculation in the following equation:

$$DEP_j = \frac{CAPEX}{N-C} + \sum_{j>k} \frac{ADD_k}{N-k} \qquad j = C+1,..., N \ \ and \ \ k = C+1,.., N$$

(4.10)

where $CAPEX$ is the total project investment and interest cost during construction period, N and C are concession period and construction period respectively, and ADD_k is additional investment made in year k. The amount of tax T_j on taxable income can be determined by $EBIT_j$ reduced by interest payment and depreciation as follows:

$$T_j = \max(0; \tau * (EBIT_j - DEP_j - I_j) \qquad j = C+1,..., N \qquad (4.11)$$

where τ represents the income tax rate, and DEP_j represents the depreciation at year j. The outstanding debt payment P_j at year j can be computed and written in a simplified form as:

$$P_j = \min(DEB_{j-1}; \max(0; EBIT_j - T_j - I_j - ADD_j)) \qquad j = C+1,..., N$$

(4.12)

The debt service reserve account R_j depends on the necessary credit enhancement. Fitch (2008) found a six-month debt service in 70% of Fitch-rated PPP projects. Mathematically, R_j can be modelled as follows:

$$R_j = \min(EBIT_j - T_j - I_j - P_j - ADD_j);(I_{j+1} + P_{j+1}) * x \;) \tag{4.13}$$

where variable x presents the duration of the necessary credit enhancement. The corresponding dividing surface on the debt perspective is called the limit investability surface. It is the probability that the project will perform its $DSCR$ requirement during the predetermined lifetime. The DSCR for the limit investability surface is computed as follows:

$$DSCR_j = \frac{EBIT_j + R_{j-1} - T_j}{P_j + I_j} \tag{4.14}$$

where $EBIT_j$ represents earnings before interest and tax, R_{j-1} stands for reserves, T_j for tax, $P_j + I_j$ for principal and interest, and the $DSCR_j$ is the minimum DSCR requirement in year j.

4.5. Performance function g(x)

The feasibility function g(x) is set to cero and defined as follows:

$$g(x)_j = EBIT_j + R_{j-1} - T_j - (P_j + I_j) * DSCR_j \tag{4.15}$$

where $EBIT_j$ represents earnings before interest and tax, R_{j-1} stands for reserves, T_j for tax, $P_j + I_j$ for principal and interest and the $DSCR_j$ is the minimum DSCR requirement in year j. Consequently, the computation would be a one year FX index.

Alternatively, a three-year FX index might be necessary to relocate assets or to refinance or to renegotiate the concessionaire contract. The FEE model is therefore designed to compute a one-year and a three-year FX index. The feasibility function $g(x)$ for the three-year FX index in year j can be described in dependency of the annual inflation rates $f_{tj}, f_{tj+1}, f_{tj+2}$ and the annual FX rates $S_{tj}, S_{tj+1}, S_{tj+2}$. The feasibility function $g(x)_{j+2}$ is written as follows:

$$g(x)_{j+2} = EBIT_{j+2} + R_{j+1} - T_{j+2} - (P_{j+2} + I_{j+2}) * DSCR \qquad j = C+1,..., N$$

(4.16)

Equivalently, the limit investability surface can be formulated in the equity perspective. In this case, the feasibility function would be defined as minimum return on equity (ROE). The FX index would then show how prepared the project is to cover FX fluctuations by maintaining a min ROE. Nevertheless, both definitions make it possible to compute the FX exposure on the NOR and dividends.

4.6. Computation of the correlation matrix

The bivariate correlations between all input variables are obtained by the SPSS software. The Pearson's correlation coefficient measures the significance levels. For example the correlation between the consumer price index in Malaysia (CPI MYS) and the producer price index in Malaysia (PPI MYS) is reported in Table 4-1 with positive correlation coefficient of 0.365 and is significantly different from 0 because the p-value of 0.001 is smaller than 0.10. The Pearson correlation coefficient measures the linear association between the variables. Variables should therefore be approximately normally distributed and have no outliers.

Table 4-1: *Correlation matrix for Malaysia*

Malaysia (1989- Malaysia (2002-2008)

		CPI MYS	PPI MYS	CPI US	WPI US	MYR/USD
CPI MYS	Pearson Correlation	1	0.365 **	0.546 **	0.208 **	0.703 **
	Sig. (2-tailed)	.	0.001	0.000	0.075	0.000
	N	74	74	74	74	27
PPI MYS	Pearson Correlation	0.365 **	1	0.784 **	0.855 **	0.712 **
	Sig. (2-tailed)	0.001	.	0.000	0.000	0.000
	N	74	74	74	74	27
CPI US	Pearson Correlation	0.546 **	0.784 **	1	0.844 **	0.584 **
	Sig. (2-tailed)	0.000	0.000	.	0.000	0.001
	N	74	74	74	74	27
WPI US	Pearson Correlation	0.208 **	0.855 **	0.844 **	1	0.527 **
	Sig. (2-tailed)	0.075	0.000	0.000	.	0.005
	N	74	74	74	74	27
MYR/USD	Pearson Correlation	0.703 **	0.712 **	0.584 **	0.527 **	1
	Sig. (2-tailed)	0.000	0.000	0.001	0.005	.
	N	27	27	27	27	27

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

4.7. Normalization of variables

The means and standard deviations of equivalent normal variables are computed by Rackwitz-Fiessler normal transformation with equivalent normal standard deviation

$$\sigma^N = \frac{\Phi\{\Phi^{-1}[F(x)]\}}{f(x)} \tag{4.17}$$

and equivalent normal mean

$$\mu^N = x - \sigma^N \Phi^{-1}[F(x)] \tag{4.18}$$

where x is the original non-normal variable, $\Phi^{-1}[\ ]$ is the inverse of the cumulative density function (CDF) of a standard normal distribution, $F(x)$ is the original non-normal CDF evaluated at x, $\Phi\{\ \}$ is the PDF of the standard normal distribution, and $f(x)$ is the original non-normal probability density ordinate at x.

Most of the market risk variables follow either log-normal or normal distributions. The transformation of log-normal μ and σ to μ^N and σ^N is derived by applying Rackwitz-Fiessler normal transformation as follows:

$$\mu^N = x(1 - \ln(x) + \ln(\mu) - \frac{1}{2}\ln(1 + (\frac{\sigma}{\mu})^2) \qquad (4.19)$$

$$\sigma^N = x * \sqrt{\ln(1 + (\frac{\sigma}{\mu})^2)} \qquad (4.20)$$

All further types of probability distributions are normalized by applying Rackwitz-Fiessler equation 4.17 and 4.18. Low (2007) published all transformations which are applied in the FEE methodology.

4.8. Modelling of the FX exposure index

The computation of the FX index involves eigenvalues and eigenvectors, rotation of the reference frame, and transformed space for the random variables. The second-moment representation of the mean vector $E[X]$ position on input parameters is judged within the set above the investability surface with respect to the covariance matrix C_x. However, the variables x must be normalized into one unit that applies irrespective of the direction in the space. This transformation of the x space in a normalized u space is done by:

$$u = C_x^{-1/2}(x - E[X]) \qquad (4.21)$$

The FX index can then be measured by the distance from the origin to any specific point of the limit investability surface L_x. The distance is the number of standard deviations from the mean value to the critical point of the limit investability surface.

The squared length of any vector u in the normalized space is defined by Hasofer-Lind (1974) as:

$$u'u = \left(x - E[x]\right)' C_x^{-1}\left(x - E[X]\right) \tag{4.22}$$

Any point x of the limit-investability surface L_x can be computed by the formula of Veneziano (1974):

$$x \in L_x = \sqrt{\left(x - E[x]\right)' C_x^{-1}\left(x - E[X]\right)} \tag{4.23}$$

The Hasofer-Lind index is defined by the smallest value of this function. The matrix formulation of the Hasofer-Lind index for correlated normal random variables is:

$$\beta_0 = \min\sqrt{\left(x - E[x]\right)' C_x^{-1}\left(x - E[X]\right)} \tag{4.24a}$$

or equivalently:

$$\beta = \min\sqrt{\left[\frac{x-\mu}{\sigma}\right]^T [R]^{-1}\left[\frac{x-\mu}{\sigma}\right]} \tag{4.24b}$$

where x represents the set of random variables, μ represents the mean value, R represents the correlation matrix, and σ represents the standard deviation. The procedure to compute β is by varying x_i to minimize the quadratic form of the ellipsoid subject to the constraint that the ellipsoid just touches the surface of the non-investability domain. The smallest ellipse or hyperellipsoid that is tangent to the non-investability domain is then equivalent to the most probable design point. Therefore, the index is equivalent to the distance from the ellipsoidal centre to the most probable point of non-investability grade (design point). The ellipsoidal centre is described by the distributions of inflation and FX rates while the distance is measured in units of directional standard deviation.

Low (2004) expanded the Hasofer-Lind ellipsoid perspective in as shown in Figure 4-2 for correlated non-normals by applying the Rackwith-Fiessler equivalent normal transformation. The normal distributions are replaced by an equivalent normal ellipsoid, centred not at the original mean values of the non-normal distribution, but at the equivalent normal mean μ^N.

The FX index β is the axis ratio (R/r) of the ellipse that touches the limit state surface of the non-investability domain and the one-standard-deviation dispersion ellipse. The FX index therefore illustrates how well the project is prepared to cover FX fluctuations. The more the ellipsoid can disperse without exceeding the non-investability surface, the more FX exposure can be absorbed by the project.

For illustrate purpose, assume that for SPC has a cash flow as shown in Table 4-2.

Table 4-2: *Cash flow example*

Months	01-Mar-09
Base case cashflow	
Fixed Tariff, Rev1, (HKD)	10.06
Variable tariff, Rev2 (YEN)	167.62
Variable tariff, Rev3 (SGD)	4.49
O&M expanditure, Opc1 (HKD)	1.54
O&M expanditure, Opc2 (USD)	0.20
O&M expanditure, Opc3 (Yen)	38.80
O&M expanditure, Opc4 (SGD)	0.15
O&M expanditure, Opc5 (USD)	0.60
Operating Cash Flow (EBITDA) (USD)	**4.18**
Depreciation	0.00
Amortization	0.00
Earnings before interest and tax (EBIT) (USD)	**4.18**
Interest tranche 1, I1	0.22
Interest tranche 2, I2	0.17
Interest tranche 3, I3	0.20
Interest tranche 4, I4	0.15
Profit before taxes (USD)	**3.44**
Corporate income tax, T	0.56
Profit after tax (USD)	**2.88**
Repayment tranche 1, P1	0.83
Repayment tranche 2, P3	0.49
Repayment tranche 3, P3	0.42
Repayment tranche 4, P4	0.30
Free Cash Flow (USD)	**0.84**
Managerial reserve, contingency budget	0.00
Redeem of Equity	
Dividends	**0.84**

The min DSCR requirement is set to 1.3. The input variables are USD/Hong Kong dollar (HKD), USD/YEN and USD/Singapore dollar (SGD) as shown as fitted PDF in Table 4-3. All input variables FX_1, FX_2, FX_3 in the following example are modelled annually. The x value of equation 4.24b is equivalent the maximum values of FX rates which can be absorbed in the one year by maintaining the min DSCR requirement. The ellipsoid is just touching the investability surface which represents the minimum DSCR. The FX index in year j is therefore a forward looking approach indicating the feasibility to absorb annual FX fluctuations.

Table 4-3: *Input variables as fitted PDF and correlation matrix*

		Distribution	μ	σ	FX_1	FX_2	FX_3
FX_1	USD/HKD	Lognormal	7.75	0.25	1	0.321	0.000
FX_2	USD/YEN	Normal	98.54	2.47	0.321	1	0.831
FX_3	USD/SGD	Lognormal	1.52	0.18	0.000	0.831	1

Figure 4-5 illustrates the feasibility analysis, using Microsoft Excel software, by applying the constraint optimization of equations (4.15) and (4.24b). The iterative process is based on the expanded Hasofer-Lind ellipsoid perspective in Low (2004). The design point is obtained by using Microsoft Excel's built-in optimization routine SOLVER. The FX index β is computed by varying x_i to minimize the quadratic form of the ellipsoid. The random variables x_i are subject to the constraint that the ellipsoid just touches the surface of the non-investability domain. This is the case when the defined feasibility function g(x) becomes zero. The example shows an FX index of (0.86) by (0.19%) probability of reaching non-investability grade.

Assumptions / **Correlation Matrix**

		Distributions	μ	σ	x*	μ^N	σ^N	nx		FX_1	FX_2	FX_3
FX_1	USD/HKD	Lognormal	7.75	0.25	7.78	7.746	0.251	0.12	**FX_1**	1	0.321	0.000
FX_2	USD/YEN	Normal	98.54	2.47	100.43	98.540	2.470	0.77	**FX_2**	0.321	1	0.831
FX_3	USD/SGD	Lognormal	1.52	0.18	1.67	1.501	0.197	0.86	**FX_3**	0.000	0.831	1

Results

Feasibility index β	0.86
Feasibility function g(x)	0.00
Prob. (non-investability)	0.194

Figure 4-5: *Feasibility analysis via SOLVER in MS Excel*

The following example shows the process to compute the first iteration by applying the same assumptions as in the feasibility analysis on the expanded Hasofer-Lind ellipsoid perspective.

By applying equation 4-17 and 4-18 the means and SD for the equivalent normal distributions of FX_1 and FX_3 are obtained as follows:

$$\mu^N = x(1-\ln(x)+\ln(\mu)-\frac{1}{2}\ln(1+(\frac{\sigma}{\mu})^2)$$

$\mu^N_{FX_1} = 7.74$; $\mu^N_{FX_3} = 1.51$;

$$\sigma^N = x*\sqrt{\ln(1+(\frac{\sigma}{\mu})^2)}$$

$\sigma^N_{FX_1} = 0.251$; $\sigma^N_{FX_1} = 0.18$

The eigenvalues of the correlation matrix in Table 4-3 are the solution of the following determinantal equation:

$$\det = \begin{bmatrix} (1-\lambda) & 0.321 & 0 \\ 0.321 & (1-\lambda) & 0.831 \\ 0 & 0.831 & (1-\lambda) \end{bmatrix} = 0$$

The corresponding eigenvalues and eigenvectors of the orthogonal correlation matrix are as follows:

$\lambda_1 = 1$, $\lambda_2 = 1.891$, $\lambda_3 = 0.109$ and

$$T = \begin{bmatrix} 0.933 & 0.255 & 0.255 \\ 0 & 0.707 & -0.707 \\ -0.360 & 0.66 & 0.66 \end{bmatrix}$$

The orthogonal transformation is derived by $X^{'} = TY$ where T represents the orthogonal transformation matrix and Y the set of uncorrelated transformed variates (Ang 1984).

Using $X = [\sigma_x]TY + \mu_x$ where X represents FX_1, FX_2 and FX_3, yields

$$X = \begin{bmatrix} 0.25 & 0 & 0 \\ 0 & 2.47 & 0 \\ 0 & 0 & 0.18 \end{bmatrix} * \begin{bmatrix} 0.923 & 0.255 & 0.255 \\ 0 & 0.707 & -0.707 \\ -0.360 & 0.66 & 0.66 \end{bmatrix} * \begin{Bmatrix} Y_1 \\ Y_2 \\ Y_3 \end{Bmatrix} + \begin{Bmatrix} 7.74 \\ 98.54 \\ 1.51 \end{Bmatrix}$$

thus obtaining:

$$FX_1 = 0.233Y_1 + 0.064Y_2 + 0.064Y_3 + 7.74$$

$$FX_2 = 1.746Y_2 - 1.746Y_3 + 98.54$$

$$FX_3 = -0.065Y_1 + 0.119Y_2 + 0.119Y_3 + 1.51$$

The performance function is defined as $\mathrm{g(x) = Ebit - T - (P + I) + DSCR_{min}}$. Applied to the cash flow in Table 4-2, the performance function becomes:

$$\begin{aligned} \mathrm{g(x)} &= \mathrm{Re}\,v_1 / FX_1 + \mathrm{Re}\,v_2 / FX_2 + \mathrm{Re}\,v_3 / FX_3 - (Opc_1 / FX_1 + OPpc2 / FX_2 + Opc_3 / FX_3 + \\ &+ Opc_4 + Opc_5) - T - (P + I) * 1.3 \end{aligned}$$

and

$$\begin{aligned} \mathrm{g(x)} &= 1/(0.231Y_1 + 0.064Y_2 + 0.064Y_3 + 7.74) * (\mathrm{Re}\,v_1 - Opc_1) + \\ &+ 1/(1.746Y_2 - 1.746Y_3 + 98.54) * (\mathrm{Re}\,v_2 - Opc_2) + \\ &+ 1/(-0.065Y_1 + 0.119Y_2 + 0.119Y_3 + 1.51) * (\mathrm{Re}\,v_3 - Opc_3) - \\ &- Opc_4 - Opc_5 - T - (P + I) * 1.3 \end{aligned}$$

The partial derivatives with respect to the reduced variates are:

$$\frac{\mathrm{dg}}{\mathrm{dY_1}} = \left(\frac{1}{0.231} * \mathrm{Re}\,v_1 - \frac{1}{0.231} * Opc_1 - \frac{1}{0.065} * \mathrm{Re}\,v_3 + \frac{1}{0.065} * \mathrm{Re}\,v_3) \right) * \frac{1}{Y_1^2} = -29.86 \frac{1}{Y_1^2}$$

$$\frac{\mathrm{dg}}{\mathrm{dY}_2}=\left(\frac{1}{0.064}*\mathrm{Re}\,v_1-\frac{1}{0.064}*Opc_1+\frac{1}{1.746}*\mathrm{Re}\,v_2-\frac{1}{1.746}*Opc_2)+\frac{1}{0.119}*\mathrm{Re}\,v_3-\frac{1}{0.119}*Opc_3\right)*\frac{1}{Y_3^2}$$

$$=243.38\frac{1}{Y_2^2}$$

$$\frac{\mathrm{dg}}{\mathrm{dY}_3}=\left(\frac{1}{0.064}*\mathrm{Re}\,v_1-\frac{1}{0.064}*Opc_1-\frac{1}{1.746}*\mathrm{Re}\,v_2-\frac{1}{1.746}*Opc_2)+\frac{1}{0.119}*\mathrm{Re}\,v_3-\frac{1}{0.119}*Opc_3\right)*\frac{1}{Y_3^2}$$

$$=95.82\frac{1}{Y_3^2}$$

The reduced variates $FX_n^{'*}=(\mu-\mu')/\sigma$ at the design point are: $FX_1=0.04$; $FX_2=0.001$; $FX_3=0.056$. To reach the transformed variates the reduced variates are multiplied with the orthogonal transformation matrix $Y^*=T^T*x^T$ (Ang, 1984):

$$\begin{Bmatrix} y_1^* \\ y_2^* \\ y_3^* \end{Bmatrix}=\begin{bmatrix} 0.923 & 0.255 & 0.255 \\ 0 & 0.707 & -0.707 \\ -0.360 & 0.66 & 0.66 \end{bmatrix}\begin{Bmatrix} 0.04 \\ 0.001 \\ 0.056 \end{Bmatrix}=\begin{Bmatrix} 0.0515 \\ -0.039 \\ 0.023 \end{Bmatrix}$$

Then, the direction cosines for the most probable design point become (Ang 1984):

$$\alpha_i^*=\frac{\left(\frac{dg}{dY_i}\right)*\lambda_i}{\sqrt{\sum_i\left(\frac{dg}{dY_i}\right)^2\lambda_i}}$$

$\alpha_{Y_1}^*=-0.049$, $\alpha_{Y_2}^*=-0.049$ and $\alpha_{Y_3}^*=-0.049$.

with

$y_1^*=-\alpha_{Y_1}^*\beta\sigma_{Y_1}=0.049\beta$; $y_2^*=-\alpha_{Y_2}^*\beta\sigma_{Y_2}=1.822\beta$; $y_3^*=-\alpha_{Y_3}^*\beta\sigma_{Y_3}=0.28\beta$

The performance function $\mathrm{g(x)}=0$ becomes:

$$\begin{aligned}
&\text{g(x)} = 1/(0.231*0.049\beta + 0.064*1.822\beta + 0.064*0.28\beta + 7.74)*(\text{Re}\,v_1 - Opc_1) + \\
&+ 1/(1.746*1.822\beta - 1.746*0.28\beta + 98.54)*(\text{Re}\,v_2 - Opc_2) + \\
&+ 1/(-0.065*0.049\beta + 0.119*1.822\beta + 0.119*0.28\beta + 1.51)*(\text{Re}\,v_3 - Opc_3) - \\
&- Opc_4 - Opc_5 - T - (P + I)*1.3
\end{aligned}$$

with $\beta = 0.64$. The final solution with the expanded Hasofer-Lind ellipsoid perspective showed an FX index $\beta = 0.86$. The next iterations would adjust the directional cosines for the most probable design point until $\beta = 0.86$ is reached.

4.9. Probability of non-investability

The matrix formulation of the Hasofer-Lind index applies for correlated normal random variables. Therefore, the probability of non-investability $P_{non-investability}$ is computed from the normal distribution of the FX index as follows:

$$P_{non-investability} = \Phi(-\beta) \tag{4.25}$$

4.10. Output

The economic FX exposure is computed by the most likely case based on a minimum DSCR of defined economic cycles. All annual FX indices are computed with a probability of reaching non-investability. The most likely exposure is computed by the following equation:

$$FX_{\exp osure,j} = (x_{Actual\ case,j} - x_{cycle_n,j})*\Phi(-\beta_j) \tag{4.26}$$

where x represents the net operating revenue, net cash flow or dividends, respectively. The maximum loss within the investability surface is adjusted to $\min DSCR_j = 45\%$ of reaching non-investability. The conditional probability of not reaching non-investability has a maximum of 50%.

$$FX_{exposure,j} = (x_{Actual\ case,j} - x_{\min DSCR,j}) * 45\% \tag{4.27}$$

The following section focuses on the implementation of the model framework in a power plant under PPP procurement in the Philippines. The case study has been conducted under a confidentiality agreement, therefore the project and the parties involved are not identified. The financial statements used as a base case are attached in Appendix 3. The objective of this case study is to quantify economic FX exposure and to show the additional information generated by the model.

4.11. FEE Model application in an IPP project

Case study A is a coal-fired power plant developed in the early 1990s. The project has a concession period of 30 years, including a five-year construction period. The project size is a capacity of 200 MW (gross) with a total estimated construction cost of around USD 400 million. The debt/equity ratio of the project is assumed to be 75%:25%. Financing is separated into local and foreign lending; local lending is equal to USD 50 million, foreign lending is equal to USD 370 million including equity. The foreign lenders have senior status to the local lenders. Both loans have a maturity of 17 years. The first loan repayment is due in year 6. Because of forecast stable demand, a grace period is not required. A subordinated working capital with assumed 10% interest rate will be drawn in case of shortcomings in interest rate payments and principal repayments.

4.11.1. Market risk factors

The tariff structure and its components are important for the evaluation of economic FX exposure. Table 4-4 illustrates the revenue positions and the major cost indexation variables. Cost positions are indexed on the nominal change of input variables. The tariff TAR_{tj} is indexed on the revenue positions by including an allowable maximum adjustment. The concessionaire contract of the case study allows a maximum 10% annual change on tariff positions.

Table 4-4: *Indexation of major cost and revenue positions*

	Currency	Cost/Revenue indexation	FX rates			Currency	Cost/Revenue indexation	FX rates
Capital Expenditure					**Revenue**			
Equity	USD				Capital Recovery Fee	USD		
Subordinated Debt	USD				Fixed Operating Fee	USD/PHP	US CPI	USD/PHP
ECA Debt	USD				Service Fee	USD/PHP		USD/PHP
Bank Debt	PHP		USD/PHP		Infrastructure Fee	USD/PHP		USD/PHP
Bank Debt	USD				Energy Fee	USD/PHP	US CPI	USD/PHP
Interest & Fees during construction	USD				Variable O&M cost rate	USD/PHP	US CPI	USD/PHP
					Variable O&M cost rate	USD/PHP	PHL CPI	USD/PHP
					VAT Receivable	USD		
Operation and maintenance costs					**Fianancing costs**			
Fixed Opex	USD	US PPI			PHP Bank Debt Interest	PHP		USD/PHP
Fixed Opex	USD	US CPI			USD Bank Debt Interest	USD		
Management Fee	USD	US CPI			ECA Interest	USD		
Fixed Opex	PHP	PHL CPI	USD/PHP		Subordinated Debt Interest	USD		
Fixed Opex	PHP	PHL WPI	USD/PHP					
					PHP Bank Debt Principal	PHP		USD/PHP
Fuel Costs	USD				USD Bank Debt Principal	USD		
Fuel Costs	PHP		USD/PHP		ECA Debt Principal	USD		
					Subordinated Debt Principal	USD		
Variable Opex	USD	US PPI						
Variable Opex	PHP	PHL CPI	USD/PHP					
Variable Opex	PHP	PHL WPI	USD/PHP					
Income Tax	PHP		USD/PHP					
VAT Payable	PHP		USD/PHP					

The variables with exposure to market risks and impact on cost and revenue positions in the case study are: (i) the consumer price index (CPI) of the Philippines (PHL), (ii) the producer price index (PPI) PHL, (iii) the CPI of the USA, (iv) wholesale price index (WPI) of the USA, and (v) FX rates of the USA and PHL. The interest rates are fixed over the whole concession period and therefore are not relevant in the model. All variables are fitted to probability density functions based on monthly rates. Each variable covers 250 data points from 1989 to 2008. The data were obtained from the international financial statistics database from the International Monetary Fund and listed in Appendix 1.

The analysis is based on three economic cycles: (i) 1989–1997, (ii) 1997–2002, and (iii) 2002–2008, indicating the period of growth in Asian markets, the Asian financial crises and the current market situation respectively. Figure 4-6 illustrates the project-linked escalators and FX rates on the local market and on the US market.

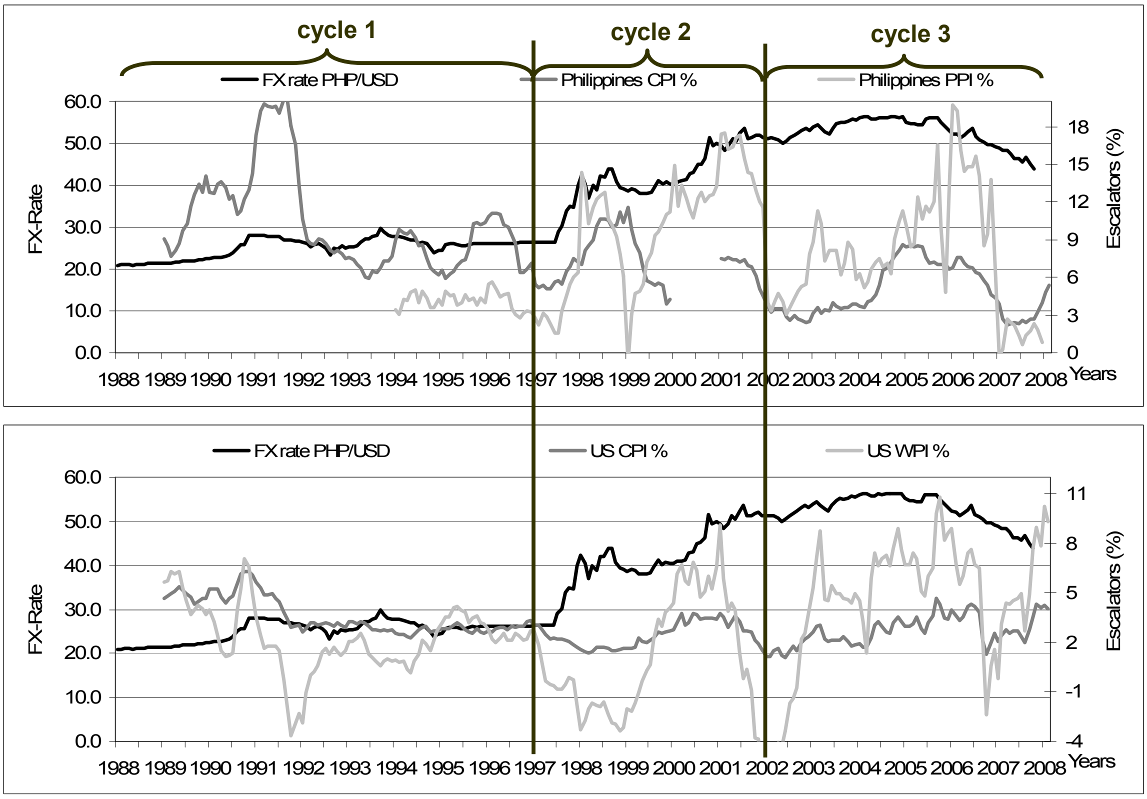

Figure 4-6: *FX rate and escalators applied on the case study in the Philippines*

The results of the fitted PDFs are shown in Table 4-5. The SD of the distributions are inversely proportional to the FX exposure index. If the standard deviation increases, the risk increases and the FX index will decrease.

Table 4-5: *Fitted probability density functions – Philippines*

		Cycle 1: 1989-1997			Cycle 2: 1997-2002		
		Distributions	μ	σ	Distributions	μ	σ
i_1	CPI PHL	Lognormal	10.45	4.74	Lognormal	7.28	2.10
i_2	WPI PHL	Triangular	4.20	0.67	Triangular	9.79	4.39
i_3	CPI US	Lognormal	3.62	1.36	Uniform	2.57	0.71
i_4	PPI US	Normal	2.26	2.02	Lognormal	1.06	3.60
FX	FX rate	Normal	54.70	3.21	Normal	57.29	3.21

		Cycle 3: 2002-2008			Base Case		
		Distributions	μ	σ	Distributions	μ	σ
i_1	CPI PHL	Lognormal	4.76	1.82	Lognormal	10.00	2.88
i_2	WPI PHL	Lognormal	7.73	4.69	Lognormal	9.32	4.69
i_3	CPI US	Triangular	2.65	0.86	Lognormal	2.85	0.91
i_4	PPI US	Normal	4.52	4.04	Normal	4.82	4.04
FX	FX rate	Normal	50.77	3.21	Normal	43.84	3.21

All inflation variables applied in the case study are modelled based on the fitted distributions in the specific cycles as illustrated in Table 4-5. In contrast, the FX rates are modelled on the maximum change during a three-year cycle. The current spot price is increased by the percentage maximum change of the specific cycle. This is the time period the project is tested on feasibility and the probability to reach non-investability grade. Furthermore, the Asian financial crisis, in cycle 2, is only modelled by 30% of the actual devaluation. This cycle illustrates the worst case assumption in FX exposure. Table 4-6 shows the adjusted probability density functions for the economic FX exposure modelling.

Table 4-6: *FX rate modelling*

	Period	3-year Δ FX rate			FX index modelling		
		min	max	% change	Distributions	μ	σ
Base Case	2008				Normal	43.8	3.21
Cycle 1	1989-1997	22.4	28.0	25	Normal	54.7	3.21
Cycle 2	1997-2002	26.3	42.4	61	Normal	70.6	3.21
Cycle 2 (30%)	1997-2003	26.3	42.4	61	Normal	57.3	3.21
Cycle 3	2002-2008	46.3	53.6	16	Normal	50.8	3.21

4.11.2. Computation of feasibility function g(x)

The feasibility function g(x) of the one year FX index is calibrated to a min DSCR of cycle 1, cycle 3 and the Base Case. The min DSCR assumption is generated from the cash flow. The feasibility function g(x) for the one-year FX index is therefore computed as follows:

$$g(i_1, i_2, i_3, i_4, FX)_j = EBIT_j - T_j - (P_j + I_j) * DSCR_{\min, j} \qquad j = C+1, \dots, N$$

Reserves are excluded in the one-year FX index in order to measure FX exposure on the net operating revenue. In case of currency devaluation reserves would offset FX exposure without being counted in the net operating revenue on a one-year basis. However, the three-year FX index includes reserves because of accumulation of changes in the reserve account during the following years. The three-year FX index in dependency of the annual inflation rates $f_{tj}, f_{tj+1}, f_{tj+2}$ and the annual FX rates $S_{tj}, S_{tj+1}, S_{tj+2}$ is written as follows:

$$g(i_1, i_2, i_3, i_4, FX)_{j+2} = EBIT_{j+2} + R_{j+1} - T_{j+2} - (P_{j+2} + I_{j+2}) * DSCR_{\min, j+2}$$

$$j = C + 1, \ldots, N$$

To compare all three cycles it is important to include minimum boundaries instead of maximum boundaries on the inflation and FX variables. The minimum boundary is set at the original mean value in each cycle. The model will have a setting-up problem in case there is no possible combination to reach the non-investability surface.

4.11.3. Computation of the correlation matrix

The bivariate correlations and the Pearson's correlation coefficient between the variables and the P-values of the CPI of PHL, the PPI of PHL, the CPI of the USA, and the WPI of the USA are listed in Table 4-7.

Table 4-7: *Correlation matrix for the Philippines*

		Philippines (1989-1997)					Philippines (1997-2002)					Philippines (2002-2008)				
		CPI PHL	PPI PHL	CPI US	WPI US	PHP/USD	CPI PHL	PPI PHL	CPI US	WPI US	PHP/USD	CPI PHL	PPI PHL	CPI US	WPI US	PHP/USD
CPI PHL	Pearson Correlation	1	0.415 *	0.514 **	-0.178	0.117	1	0.552 **	-0.777 **	-0.721 **	0.852 **	1	0.697 **	0.632 **	0.515 **	0.515 **
	Sig. (2-tailed)	.	0.012	0.000	0.083	0.257	.	0.004	0.000	0.000	0.000	.	0.000	0.000	0.000	0.000
	N	96	36	96	96	96	25	25	25	25	25	70	70	70	70	70
PPI PHL	Pearson Correlation	0.415 *	1	-0.287	0.056	0.002	0.552 **	1	-0.704 **	-0.613 **	0.793 **	0.697 **	1	0.642 **	0.499 **	0.440 **
	Sig. (2-tailed)	0.012	.	0.090	0.744	0.991	0.004	.	0.000	0.001	0.000	0.000	.	0.000	0.000	0.000
	N	36	36	36	36	36	25	25	25	25	25	70	70	70	70	70
CPI US	Pearson Correlation	0.514 **	-0.287	1	0.556 **	-0.390 **	-0.777 **	-0.704 **	1	0.916 **	-0.891 **	0.632 **	0.642 **	1	0.833 **	0.174
	Sig. (2-tailed)	0.000	0.090	.	0.000	0.000	0.000	0.000	.	0.000	0.000	0.000	0.000	.	0.000	0.149
	N	96	36	96	96	96	25	25	25	25	25	70	70	70	70	70
WPI US	Pearson Correlation	-0.178	0.056	0.556 **	1	-0.477 **	-0.721 **	-0.613 **	0.916 **	1	-0.815 **	0.515 **	0.499 **	0.833 **	1	0.354 **
	Sig. (2-tailed)	0.083	0.744	0.000	.	0.000	0.000	0.001	0.000	.	0.000	0.000	0.000	0.000	.	0.003
	N	96	36	96	96	96	25	25	25	25	25	70	70	70	70	70
PHP/USD	Pearson Correlation	0.117	0.002	-0.390 **	-0.477 **	1	0.852 **	0.793 **	-0.891 **	-0.815 **	1	0.515 **	0.440 **	0.174	0.354 **	1
	Sig. (2-tailed)	0.257	0.991	0.000	0.000	.	0.000	0.000	0.000	0.000	.	0.000	0.000	0.149	0.003	.
	N	96	36	96	96	96	25	25	25	25	25	70	70	70	70	70

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

All correlations until the 0.05 significance level are included in the FX index computation.

4.11.4. Results

Figure 4-7 illustrates the output of the feasibility analysis with the FX indices based on the defined economic cycles: (i) 1989–1997, (ii) 1997–2002, and (iii) 2002–2008. The FX index therefore illustrates how well the project is prepared to cover FX fluctuations. Each combination fulfils the constraint of feasibility function g(x) = 0 and a minimum FX index. It is therefore a forward-looking approach searching for the combination of the possible maximum market variables with the shortest distance to the non-investability surface without exceeding the non-investability domain. The possible combinations of the inflation and FX rates are based on the fitted distributions and the correlation assumptions. The FX index is unit independent and allows for comparison of different projects in different markets.

Figure 4-7 shows the FX index compared to the base case DSCR during the defined cycles. The input parameters are linked to the cash flow and reflect the different life-cycle cost and revenue structures. Higher x-values compared with the original μ illustrate the potential of increased inflation rates or FX rates without reaching the non-investability domain. Therefore, the higher the FX index, the more feasible is the project to absorb FX fluctuations. The upper line in Figure 4-7 represents the base case. All other cycles have FX indexes with a distance of around two units to the base case. Cycle 3 is the bottom line with a maximum of the FX index equal to 0.8. The figure illustrates that the DSCR cannot reflect the uncertainties of economic FX exposure. The DSCR increases constantly until the end of the concession period. In this case, the DSCR could mislead one to the interpretation that the project becomes increasingly resistant to market risk during the concession period. The FX index shows by how many standard deviations of the feasibility function the expected condition reaches the defined investability grade. Each standard deviation can be expressed in nominal absolute values. The FX index is approximately constant over the whole period while the DSCR is increasing. The only increase of the FX index by 0.3 units in all cycles is from 2012 to 2013. This increase reflects a change in replacement costs during the year 2013. From 2013 to 2020 the FX indices are decreasing back to the value of 2012. The index illustrates very low feasibility to cover FX exposure by applying cycle 1, cycle 2 and cycle 3. The lowest values can be seen in the years 2008 to 2012.

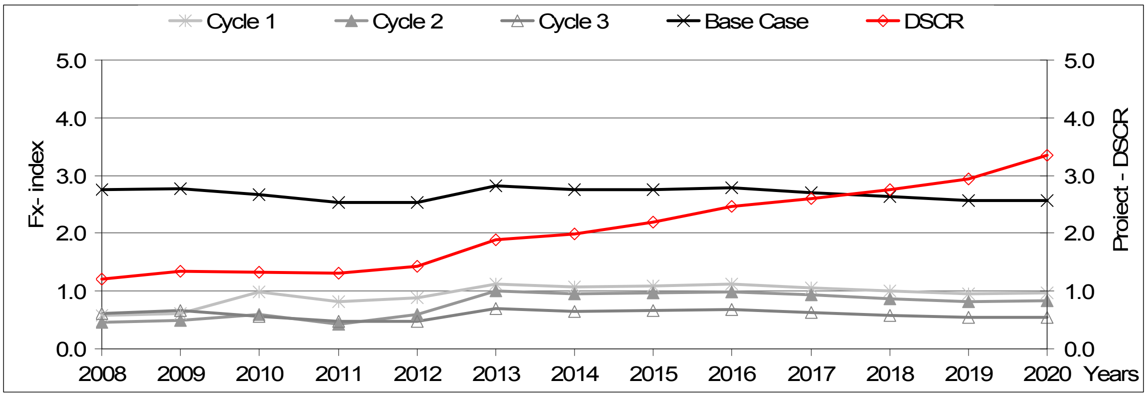

Figure 4-7: *FX- index for the defined cycles compared with DSCR*

Table 4-8 shows a comparison of beta indices in the engineering field with a minimum requirement of beta equal to 3.0.

Table 4-8: *Reliability indices in engineering*

Structure systems	Reliability β	Probability of failure
Structural components (beams, slabs, columns)	3 - 4	0.00317% - 0.13499%
Connections:		
welded	3 - 4	0.00317% - 0.13499%
bolted	5 - 7	0.00000% - 0.00003%
Structural systems (building frames, girder, bridges)	6 - 8	0.00000% - 0.00000%

Figures 4-8 and 4-9 illustrate the market risk exposure on net operating revenue and dividends. The market exposure is calculated based on the change of the variables in each applied cycle compared with the actual case. Each annual combination of inflation rates and FX rates fulfils the constraint of just touching the non-investability surface and reaching a minimum FX index. The escalators and FX rates are changed randomly under the constraint of the fitted PDFs and the correlations between the variables. The economic FX exposure is computed by a most likely case based on a minimum DSCR from cycle 1, cycle 3 and the base case. All annual FX indices are computed with a probability of reaching non-investability. The annual most likely and maximum FX exposure is computed as stated in equation 4.26 and 4.27, respectively. Figure 4-8 illustrates that the FX exposure on net operating revenue varies from USD 1.8 to 3.9 million in cycle 1, USD 3.9 to 5.9 million in cycle 2, and USD 1.9 to 2.8 million in cycle 3. FX exposure on dividends varies from USD 1.5 to 2.6 million in cycle 1, USD 2.0 to 3.1 million in cycle 2, and USD 1.0 to 1.5 million in cycle 3 as shown in Figure 4-9. The most likely case is based on the minimum DSCR of the base case, cycle 3 and cycle 1. The base case has zero probability of reaching non-investability and therefore no FX exposure.

The maximum FX exposure for NOR and dividends with 45% probability of reaching non-investability is shown in Figures 4-10 and 4-11. In contrast to the most likely case computed on the minimum DSCR, the maximum FX computation fulfils a minimum DSCR of 45% probability of reaching the non-investability domain based on the actual DSCR derived by the cash flow. The FX exposure is therefore increasing based on the growing cash flow with escalated cost and revenues until the end of the concession period. Cycle 2 has the highest maximum exposure on net operating revenue, growing to USD 10 million until year 2022. It is followed by cycle 1 with USD 8 million and cycle 3 with USD 2.3 million. The exposure on dividends grows to USD 5.5 million in cycle 2, USD 4.3 million in cycle 1 and USD 1.3 million in cycle 3.

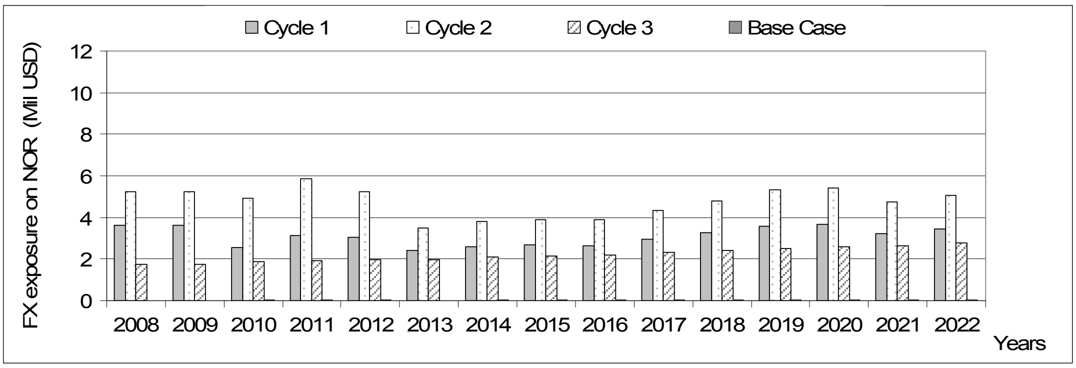

Figure 4-8: *Economic FX exposure on net operating revenue*

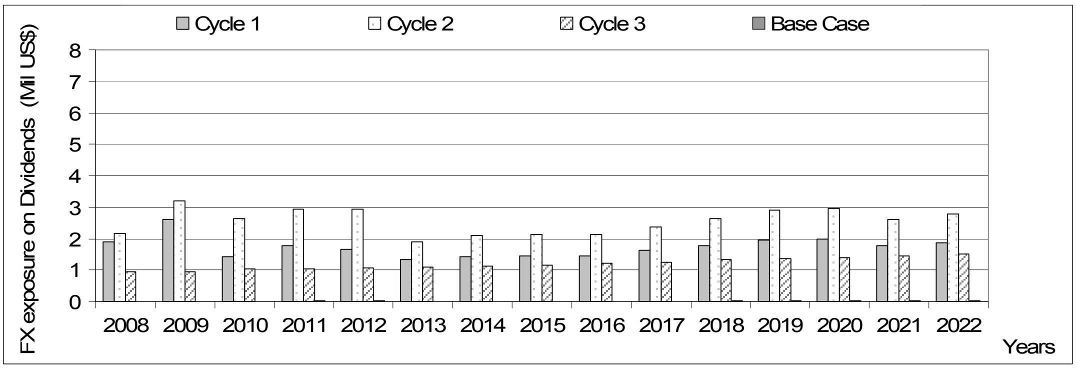

Figure 4-9: *Economic FX exposure on dividends*

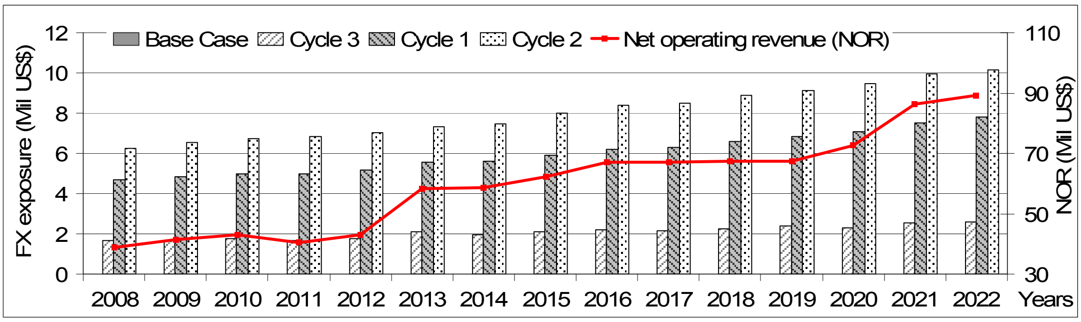

Figure 4-10: *Maximum economic FX exposure on the net operating revenue*

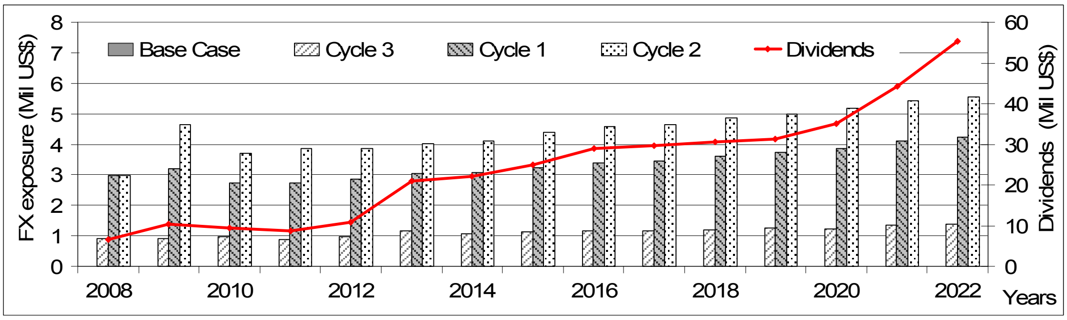

Figure 4-11: *Maximum economic FX exposure on dividends*

In the next section, the case study is tested in three different emergent markets. The base case of the project will be compared in the markets of Indonesia (IDN), Philippines (PHL) and Malaysia (MYS). Investors are concerned about the impact of FX exposure on the cash flow of the project. The objective in the next section is to show the differences of economic FX exposure on the net operating revenue and the dividends.

4.12. Validation of the FX index

4.12.1. Comparison of the FX index in three different markets

The comparison between the three different economies is possible because the project cash flow is stated in USD. Local currency cost and revenue positions are adjusted by the exchange rates of the different markets. The annual values of internal rate of return (IRR), net present value (NPV) and equity IRR are the same in all three cases. This provides the basis to compare the economic FX exposure on the project within the three different markets.

Similarly to section 4.3, the analysis is structured on three cycles: (i) 1989–1997, (ii) 1997–2002, and (iii) 2002–2008, indicating the period of growth in Asian markets, the Asian financial crises and the current market situation respectively. Figures 4-12 and 4-13 illustrate project-linked escalators and FX rates in PHL, IDN, MYS, and on the US market during the three cycles.

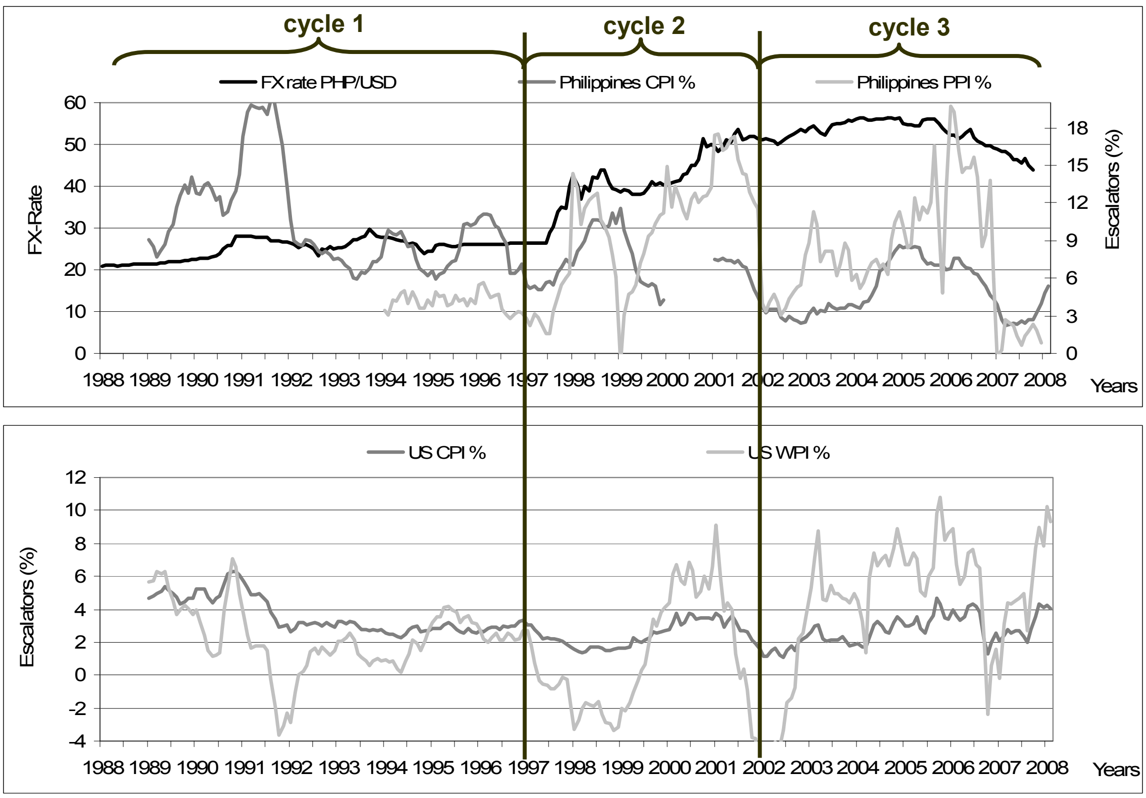

Figure 4-12: *FX rate and escalators applied on the case study in the Philippines*

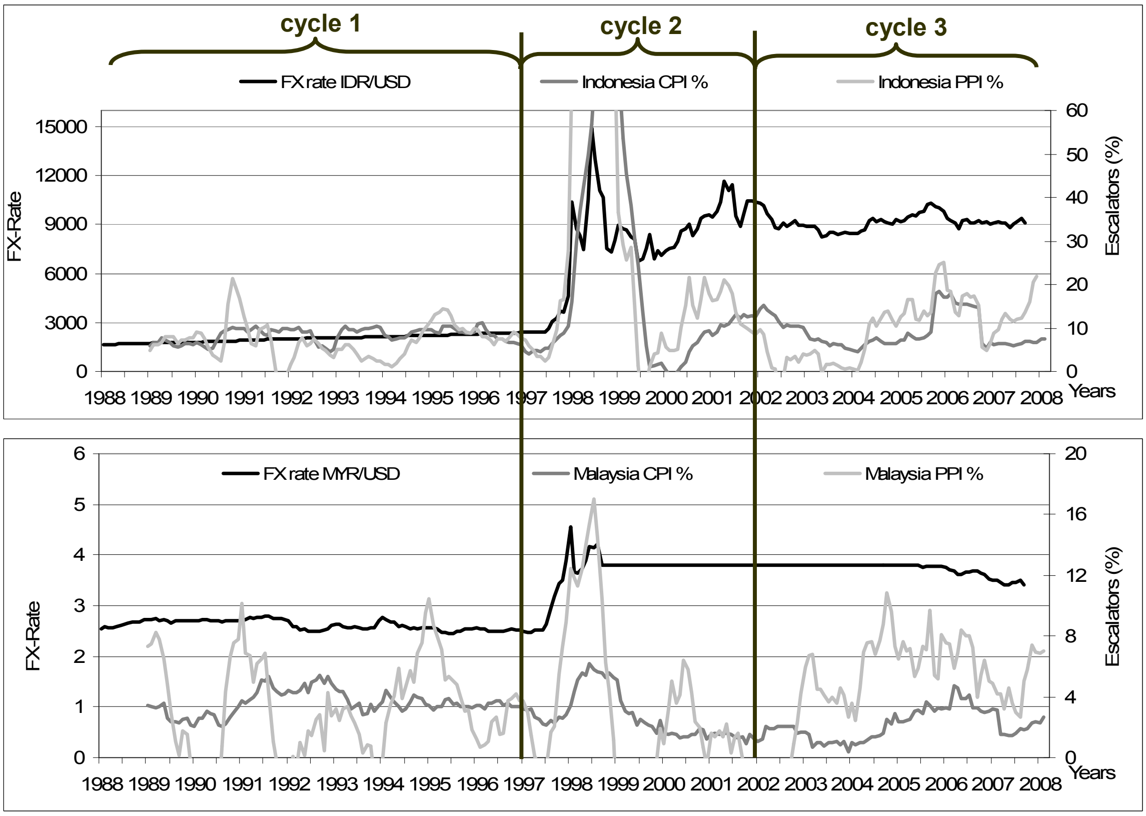

Figure 4-13: *FX rate and escalators applied on the case study in Indonesia and Malaysia*

The results of the fitted probability density functions on market variables in the Philippines, Indonesia and Malaysia are shown in Tables 4-9 to 4-11.

Table 4-9: *Fitted PDF– Philippines*

		Cycle 1: 1989-1997			Cycle 2: 1997-2002		
		Distributions	**μ**	**σ**	**Distributions**	**μ**	**σ**
i_1	CPI PHL	Lognormal	10.45	4.74	Lognormal	7.28	2.10
i_2	WPI PHL	Triangular	4.20	0.67	Triangular	9.79	4.39
i_3	CPI US	Lognormal	3.62	1.36	Uniform	2.57	0.71
i_4	PPI US	Normal	2.26	2.02	Lognormal	1.06	3.60
FX	PHP/USD	Normal	54.70	3.21	Normal	57.29	3.21

		Cycle 3: 2002-2008			Base Case		
		Distributions	**μ**	**σ**	**Distributions**	**μ**	**σ**
i_1	CPI PHL	Lognormal	4.76	1.82	Lognormal	10.00	2.88
i_2	WPI PHL	Lognormal	7.73	4.69	Lognormal	9.32	4.69
i_3	CPI US	Triangular	2.65	0.86	Lognormal	2.85	0.91
i_4	PPI US	Normal	4.52	4.04	Normal	4.82	4.04
FX	PHP/USD	Normal	50.77	3.21	Normal	43.84	3.21

Table 4-10: *Fitted PDF – Indonesia*

		Cycle 1: 1989-1997			Cycle 2: 1997-2002		
		Distributions	μ	σ	Distributions	μ	σ
i_1	CPI IDN	Triangular	8.36	1.54	Lognormal	27.56	48.67
i_2	WPI IDN	Lognormal	7.01	4.12	Lognormal	29.16	37.89
i_3	CPI US	Lognormal	3.62	1.36	Uniform	2.57	0.71
i_4	PPI US	Normal	2.26	2.02	Lognormal	1.06	3.60
FX	IDR/USD	Normal	9656	482	Normal	13364	482

		Cycle 3: 2002-2008			Base Case		
		Distributions	μ	σ	Distributions	μ	σ
i_1	CPI IDN	Lognormal	9.17	4.64	Lognormal	9.17	4.64
i_2	WPI IDN	Normal	9.54	6.90	Normal	9.54	6.90
i_3	CPI US	Triangular	2.65	0.86	Lognormal	2.85	0.91
i_4	PPI US	Normal	4.52	4.04	Normal	4.82	4.04
FX	IDR/USD	Normal	10801	482	Normal	9412	482

Table 4-11: *Fitted probability density functions – Malaysia*

		Cycle 1: 1989-1997			Cycle 2: 1997-2002		
		Distributions	μ	σ	Distributions	μ	σ
i_1	CPI MYS	Lognormal	3.60	0.79	Lognormal	2.75	1.78
i_2	WPI MYS	Normal	3.04	3.30	Lognormal	2.80	5.52
i_3	CPI US	Lognormal	3.62	1.36	Uniform	2.57	0.71
i_4	PPI US	Normal	2.26	2.02	Lognormal	1.06	3.60
FX	MYR/USD	Lognormal	3.78	0.13	Normal	4.92	0.13

		Cycle 3: 2002-2008			Base Case		
		Distributions	μ	σ	Distributions	μ	σ
i_1	CPI MYS	Triangular	2.10	1.04	Triangular	2.10	1.04
i_2	WPI MYS	Triangular	4.71	3.21	Triangular	4.71	3.21
i_3	CPI US	Triangular	2.65	0.86	Triangular	2.65	0.86
i_4	PPI US	Normal	4.52	4.04	Normal	4.52	4.04
FX	MYR/USD	Normal	3.68	0.13	Normal	3.4	0.13

The feasibility function $g(x)_j$ is based on the debt service cover ratio (DSCR) calculation and divides the investability domain from the non-investability domain. The function $g(x)_j$ will be set to cero in the FX index computation. Consequently, the feasibility function is defined as follows:

$$g(x)_j = EBIT_j + R_{j-1} - T_j - (P_j + I_j) * DSCR_j$$

where $EBIT_j$ represents earnings before interest and tax, R_{j-1} stands for reserves, T_j for tax, $P_j + I_j$ for principal and interest and the $DSCR_j$ is the minimum DSCR requirement in year j. The correlations between the variables and the P-values of CPI, PPI in the different economies and the CPI and WPI of the USA are listed in Tables 4-12 to 4-14. Correlations until 0.05% confidence interval are considered in the FX index computation. The strong correlations between the factors in different cycles indicate the importance of modelling FX exposure in a system of relationships.

***Table 4-12:** Correlation matrix – the Philippines*

Philippines (1989-1997)

		CPI PHL	PPI PHL	CPI US	WPI US	PHP/USD
CPI PHL	Pearson Correlation	1	0.415 *	0.514 **	-0.178	0.117
	Sig. (2-tailed)	.	0.012	0.000	0.083	0.257
	N	96	36	96	96	96
PPI PHL	Pearson Correlation	0.415 *	1	-0.287	0.056	0.002
	Sig. (2-tailed)	0.012	.	0.090	0.744	0.991
	N	36	36	36	36	36
CPI US	Pearson Correlation	0.514 **	-0.287	1	0.556 **	-0.390 **
	Sig. (2-tailed)	0.000	0.090	.	0.000	0.000
	N	96	36	96	96	96
WPI US	Pearson Correlation	-0.178	0.056	0.556 **	1	-0.477 **
	Sig. (2-tailed)	0.083	0.744	0.000	.	0.000
	N	96	36	96	96	96
PHP/USD	Pearson Correlation	0.117	0.002	-0.390 **	-0.477 **	1
	Sig. (2-tailed)	0.257	0.991	0.000	0.000	.
	N	96	36	96	96	96

Philippines (1997-2002)

		CPI PHL	PPI PHL	CPI US	WPI US	PHP/USD
CPI PHL	Pearson Correlation	1	0.552 **	-0.777 **	-0.721 **	0.852 **
	Sig. (2-tailed)	.	0.004	0.000	0.000	0.000
	N	25	25	25	25	25
PPI PHL	Pearson Correlation	0.552 **	1	-0.704 **	-0.613 **	0.793 **
	Sig. (2-tailed)	0.004	.	0.000	0.001	0.000
	N	25	25	25	25	25
CPI US	Pearson Correlation	-0.777 **	-0.704 **	1	0.916 **	-0.891 **
	Sig. (2-tailed)	0.000	0.000	.	0.000	0.000
	N	25	25	25	25	25
WPI US	Pearson Correlation	-0.721 **	-0.613 **	0.916 **	1	-0.815 **
	Sig. (2-tailed)	0.000	0.001	0.000	.	0.000
	N	25	25	25	25	25
PHP/USD	Pearson Correlation	0.852 **	0.793 **	-0.891 **	-0.815 **	1
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	.
	N	25	25	25	25	25

Philippines (2002-2008)

		CPI PHL	PPI PHL	CPI US	WPI US	PHP/USD
CPI PHL	Pearson Correlation	1	0.697 **	0.632 **	0.515 **	0.515 **
	Sig. (2-tailed)	.	0.000	0.000	0.000	0.000
	N	70	70	70	70	70
PPI PHL	Pearson Correlation	0.697 **	1	0.642 **	0.499 **	0.440 **
	Sig. (2-tailed)	0.000	.	0.000	0.000	0.000
	N	70	70	70	70	70
CPI US	Pearson Correlation	0.632 **	0.642 **	1	0.833 **	0.174
	Sig. (2-tailed)	0.000	0.000	.	0.000	0.149
	N	70	70	70	70	70
WPI US	Pearson Correlation	0.515 **	0.499 **	0.833 **	1	0.354 **
	Sig. (2-tailed)	0.000	0.000	0.000	.	0.003
	N	70	70	70	70	70
PHP/USD	Pearson Correlation	0.515 **	0.440 **	0.174	0.354 **	1
	Sig. (2-tailed)	0.000	0.000	0.149	0.003	.
	N	70	70	70	70	70

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

***Table 4-13:** Correlation matrix - Indonesia*

Indonesia (1989-1997)

		CPI IDN	PPI IDN	CPI US	WPI US	IDR/USD
CPI IDN	Pearson Correlation	1	0.183	-0.207 *	-0.173	0.304 **
	Sig. (2-tailed)	.	0.074	0.043	0.092	0.003
	N	96	96	96	96	96
PPI IDN	Pearson Correlation	0.183	1	0.411 **	0.726 **	0.066
	Sig. (2-tailed)	0.074	.	0.000	0.000	0.523
	N	96	96	96	96	96
CPI US	Pearson Correlation	-0.207 *	0.411 **	1	0.556 **	-0.782 **
	Sig. (2-tailed)	0.043	0.000	.	0.000	0.000
	N	96	96	96	96	96
WPI US	Pearson Correlation	-0.173	0.726 **	0.556 **	1	-0.221 *
	Sig. (2-tailed)	0.092	0.000	0.000	.	0.031
	N	96	96	96	96	96
IDR/USD	Pearson Correlation	0.304 **	0.066	-0.782 **	-0.221 *	1
	Sig. (2-tailed)	0.003	0.523	0.000	0.031	.
	N	96	96	96	96	96

Indonesia (1997-2002)

		CPI IDN	PPI IDN	CPI US	WPI US	IDR/USD
CPI IDN	Pearson Correlation	1	0.836 **	-0.664 **	-0.593 **	0.362 **
	Sig. (2-tailed)	.	0.000	0.000	0.000	0.004
	N	60	60	60	60	60
PPI IDN	Pearson Correlation	0.836 **	1	-0.564 **	-0.464 **	0.463 **
	Sig. (2-tailed)	0.000	.	0.000	0.000	0.000
	N	60	60	60	60	60
CPI US	Pearson Correlation	-0.664 **	-0.564 **	1	0.910 **	0.022
	Sig. (2-tailed)	0.000	0.000	.	0.000	0.865
	N	60	60	60	60	60
WPI US	Pearson Correlation	-0.593 **	-0.464 **	0.910 **	1	0.023
	Sig. (2-tailed)	0.000	0.000	0.000	.	0.860
	N	60	60	60	60	60
IDR/USD	Pearson Correlation	0.362 **	0.463 **	0.022	0.023	1
	Sig. (2-tailed)	0.004	0.000	0.865	0.860	.
	N	60	60	60	60	60

Indonesia (2002-2008)

		CPI IDN	PPI IDN	CPI US	WPI US	IDR/USD
CPI IDN	Pearson Correlation	1	0.486 **	0.321 **	-0.061	0.461 **
	Sig. (2-tailed)	.	0.000	0.007	0.619	0.000
	N	69	69	69	69	69
PPI IDN	Pearson Correlation	0.486 **	1	0.768 **	0.539 **	0.646 **
	Sig. (2-tailed)	0.000	.	0.000	0.000	0.000
	N	69	69	69	69	69
CPI US	Pearson Correlation	0.321 **	0.768 **	1	0.831 **	0.361 **
	Sig. (2-tailed)	0.007	0.000	.	0.000	0.002
	N	69	69	69	69	69
WPI US	Pearson Correlation	-0.061	0.539 **	0.831 **	1	0.011
	Sig. (2-tailed)	0.619	0.000	0.000	.	0.931
	N	69	69	69	69	69
IDR/USD	Pearson Correlation	0.461 **	0.646 **	0.361 **	0.011	1
	Sig. (2-tailed)	0.000	0.000	0.002	0.931	.
	N	69	69	69	69	69

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Table 4-14: *Correlation matrix - Malaysia*

Malaysia (1989-1997)

		CPI MYS	PPI MYS	CPI US	WPI US	MYR/USD
CPI MYS	Pearson Correlation	1	0.132	-0.398 **	-0.494 **	-0.147
	Sig. (2-tailed)	.	0.200	0.000	0.000	0.154
	N	96	96	96	96	96
PPI MYS	Pearson Correlation	0.132	1	0.142	0.507 **	-0.064
	Sig. (2-tailed)	0.200	.	0.168	0.000	0.534
	N	96	96	96	96	96
CPI US	Pearson Correlation	-0.398 **	0.142	1	0.556 **	0.643 **
	Sig. (2-tailed)	0.000	0.168	.	0.000	0.000
	N	96	96	96	96	96
WPI US	Pearson Correlation	-0.494 **	0.507 **	0.556 **	1	-0.015
	Sig. (2-tailed)	0.000	0.000	0.000	.	0.888
	N	96	96	96	96	96
MYR/USD	Pearson Correlation	-0.147	-0.064	0.643 **	-0.015	1
	Sig. (2-tailed)	0.154	0.534	0.000	0.888	.
	N	96	96	96	96	96

Malaysia (1997-2002)

		CPI MYS	PPI MYS	CPI US	WPI US	MYR/USD
CPI MYS	Pearson Correlation	1	0.885 **	-0.591 **	-0.477 *	0.677 **
	Sig. (2-tailed)	.	0.000	0.006	0.034	0.001
	N	20	20	20	20	20
PPI MYS	Pearson Correlation	0.885 **	1	-0.758 **	-0.634 **	0.916 **
	Sig. (2-tailed)	0.000	.	0.000	0.003	0.000
	N	20	20	20	20	20
CPI US	Pearson Correlation	-0.591 **	-0.758 **	1	0.916 **	-0.852 **
	Sig. (2-tailed)	0.006	0.000	.	0.000	0.000
	N	20	20	20	20	20
WPI US	Pearson Correlation	-0.477 *	-0.634 **	0.916 **	1	-0.790 **
	Sig. (2-tailed)	0.034	0.003	0.000	.	0.000
	N	20	20	20	20	20
MYR/USD	Pearson Correlation	0.677 **	0.916 **	-0.852 **	-0.790 **	1
	Sig. (2-tailed)	0.001	0.000	0.000	0.000	.
	N	20	20	20	20	20

Malaysia (2002-2008)

		CPI MYS	PPI MYS	CPI US	WPI US	MYR/USD
CPI MYS	Pearson Correlation	1	0.365 **	0.546 **	0.208 **	0.703 **
	Sig. (2-tailed)	.	0.001	0.000	0.075	0.000
	N	74	74	74	74	27
PPI MYS	Pearson Correlation	0.365 **	1	0.784 **	0.855 **	0.712 **
	Sig. (2-tailed)	0.001	.	0.000	0.000	0.000
	N	74	74	74	74	27
CPI US	Pearson Correlation	0.546 **	0.784 **	1	0.844 **	0.584 **
	Sig. (2-tailed)	0.000	0.000	.	0.000	0.001
	N	74	74	74	74	27
WPI US	Pearson Correlation	0.208 **	0.855 **	0.844 **	1	0.527 **
	Sig. (2-tailed)	0.075	0.000	0.000	.	0.005
	N	74	74	74	74	27
MYR/USD	Pearson Correlation	0.703 **	0.712 **	0.584 **	0.527 **	1
	Sig. (2-tailed)	0.000	0.000	0.001	0.005	.
	N	27	27	27	27	27

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

The economic FX exposure is computed based on the probabilities of reaching non-investability and the difference of the actual case with the defined economic cycles. All annual FX indices are computed as annual exposure. The most likely exposure on net operating revenue (NOR_j) in year j is computed by the following equation:

$$FX_{\exp osure,j} = (NOR_{Actual\ \ case,j} - NOR_{cycle_n,j}) * \Phi(-\beta_j)$$

All input variables $x_1, x_2,...x_n$ are modelled annually. The x value of equation 4.24b is equivalent to the maximum values of inflation and FX rates which can be absorbed in the one year by maintaining the minimum DSCR requirement in each year j. The ellipsoid is just touching the investability surface which represents the minimum DSCR. The project DSCR on the feasibility function is attached in Appendix 2.

Figures 4-14 to 4-16 show the FX index during all three cycles and the base case in Indonesia, the Philippines and Malaysia. The base case indicates the highest FX indices for Malaysia and the lowest values for Indonesia. The base case in Malaysia is around 2.5 points higher than for Indonesia. The base case is 0.5 points higher than for Indonesia. Each FX index is associated with the probability of reaching non-investability. The higher the FX index, the lower is the probability of reaching non-investability. An FX index between 2.0 and 3.0 has a probability of less than 2% of reaching non-investability grade and could be a base line to structure the project.

In Indonesia, cycle one is significantly higher than the base case, cycle 3 and cycle 2.

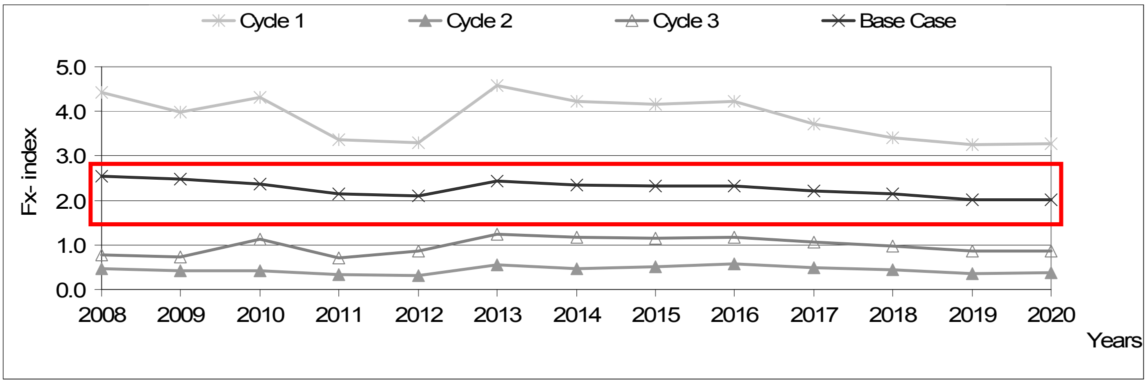

Figure 4-14: *FX index - Indonesia*

The reasons are illustrated in a snap shot between cycle 1 and the base case during 2012 and 2013 as shown in Table 4-15. The methodology explains the behaviour of the market variables and the impact on the FX index in each year.

Table 4-15: *Change in standard deviation between the variables in 2012 and 2013*

Year	2012				2013			
	Cycle 1		Base Case		Cycle 1		Base Case	
	SD	Values	SD	Values	SD	Values	SD	Values
CPI IDN (%)	0.90	9.84	1.44	16.31	1.06	10.00	1.64	17.90
WPI IDN (%)	1.74	15.63	1.60	20.55	2.95	30.16	1.80	21.96
CPI US (%)	-0.87	2.47	1.03	3.74	-0.87	2.47	1.11	3.84
PPI US (%)	0.93	4.15	0.23	5.75	1.63	5.55	0.18	5.53
FX rate	2.62	11208	2.00	10378	3.32	11548	2.33	10537
FX Index β		**3.30**		**2.10**		**4.58**		**2.43**

The difference between cycle 1 and the base case is driven by the possible expansion of the ellipsoid by the PPI US rate, the FX rate, and CPI US in 2012. In 2013 the WPI IDN has additional impact on the change in the FX index. In 2012 the increase of 0.7 SD by PPI US and the 0.61 SD increase by FX rate leads to an increase from FX index 2.1 in the base case to 3.3 in cycle 1. In 2013 PPI US increases by 1.45 SD, FX rates by one SD and WPI IDN by one SD, leading to an increase from FX index 2.43 in the base case to 4.58 in cycle 1. The possible increase of CPI IDN and CPI has less impact on the FX index between 2012 and 2013. The jump from 2012 to 2013 can be explained by the difference of 0.2 SD increase in WPI IDN, 0.2 SD CPI IDN, and 0.33 SD in FX rate for the base case. The jump in cycle 1 from FX index 3.3 to 4.58 is larger compared to the jumps in the base case. It is mainly driven by the change of 1.21 SD in WPI IDN, 0.7 SD increase in FX rate and additional increase of 0.69 SD in PPI US.

In the Philippine case, the FX index is between 0.5 and 1.1 by applying the assumptions of cycle 1, 2 and 3. An FX index below one has a probability of 16% of reaching non-investability grade. The index should be above a minimum of two to reach probabilities less than 2%. From 2013 onwards the cycle 3 is lower compared with cycle 2 simulating the financial crises period. The reason can be explained by CPI PHL and WPI PHL rates which have a further expansion of 0.54 SD in cycle 2 compared to cycle 3. The CPI US and PPI US rates are negatively correlated to CPI PHL and WPI PHL in cycle 2. Both inflation rates CPI US and PPI US disperse by 0.8 SD and one SD in cycle 2 respectively. The FX rate disperses additional 0.3 SD compared with cycle 3.

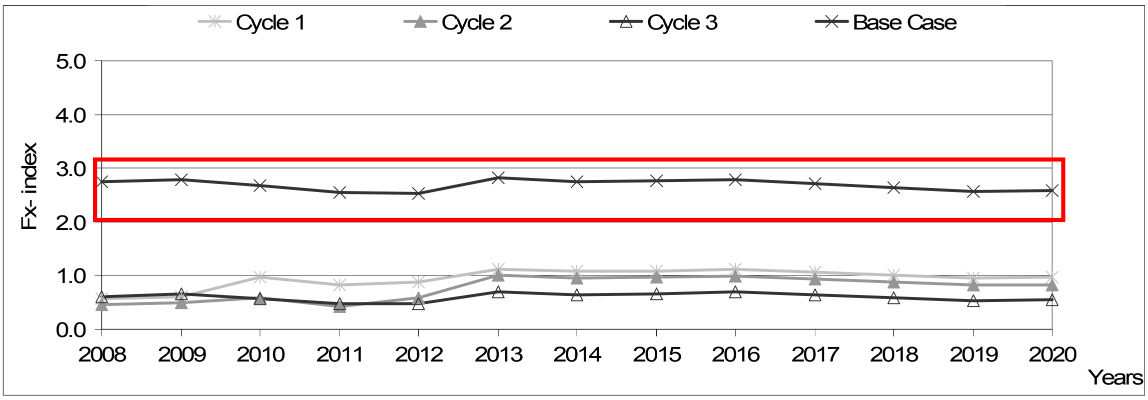

Figure 4-15: *FX index - Philippines*

In Malaysia the base case of the FX index is between 4.5 and 5.5. Variables disperse on average an additional 2.95 SD compared with Indonesia and disperse an additional 2.46 SD compared with the Philippines.

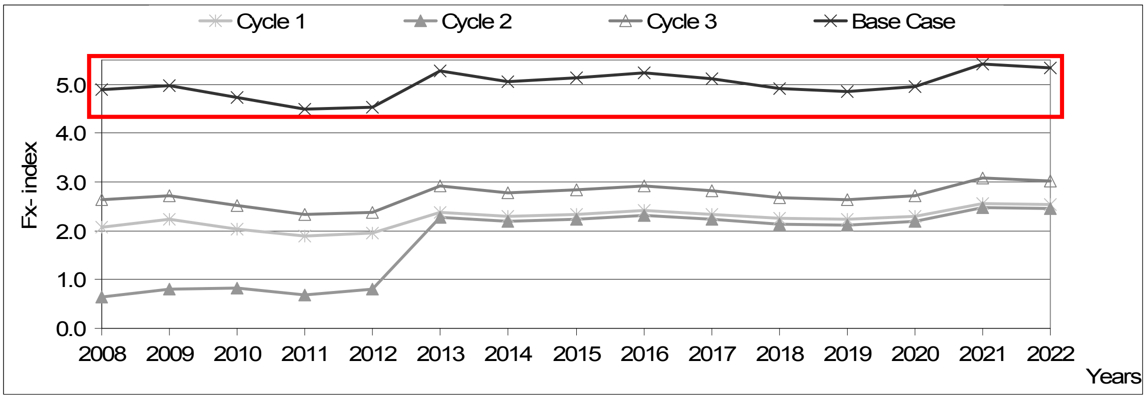

Figure 4-16: *FX index - Malaysia*

For additional information, Appendix 2 shows the FX index for the defined cycles compared with the DSCR. It shows that the DSCR increases with repayments of interest and principal and would not be a good indicator of financial feasibility to absorb economic FX exposure in the project.

The following graphs illustrate the dependency between the FX index and the probability of reaching non-investability. Figures 4-17 to 4-19 illustrate cycle 2 during the Asian financial crisis. The higher the FX index, the more reliably can the project absorb FX fluctuations. Therefore, the FX index and the probability of non-investability always move in the opposite direction. In Indonesia the FX index is constant below 0.6, indicating a probability of non-investability larger than 27% during the whole concession period.

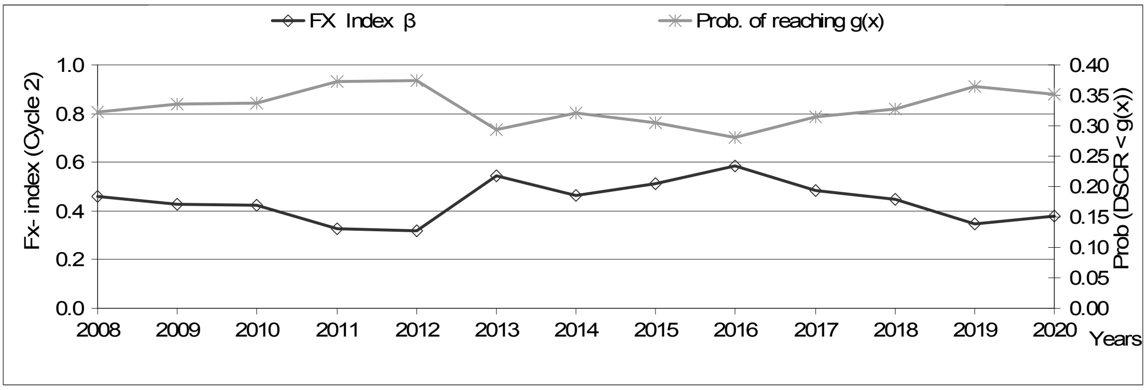

Figure 4-17: *FX index and probability of reaching g(x) in the case of Indonesia*

In the Philippines the FX index reaches nearly 1.0 during 2013 to 2016 in cycle 2. Consequently, the probability of reaching non-investability decreases from 34% to 15% during the period 2011 to 2013. The probability of non-investability is therefore much lower from 2013 to 2020 than the Indonesian market.

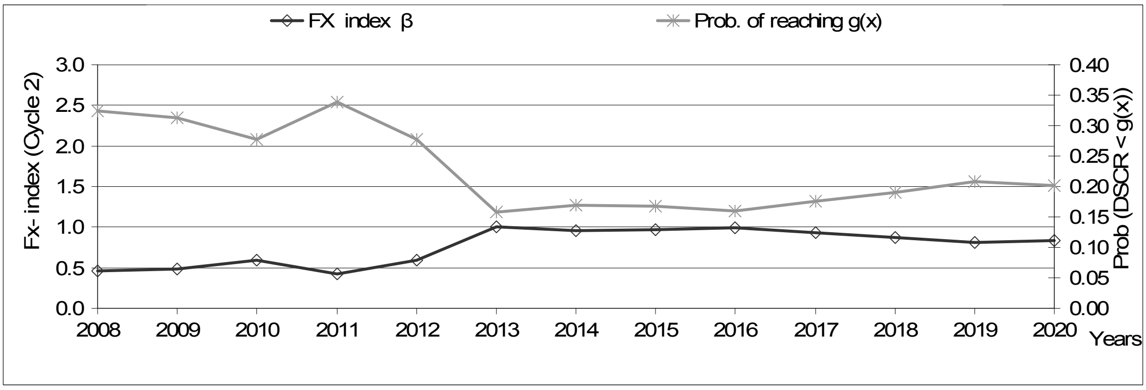

Figure 4-18: *FX index and probability of reaching g(x) in the case of the Philippines*

Cycle 2 has the lowest impact in the Malaysian case. The probability of non-investability is significant until the year 2012. Between the years 2012 and 2020 the probability of non-investability decreases below 2%.

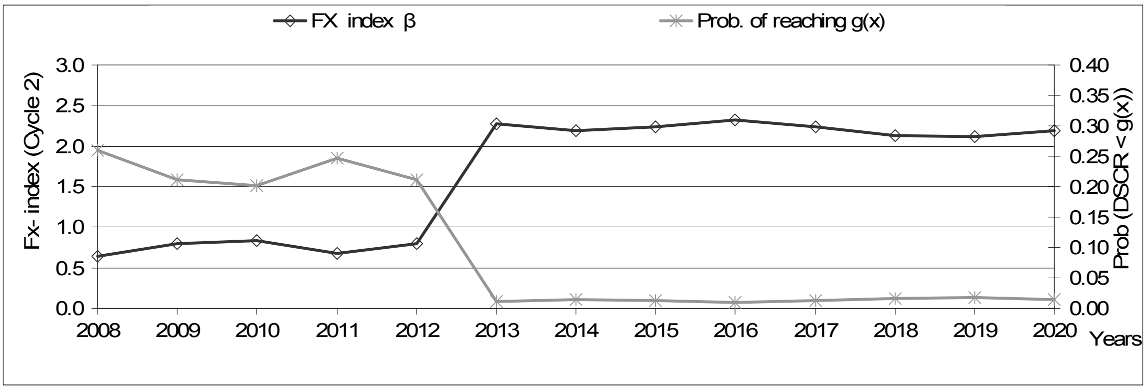

Figure 4-19: *FX index and probability of reaching g(x) in the case of Malaysia*

The actual dollar value is computed based on the FX index and the probability of non-investability as shown in equation 4-15 and 4-16. Figures 4-20 to 4-25 show the economic FX exposure on net operating revenue and dividends for all cycles in Indonesia, the Philippines, and Malaysia. Cycle 1 and the base case indicate no FX exposure in Indonesia. Cycle 2 and cycle 3 are significantly different, as shown in Figure 4-20. However, cycle 2 represents the absolute worst case during the Asian financial crises. The absolute value of USD 11 million FX exposure in the year 2012 would represent 28% of the net operating revenue. The highest value of USD 14.6 million represents 21.5% of the net operating revenue in the year 2020 (Appendix 4-10). The probabilities of reaching g(x) and the percentages of FX exposure on net operating revenue, dividends and net cash flow in cycle 1, cycle 3 and base case are illustrated in Appendix 4.

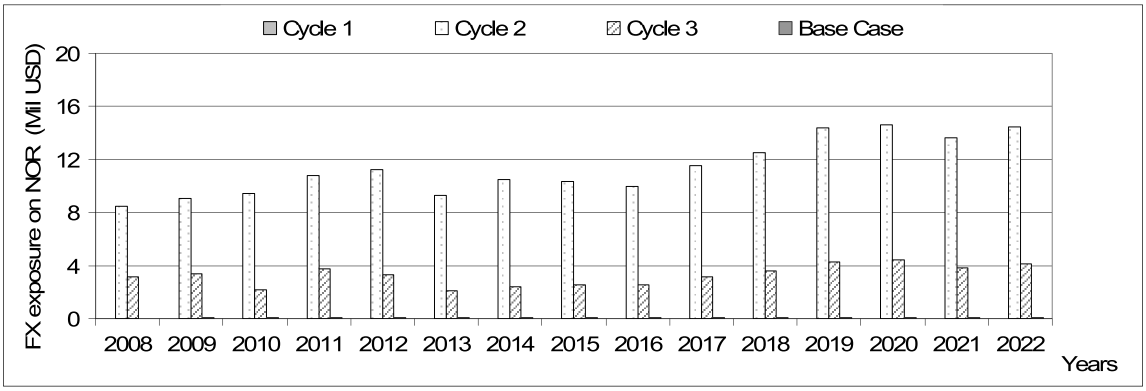

Figure 4-20: *FX exposure on net operating revenue - Indonesia*

The highest percentages of FX exposure on dividends occur from 2008 to 2012. During this time period the dividends are lower than in the later years, due to a higher FX exposure measured as percentage of dividends. As shown in Figure 4-21, cycle 3 has FX exposure of USD 1.3–2.5 million and in cycle 2 USD 2.9–7.8 million in absolute values. The values of FX exposure on dividends are lower than net operating revenue.

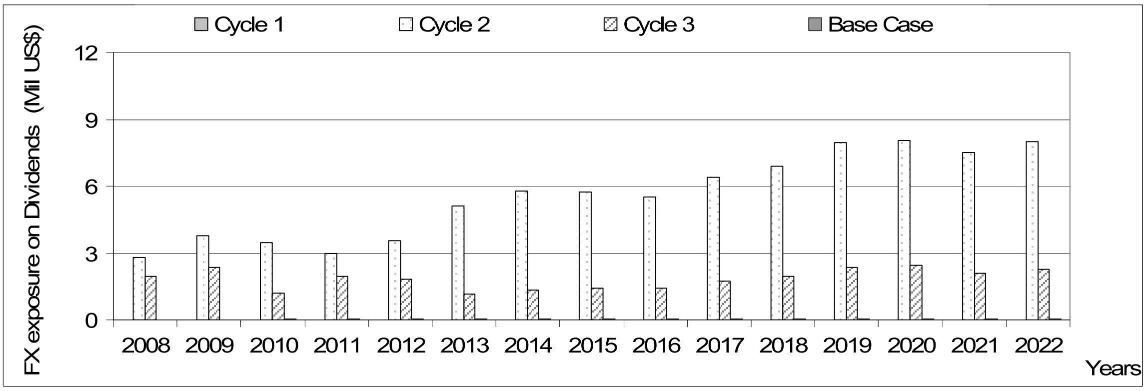

Figure 4-21: *FX exposure on dividends in Indonesia*

The base case has no economic FX exposure on net operating revenue and dividends in the Philippines. Cycle 2 and cycle 3 have less volatility between the market variables. Consequently, cycle 1 and cycle 3 illustrate lower absolute values compared with Indonesia. The FX exposure on net operating revenue varies from USD 1.8 to 3.9 million in cycle 1, from USD 3.9 to 5.9 million in cycle 2, and from USD 1.9 to 2.8 million in cycle 3.

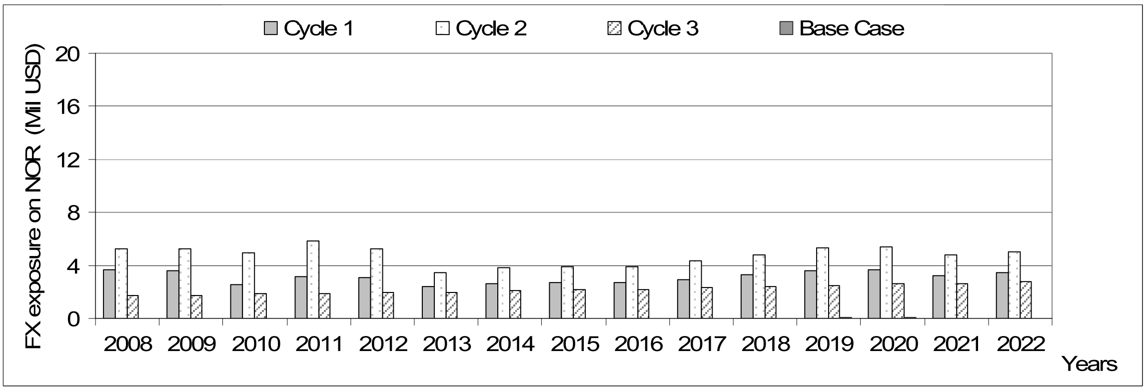

Figure 4-22: *FX exposure on net operating revenue in the Philippines*

Figure 4-23 shows that the differences between cycle 1 and cycle 3 on dividends are highest from 2008 to 2012, except 2010, and from 2018 to 2022. The FX exposure on dividends varies from USD 1.5 to 2.6 million in cycle 1, from USD 2.0 to 3.1 million in cycle 2, and from USD 1.0 to 1.5 million in cycle 3. The base case has zero probability of reaching non-investability and therefore no FX exposure. The percentage of FX exposure on dividends is largest with 30% during 2008 to 2012 in cycle 2. From 2012 to 2020 the percentage of FX exposure decreases below 10% in all cycles (Appendix 4-16).

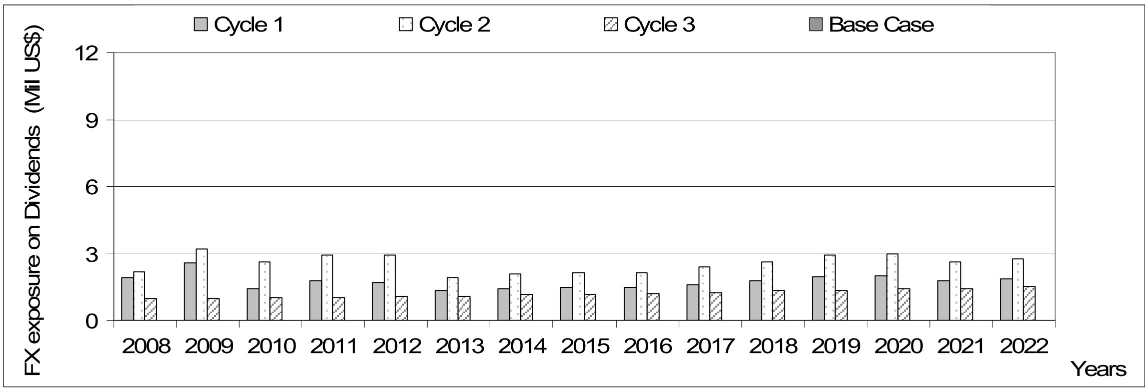

Figure 4-23: *FX exposure on dividends in the Philippines*

In Malaysia the only significant FX exposure is experienced in cycle 2 in the initial years of 2008 to 2012, as shown in Figure 4-24. During that time period it reaches around 15% of the net operating revenue with an absolute value of USD 5.3–6.6 million (Appendix 4-22).

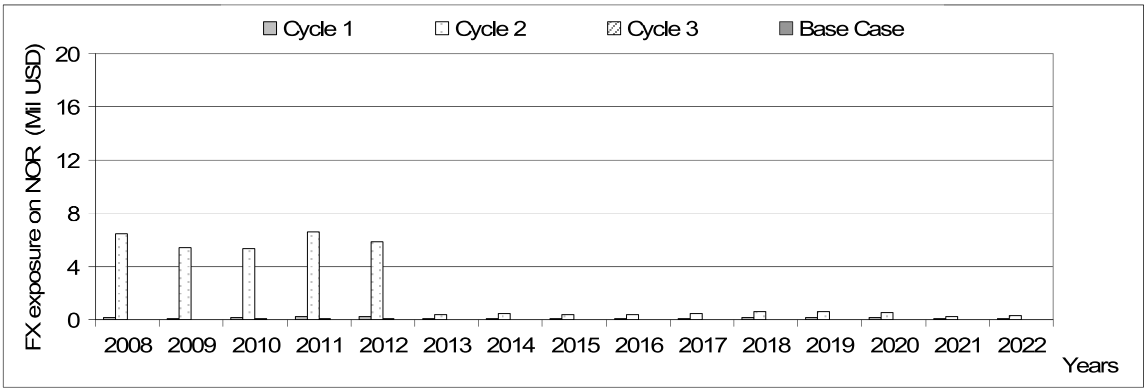

Figure 4-24: *FX exposure on net operating revenue in Malaysia*

The absolute value of FX exposure on dividends is lower compared with net operating revenue, varying from USD 1.8 to 2.9 million. Nevertheless, the FX exposure reaches around 30% of the amount of dividends in year 2012.

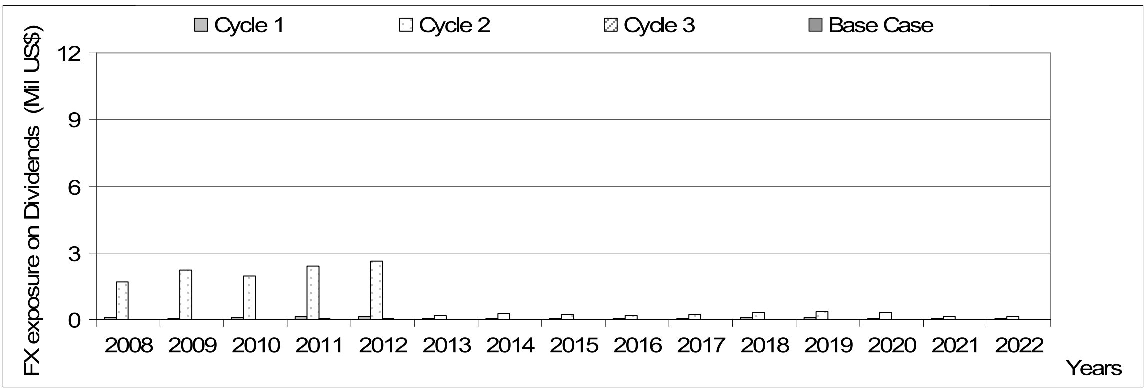

Figure 4-25: *FX exposure on dividends in Malaysia*

Appendix 4 shows a detailed analysis of FX exposure as percentage and absolute values on net operating revenue, dividends and net cash flow. Overall, the case study shows the importance of economic FX risk modelling in PPP infrastructure projects. Table 4-16 lists the range of economic FX exposure in all markets on the net operating revenue. The range includes the values with FX index below 2.0 which indicates a higher probability of 2% to reach non-investability grade. The probability of 2% could be a base line to structure the project. The base line will vary based on the risk appetite. Indonesia shows the highest potential of economic FX exposure as well as the highest differences between the cycles. Investors can decide if they should price the most negative scenario of cycle 2, indicating the Asian financial crises, or if they should follow the pattern of the last five years by adopting the lower end of the computed economic FX exposure. In both cases investors would have an indicator of how deeply currency devaluation can affect the project and they can compute a most likely case by replicating the history. The Philippines scenario illustrates much lower economic FX exposure as well as a narrower range compared to Indonesia. In Malaysia the project only shows economic FX exposure from 2008 to 2012. After this period the FX index is above 2.0 for all cycles.

Table 4-16: *FX exposure on net operating revenue (NOR)*

	Indonesia		Philippines		Malaysia	
Years	FX exposure (Mil USD)	FX exposure on NOR (%)	FX exposure (Mil USD)	FX exposure on NOR (%)	FX exposure (Mil USD)	FX exposure on NOR (%)
2008	3.2 - 8.5	7.4% - 19.9%	1.8 - 5.2	4.5% - 13.6%	6.41	16.2%
2009	3.4 - 9.1	7.7% - 20.8%	1.8 - 5.2	4.2% - 12.6%	5.40	12.5%
2010	2.2 - 9.5	4.8% - 20.9%	1.9 - 4.9	4.3% - 11.5%	5.32	11.9%
2011	3.8 - 10.7	9.5% - 27.0%	1.9 - 5.9	4.7% - 14.6%	6.60	15.3%
2012	3.3 - 11.2	7.9% - 27.1%	2.0 - 5.2	4.6% - 12.1%	5.85	12.6%
2013	2.1 - 9.3	3.5% - 15.4%	2.0 - 3.5	3.4% - 5.9%	-	-
2014	2.4 - 10.5	4.0% - 17.5%	2.1 - 3.8	3.6% - 6.5%	-	-
2015	2.6 - 10.3	4.0% - 16.4%	2.1 - 3.9	3.4% - 6.2%	-	-
2016	2.6 - 9.9	3.8% - 14.6%	2.2 - 3.9	3.3% - 5.8%	-	-
2017	3.1 - 11.6	4.7% - 17.4%	2.3 - 4.3	3.4% - 6.5%	-	-
2018	3.6 - 12.5	5.4% - 18.9%	2.4 - 3.8	3.6% - 7.1%	-	-
2019	4.3 - 14.4	6.7% - 22.8%	2.5 - 5.3	3.7% - 7.9%	-	-
2020	4.4 - 14.6	6.5% - 21.5%	2.6 - 5.4	3.6% - 7.5%	-	-
2021	3.8 - 13.6	4.5% - 16.2%	2.7 - 4.8	3.1% - 5.5%	-	-
2022	4.1 - 14.5	4.8% - 16.7%	2.8 - 5.1	3.1% - 5.7%	-	-

4.12.2. Validation of the FEE model with Monte Carlo Simulation

Table 4-17 illustrates a comparison between the FEE methodology versus Monte Carlo simulations in the case of the Philippines. The computation time of the two methods show a significant advantage of around six minutes for the FEE methodology, compared with 30 minutes for the Monte Carlo simulation. Both probabilities are computed with 1.8 GHz CPU and 10,000 simulation trials in the Monte Carlo simulation and a maximum of 300 iterations with a minimum precision of 0.01% in the FEE methodology. The computation time depends on the complexity of the financial model. The trend shows that the Monte Carlo simulation takes much more computation time if the dependencies between the variables increase. The time advantage becomes even more significant when comparing several economic cycles. Consequently, the aggregated time advantage of three cycles in the case study is 17 minutes for the FEE methodology and 89 minutes for the Monte Carlo simulation. Due to the stochastic character of both methods, the probability of reaching non-investability grade depends on the numbers of simulation trials with the Monte Carlo simulation. Under the assumptions of the case study, both methods show a maximum variation of 4% in the results of the probability of non-investability.

Table 4-17: *Beta dispersion ellipsoid versus Monte Carlo Simulation*

Years	Cycle 1							Cycle 3							Base Case						
	Feasibility index β				Monte Carlo (10000 Trials)			Feasibility index β				Monte Carlo (10000 Trials)			Feasibility index β				Monte Carlo (10000 Trials)		
	β	Φ(-β)	Time		Φ(-β)	Time		β	Φ(-β)	Time		Φ(-β)	Time		β	Φ(-β)	Time		Φ(-β)	Time	
			min	sec		min	sec			min	sec		min	sec			min	sec		min	sec
2008	0.57	0.28		23	0.32	1	54	0.61	0.27		23	0.29	2	2	2.75	0.00		21	0.00	1	46
2009	0.61	0.27		23	0.29	1	35	0.66	0.26		23	0.26	1	53	2.78	0.00		21	0.00	2	3
2010	0.98	0.16		23	0.18	2	5	0.56	0.29		23	0.29	2	7	2.67	0.00		21	0.00	1	45
2011	0.82	0.21		23	0.22	1	56	0.47	0.32		23	0.31	2	7	2.54	0.01		21	0.01	2	3
2012	0.88	0.19		23	0.18	1	45	0.47	0.32		23	0.32	2	7	2.53	0.01		21	0.01	1	45
2013	1.11	0.13		24	0.13	1	47	0.69	0.24		23	0.25	1	53	2.82	0.00		22	0.00	2	3
2014	1.08	0.14		25	0.13	1	56	0.65	0.26		23	0.27	1	45	2.75	0.00		21	0.00	1	48
2015	1.09	0.14		25	0.15	2	6	0.66	0.25		25	0.24	1	65	2.76	0.00		21	0.00	2	6
2016	1.11	0.13		25	0.14	2	9	0.69	0.25		25	0.23	1	53	2.79	0.00		21	0.00	1	48
2017	1.06	0.14		25	0.18	2	14	0.64	0.26		25	0.26	1	43	2.71	0.00		21	0.00	1	39
2018	1.01	0.16		25	0.18	1	58	0.59	0.28		25	0.28	1	54	2.64	0.00		21	0.00	2	9
2019	0.95	0.17		25	0.19	2	3	0.54	0.30		25	0.30	2	34	2.56	0.01		21	0.01	2	2
2020	0.97	0.17		25	0.17	2	12	0.55	0.29		25	0.29	2	23	2.58	0.00		21	0.01	1	47
2021	1.11	0.13		25	0.13	2	10	0.68	0.25		25	0.26	2	12	2.74	0.00		21	0.00	1	45
2022	1.09	0.14		25	0.15	2	1	0.67	0.25		25	0.25	2	23	2.70	0.00		21	0.00	1	12
Computation time (min)			**6**			**30**				**6**			**31**				**5**			**28**	

Furthermore, the FEE methodology is an extra tool which is linked to the financial models. Therefore, the methodology needs to be developed just once, and only the input variables are linked to the financial models. As a result, the whole modelling process becomes much simpler compared with the Monte Carlo simulation. A Monte Carlo simulation is normally built up and integrated in the financial models.

In addition, the FX index can be derived by both methodologies. The FEE methodology would compute the FX index directly as an outcome of the simulation. The Monte Carlo simulation provides the probability of non-investability, and from there the FX index can be computed indirectly.

4.12.3. Test of estimated FX exposure versus actual FX exposure in Case Study B

Since the case study has been conducted under a confidentiality agreement, the name of the project and the parties involved will not be mentioned. The case study is a coal-fired power plant with a project concession period of 30 years with an additional four-year construction period. The project size is a capacity of 2 x 670 MW (gross) with a total estimated construction cost of USD 1820 million. The case study's capital expenditures are denominated in USD and IDR and its sources of funding are, likewise, available in these currencies. The debt/equity ratio of the project is 73%:27%. The senior debt tranches covers USD 954 million and subordinated debt tranches cover USD 374 million. The power purchase agreement has a 83% dependable capacity. A tariff structure with two capacity components and two energy components are implemented in the project. All components are adjusted to the extent the IDR/USD exchange rate differs from a defined base exchange rate. The IDR portion and USD portion of one capacity component and one energy component are adjusted annually for changes in the Indonesian and US consumer price indexes respectively. Case Study B is used to validate the FEE model in terms of estimated FX exposure versus actual FX exposure. Comparing the values derived, it can be shown that the FX index captures potential FX exposure. The potential FX exposure can in fact be substantial.

As in case study A, cycle 1 is applied during the time period of 1989 to 1997 and cycle 3 during the time period of 2002 to 2008. Economic FX exposure arises from capital expenditure being different from those in which funding is available to meet that expenditure. The second source of FX risk arises from revenue mismatches with currency of tariff revenues being different from O&M costs including debt service.

The correlation matrix and the fitted PDFs are shown in Table 4-18. The base case scenario has the same correlation assumptions as cycle 3.

Table 4-18: *Correlation matrix*

		Cycle 1 (1989-1997)					Cycle 3 (2002-2008)				
		CPI IDN	PPI IDN	CPI US	WPI US	IDR/USD	CPI IDN	PPI IDN	CPI US	WPI US	IDR/USD
CPI IDN	Pearson Correlation	1	0.183	-0.207 *	-0.173	0.304 **	1	0.486 **	0.321 **	-0.061	0.461 **
	Sig. (2-tailed)	.	0.074	0.043	0.092	0.003	.	0.000	0.007	0.619	0.000
	N	96	96	96	96	96	69	69	69	69	69
PPI IDN	Pearson Correlation	0.183	1	0.411 **	0.726 **	0.066	0.486 **	1	0.768 **	0.539 **	0.646 **
	Sig. (2-tailed)	0.074	.	0.000	0.000	0.523	0.000	.	0.000	0.000	0.000
	N	96	96	96	96	96	69	69	69	69	69
CPI US	Pearson Correlation	-0.207 *	0.411 **	1	0.556 **	-0.782 **	0.321 **	0.768 **	1	0.831 **	0.361 **
	Sig. (2-tailed)	0.043	0.000	.	0.000	0.000	0.007	0.000	.	0.000	0.002
	N	96	96	96	96	96	69	69	69	69	69
WPI US	Pearson Correlation	-0.173	0.726 **	0.556 **	1	-0.221 *	-0.061	0.539 **	0.831 **	1	0.011
	Sig. (2-tailed)	0.092	0.000	0.000	.	0.031	0.619	0.000	0.000	.	0.931
	N	96	96	96	96	96	69	69	69	69	69
IDR/USD	Pearson Correlation	0.304 **	0.066	-0.782 **	-0.221 *	1	0.461 **	0.646 **	0.361 **	0.011	1
	Sig. (2-tailed)	0.003	0.523	0.000	0.031	.	0.000	0.000	0.002	0.931	.
	N	96	96	96	96	96	69	69	69	69	69

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

The fitted PDFs are equal in cycle 3 and the base case assumptions except for the mean value of the FX rate. All FX rates are adjusted to the spot rate in the base case (Table 4-19).

Table 4-19: *Fitted probability density functions*

Cycle 1: 1989-1997

		Distributions	μ	σ
i_1	CPI IDN	Triangular	8.36	1.54
i_2	WPI IDN	Lognormal	7.01	4.12
i_3	CPI US	Lognormal	3.62	1.36
i_4	PPI US	Normal	2.26	2.02
FX	FX rate	Normal	9656	482

Cycle 3: 2002-2008

		Distributions	μ	σ
i_1	CPI IDN	Lognormal	9.17	4.64
i_2	WPI IDN	Normal	9.54	6.90
i_3	CPI US	Lognormal	2.85	0.91
i_4	PPI US	Normal	4.52	4.04
FX	FX rate	Normal	10801	482

Base Case

		Distributions	μ	σ
i_1	CPI IDN	Lognormal	9.17	4.64
i_2	WPI IDN	Normal	9.54	6.90
i_3	CPI US	Lognormal	2.85	0.91
i_4	PPI US	Normal	4.82	4.04
FX	FX rate	Normal	9412	482

Figure 4-26 illustrates the computed FX indices for cycle 1, cycle 3 and the base case. The fitted distributions of cycle 3 and base case would not be known during the time period of 1999 to 2008. The index illustrates the feasibility of covering FX exposure by measuring by how many standard deviations of the feasibility function the expected condition reaches the defined investability grade.

The FX index of the base case is around 2 SD higher compared with cycle 3 except in the year 2003. In 2003 the FX rates increase by an additional 0.5 SD in the base case together with a 1.75 SD increase in US CPI rates compared with cycle 1. Cycle 1 and cycle 3 move in synchrony in direction, but change in the differences of SD. The FX index has peaks in 2001, 2005 and 2010 in all cycles, which reflects a change in replacement costs.

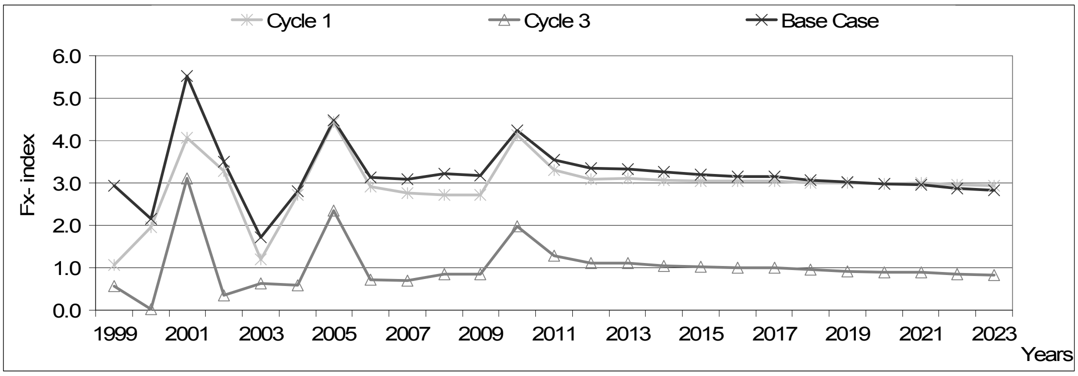

Figure 4-26: *FX index in case study B*

The FX index always refers to the underlying cash flow position. Therefore, the FX index can have different FX exposure depending on the size of the cash flow position. Figures 4-27 to 4-28 show the FX exposure on net operating revenue in percentage and absolute values. The base case and cycle 1 have FX indices higher than 3.0 in the years 2001, 2002 and 2005. Figure 4-27 shows no FX exposure during these years. Cycle 3 has the lowest FX indices and the highest FX exposure with 13.2% in the year 2000 and 12.4% in 2003. Cycle 3 and base case show FX exposure between 8% to 13% on net operating revenue by excluding 2001, 2002 and 2005. Interestingly, cycle 1 and base case have an FX index of 4.4 in year 2005, but cycle 1 shows no FX exposure. The reasons are the correlation assumptions and the fitted PDFs. The FX index is mainly influenced by the inflation rates of 4.45 SD of WPI-IND, 1.98 SD of CPI-US and 3.28 SD of PPI-US. However the mean value of the FX rate PDF in cycle 1 is very close to the actual FX rate in the year 2005 which results in zero FX exposure by applying cycle 1.

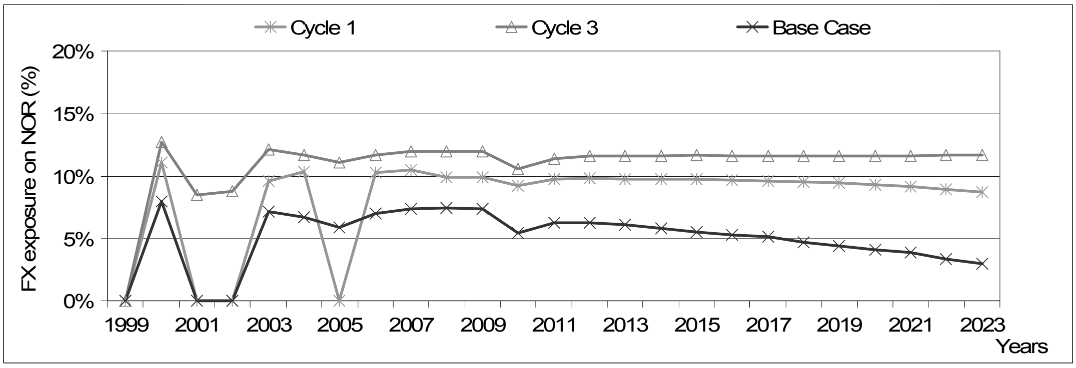

Figure 4-27: *Percentage FX exposure on net operating revenue*

The absolute vales of FX exposure on net operating revenue are shown in Figure 4-28. The maximum values are shown in cycle 3. Figure 4-28 shoes a constant growth from 2011 onwards, while the percentage change in Figure 4-27 is nearly linear. The reason can be explained by a nearly constant growth in net operating revenues. The maximum difference of 9% between base case and cycle 3 are equal an absolute value of around USD 80 million in the case study.

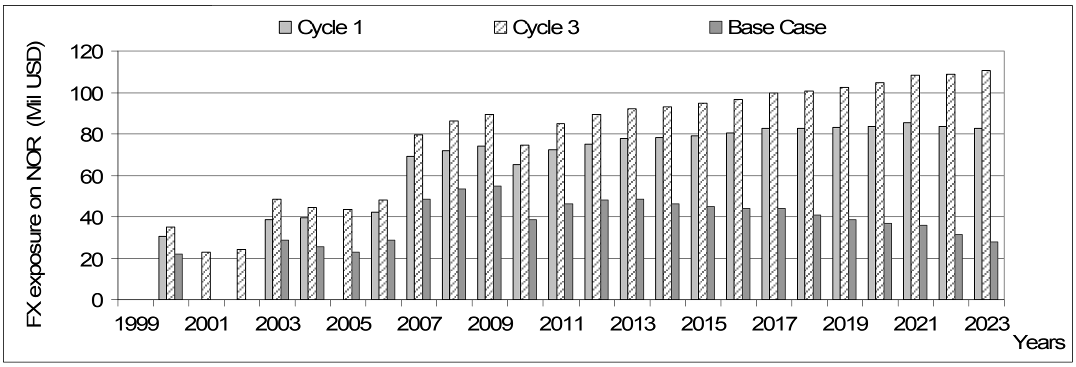

Figure 4-28: *Absolute values of FX exposure on net operating revenue*

In year 2006 the first payment on dividends results in a peak of FX exposure by over 50% in cycle 3 as shown in Figure 4-29. The percentage amount depends on the size of dividends which is only 15% in years 2006 compared to the year 2007.

Therefore the absolute values of FX exposure in 2006 are only half the amount in 2007 as indicated in Figure 4-30.

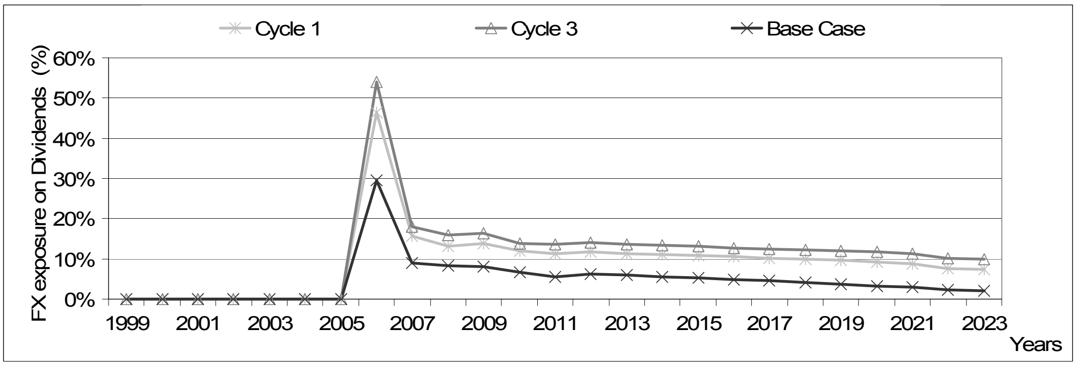

Figure 4-29: *Percentage FX exposure on Dividends*

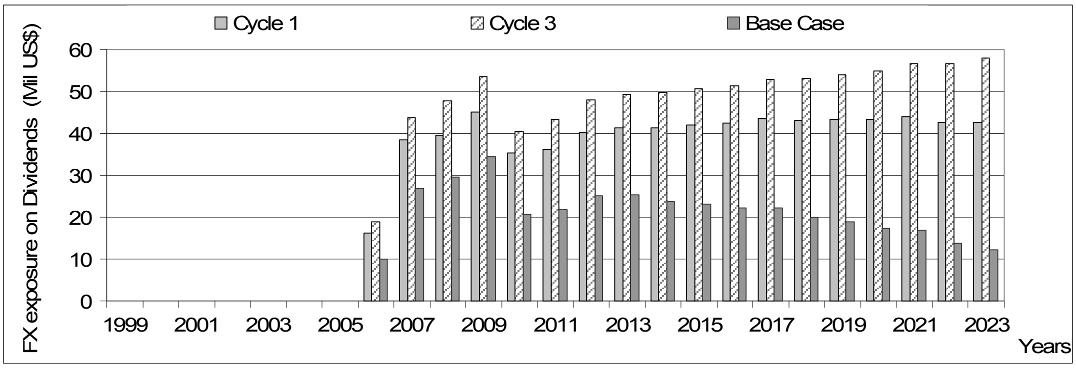

Figure 4-30: *Absolute values of FX exposure on Dividends*

Additional to the net operating revenue includes the net cash flow principal and interest rates plus income tax. As shown in Figure 4-32 the absolute values of FX exposure are only half or less during 2003 to 2006 compared to 2007. The percentage vales of FX exposure on net cash flow as shown in Figure 4-31 are higher during these years because of lower cash flow values of net cash flow. From 2007 onwards the percentage values of FX exposure on net cash flow are similar the percentage values on net operating revenue which is caused by the annuity repayments for all tranches. If the repayment would happen in bullet payments or tailored repayments the percentage values would differ between operating cash flow and net cash flow.

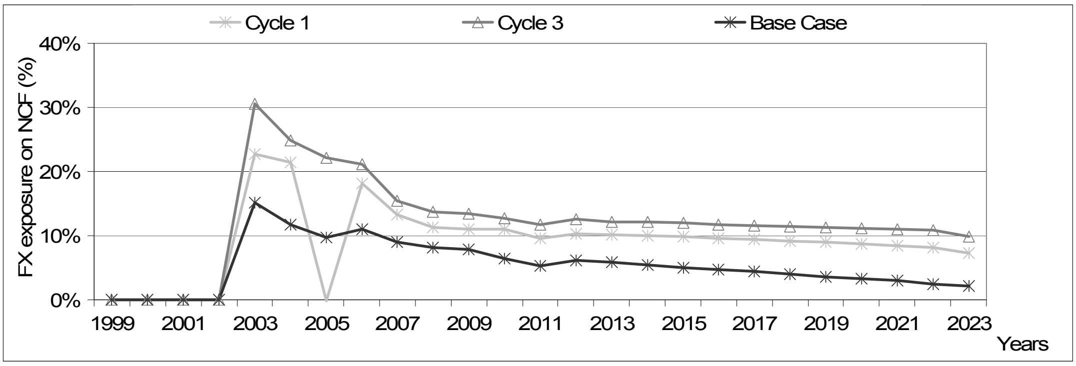

Figure 4-31: *Percentage FX exposure on net cash flow*

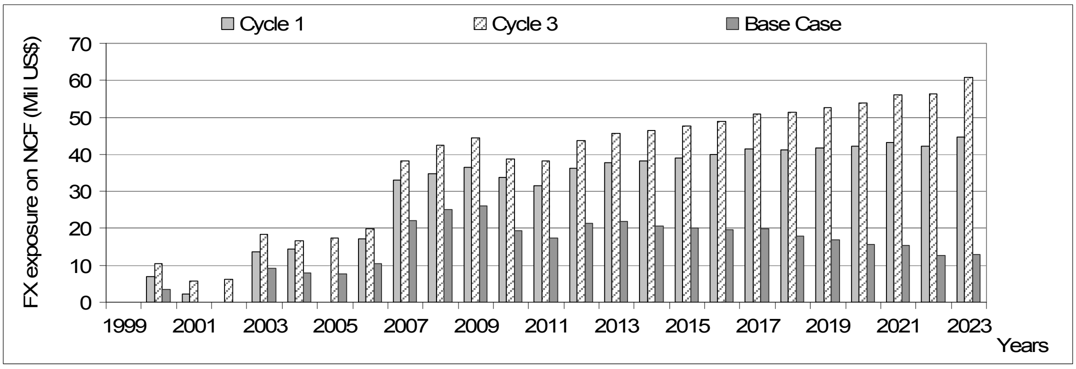

Figure 4-32: *Absolute values of FX exposure on NCF*

The Figures 4-33 to 4-35 illustrate the actual FX exposure with the base exchange rate in the year 2000 compared to the computed FX exposure by applying the distributions and correlation assumptions during the defined cycles in the FEE methodology. The line illustrates actual FX exposure is mostly below the expected FX exposure computed by the defined cycles. The model forecasts much higher FX exposure in the year 2003 where the real FX exposure was nearly zero. In 2001 and 2002 the FX exposure is only shown by cycle 3 and would be below the actual FX exposure in the year 2001. To increase the accuracy it is necessary to scale the model in annual, monthly or weekly cycles by applying daily rates.

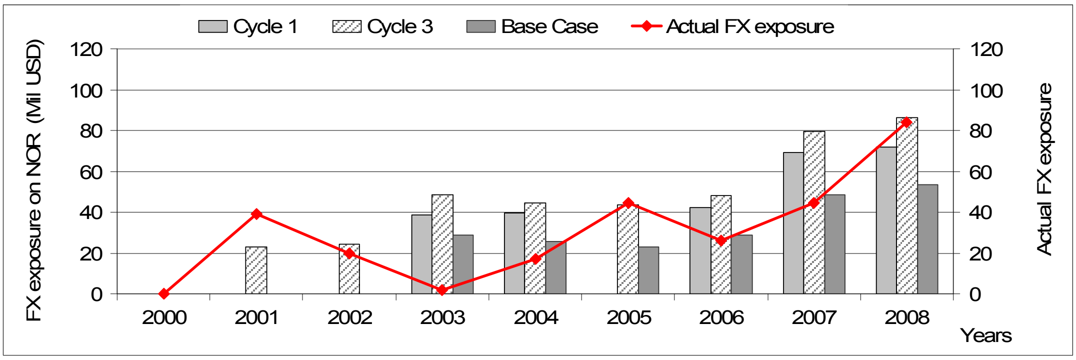

***Figure 4-33**: Actual FX exposure on NOR versus computed FX exposure*

Cycle 3 shows only 6% variance between the computed and the actual FX exposure on dividends in the years 2006 and 2008. However, in 2007 the forecast would be significantly higher. Overall the applied cycles show the trend in the actual FX exposure (Figure 4-34).

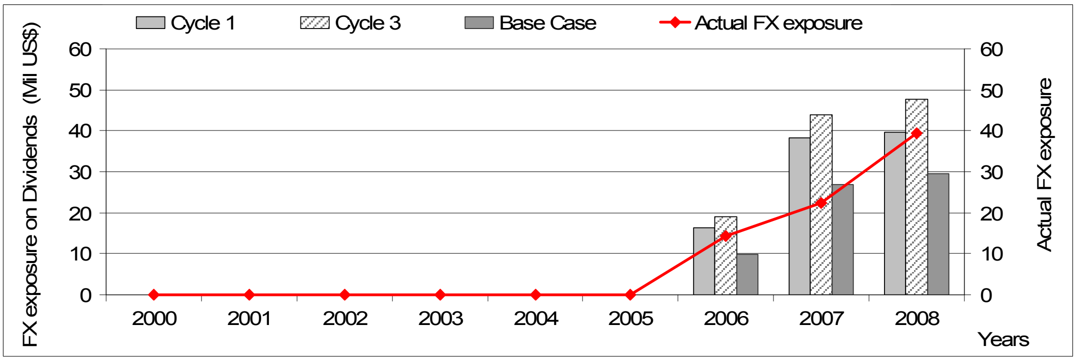

***Figure 4-34:** Actual FX exposure on dividends versus computed FX exposure*

Figure 4-35 shows the actual FX exposure is above the computed FX exposure during the years 2001, 2002 and 2005. Similar to the comparison on NOR, the model forecasts much higher FX exposure in the year 2003. From year 2000 to 2001 there is a significant devaluation in exchange rates. The computed FX exposure is much lower compared with the actual exposure because of an excessively low mean value in the fitted PDFs of the exchange rate. The larger currency devaluations can be covered by applying annual or monthly cycles.

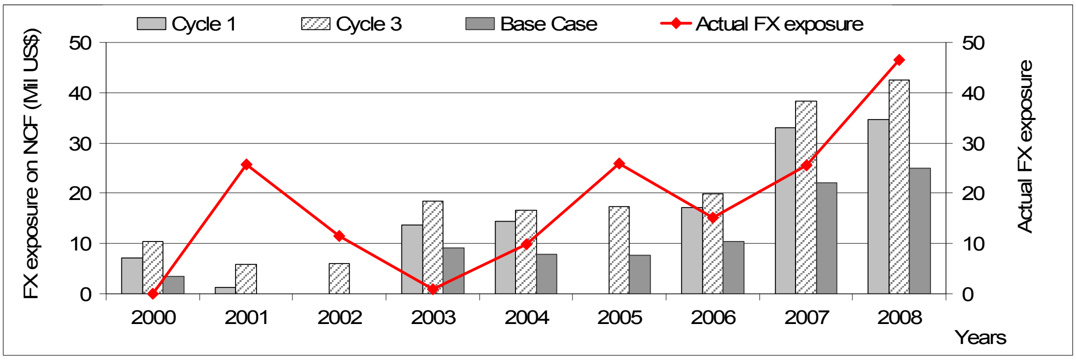

Figure 4-35: *Actual FX exposure on NCF versus computed FX exposure*

4.13. Summary

The FX index represents a strategic component of the set of quantitative tools. It is a transparent methodology to address uncertainties of economic FX exposure in PPP projects. It is common practice in project finance to apply scenarios and to monitor the impact on financial ratios such as DSCR or LLCR. However, the contribution of the FX index is to estimate the potential FX exposure by applying historical data. The FX exposure index is unit independent and allows comparisons of different projects in different markets. The index can be used as a monitoring tool for performing FX exposure and return analysis. The index has been designed to act as an assessment system to evaluate the sponsor's FX exposure by monitoring changes in the market condition. It accounts for the particular features of a project through adjustments to input data based on the specific project variables. Based on the information aggregated by the FX index, investors have a means to estimate the length of time the project could withstand a FX loss and how well the project is prepared to capture FX exposure. The model can be applied to infrastructure projects such as power, water supply and transportation. It will also assist project sponsors in evaluating critical variables that they need to control. The case study shows that the FX index is a contribution to the traditional risk modelling framework and a fast and robust way to determine the economic FX risk exposure.

CHAPTER 5

Modelling country reliability

As described in chapter 3 governments frequently implement RMIs to compensate FX loss. However, the value of RMIs depends on the affordability and the willingness of the government to compensate unforeseen FX fluctuation in the project. Therefore, the overall objective in this chapter is to analyze possible RMIs and to design a methodology to value RMIs by simulating country risk. Acting as an assessment system, the model includes a country reliability risk index. The country reliability risk index is developed and simulated in a Conditional Credit Rating Transition Matrix.

5.1. Computation of the CRR Index

Country reliability risk can be defined as the risk of loss arising from the failure of public authorities to exercise agreed risk mitigation instruments. The country reliability risk (CRR) model in Figure 5-1 is designed to evaluate specific risk mitigation instruments such as tariff adjustment mechanisms or governmental guarantees. The value of a risk mitigation instrument depends on the affordability and willingness of the government to compensate contingent claims on RMIs. Therefore, the purpose of the CRR model is to generate and aggregate an opinion about the reliability of the country in performance on RMIs. Figure 5-1 shows the core structure of the model. Based on proxies, the CRR index is modelled in a Conditional Country Rating Transition Matrix (CCRTM) to predict default probabilities on RMIs.

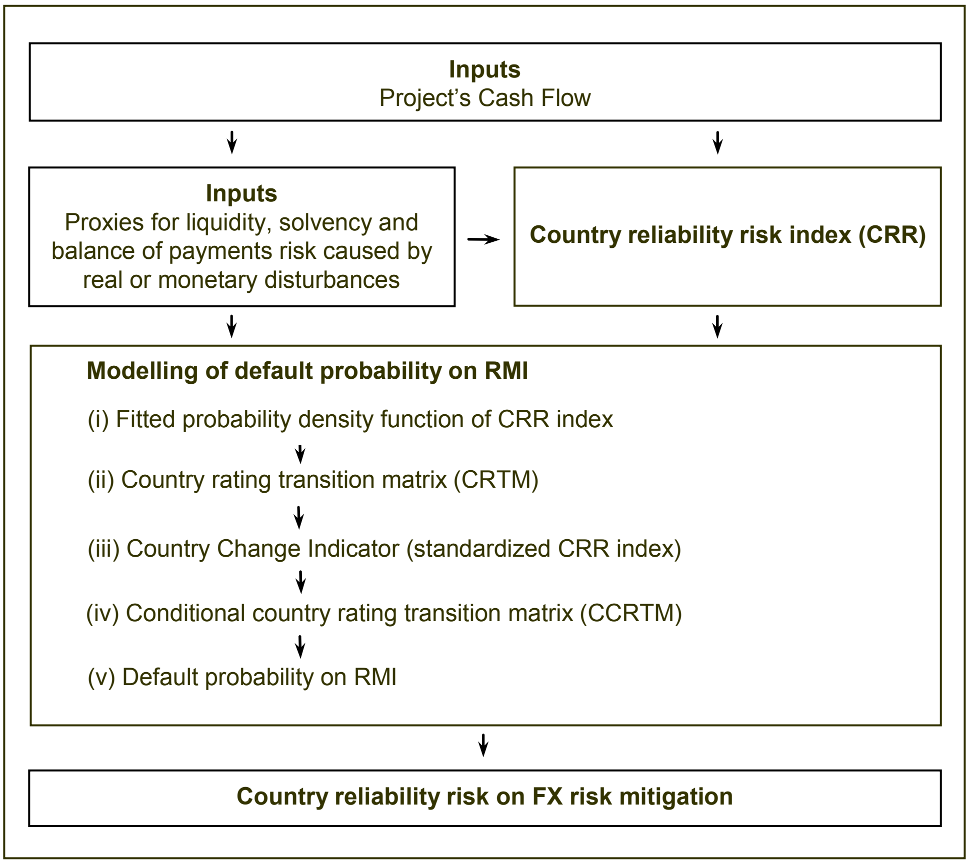

***Figure 5-1:** Country reliability risk model*

Factors influencing country reliability can be identified in the government's ability to repay debt obligations, liquidity difficulties and political difficulties. According to Ciarrapico (1992), proxies for country risk regarding payment feasibility may be found in indicators like balance-of-payment difficulties, liquidity difficulties and political difficulties. Ciarrapico (1992) chose four proxies as significant explanatory variables for country reliability risk evaluation: (i) growth of money supply (M2), which serves as proxy for balance-of-payments difficulties due to monetary risk, (ii) growth of exports, which measures balance-of-payments risk due to real disturbances, (iii) growth of international reserves, and (iv) growth of reserves to imports, both of which serve as proxies for liquidity risk. The CRR index is computed with six dimensionless ratios. The data are from the International Financial Statistics (IFS) database and listed in Appendix 5.

All the ratios are identified from the literature and tested in a regression analysis versus the foreign currency long term debt ratings. In total 243 data points are obtained from the IFS database during the time period from 1989 to 2009. The proxies chosen to develop the CRR index include: (i) growth of M2 (IFS line 34+35), (ii) growth of exports (IFS line 70), (iii) growth of foreign reserves (IFS line 1.D.D), (iv) M2 to foreign reserves (IFS line 34+35 and 1.D.D), (v) foreign assets to foreign liabilities (IFS line 21 and 26C), and (vi) growth in domestic debt (IFS line 32AN, 32B, 32C). Ratios (i) and (ii) are proxies for solvency risk focusing on balance of payments risk caused by monetary and real disturbances, respectively, while ratios three to six are liquidity risk proxies for debt rescheduling and financial leverage. The weights attached to the ratios of the index are the inverse of the standard deviation for each series, in order to equalize volatilities of the five components and to avoid any of them dominating the index. Each factor is expressed in the rate of change in the ratios. The formulation of the aggregated index is described in equation 5.1 as follows:

$$CRR = (1/\sigma_{M2})(\frac{\Delta M2}{M2}) + (1/\sigma_R)(\frac{\Delta R}{R}) + (1/\sigma_E)(\frac{\Delta E}{E}) + (1/\sigma_{M2/FR})(\frac{\Delta(M2/FR)}{M2/FR}) +$$
$$+ (1/\sigma_{FA/FL})(\frac{\Delta(FA/FL)}{FA/FL}) - (1/\sigma_D)(\frac{\Delta D}{D})$$

(5.1)

where σ_{M2} is the SD of M2, σ_R is the SD of foreign reserves, σ_E is the SD of exports, $\sigma_{FA/FL}$ is the SD of foreign assets to foreign liabilities, and σ_D is the SD of debt. A low CRR index indicates a low risk in terms of country reliability and low probability of default, while a high CRR value measures a high risk in terms of country reliability and high probability of default, as shown in Table 5-1.

Table 5-1: *Characteristics of the CRR index in appraising default probability*

Characteristics of the CRR index	**Default probability**
Country Reliability Risk > 0	Low
	The higher the positive value, the lower is default probability
Country Reliability Risk = 0	Constant
Country Reliability Risk < 0	High
	The lower the negative value, the higher is default probability

The CRR index is tested against the sovereign ratings of foreign currency long-term debt in the cases of the Philippines, Indonesia and Malaysia. However, sovereign ratings can remain constant over long time periods and do not change very often. The CRR index changes immediately if the related macroeconomic factors change. Due to the limited changes of ratings, data from Standard&Poor's (S&P), Fitch Rating and Moodys are obtained. The following rating scale is used for the application of default probabilities (Table 5-2). For example, an S&P convention of "AAA" would have a default probability of 0.01%.

Table 5-2: *Default probabilities scale*

Rating scale					
Moody		**S&P/ Fitch**			**Default probabilities (%)**
Long Term	Short Term	Long Term	Short Term		
Aaa	P-1	AAA	A-1+	Prime	0.01
Aa1		AA+		High grade	0.02
Aa2		AA			0.03
Aa3		AA-			0.04
A1		A+	A-1	Upper medium grade	0.05
A2		A			0.08
A3	P-2	A-	A-2		0.11
Baa1		BBB+		Lower medium grade	0.15
Baa2	P-3	BBB	A-3		0.2
Baa3		BBB-			0.4
Ba1	Not prime	BB+	B	Non Investment grade (speculative)	0.65
Ba2		BB			1.2
Ba3		BB-			1.95
B1		B+		Highly speculative	3.2
B2		B			7
B3		B-			13
Caa		CCC	C	Substantial risks	20

The next section explains the steps in developing the conditional country rating transition matrix. First, the CRR index of the 243 data points is aggregated to a distribution. Figure 5-2 shows the aggregated distribution of the CRR index for the Philippines from 1989 to 2009

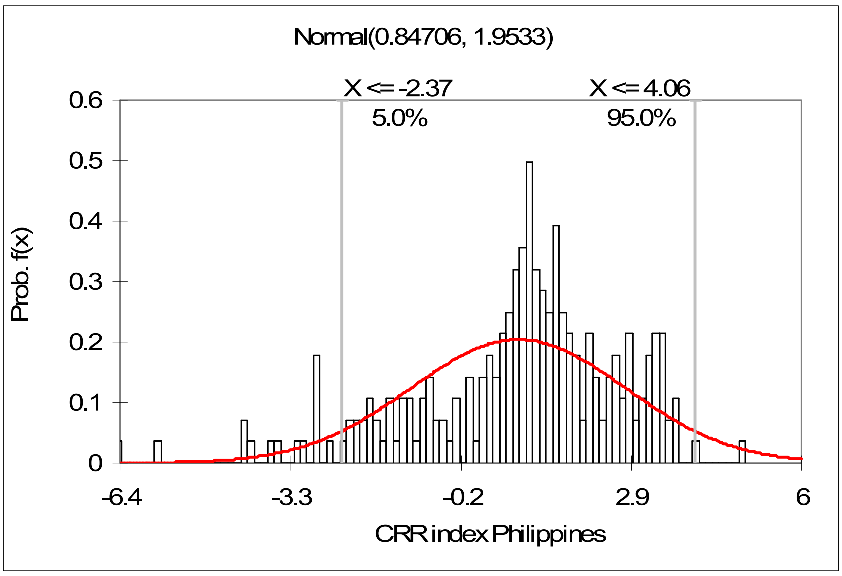

Figure 5-2: *Fitted CRR index – Philippines*

If $CRR \sim N(\mu,\sigma)$, then the country change indicator (CCI) Z will be standardized by equation 5.2:

$$Z = \frac{X - \mu}{\sigma} \tag{5.2}$$

where x represents the CRR index values and μ and σ are parameters from the fitted normal distribution. The standardizing process is necessary because the probabilities of the country rating transition matrix (CRTM) are based on the standard normal distribution.

The country reliability risk grade is labelled as a vector R with elements $\{r_1, r_2, ..., r_m\}$. The grade r_m is the lowest default probability. The country reliability rating grade at time t is labelled as random variant R_t. The probability that the country reliability grade is r_j at time $t+1$ (i.e., $R_{t+1} = r_j$) on the condition that at time t the grade is r_i (i.e. $R_t = r_i$) is labelled as $\lambda^t_{i,j}$:

$$\lambda^t_{i,j} = \text{Prob}\{ R_{t+1} = r_j \mid R_t = r_i \} \tag{5.3}$$

The CRTM at time t, Ω^t, can thus be represented by elements of $\lambda^t_{i,j}$:

$$= \Omega^t = (\lambda^t_{i,j})_{m,m} = \begin{pmatrix} \lambda^t_{1,1} & \lambda^t_{1,2} & .... & \lambda^t_{1,m} \\ \lambda^t_{2,1} & \lambda^t_{2,2} & .... & \lambda^t_{2,m} \\ .... & .... & .... & .... \\ \lambda^t_{m,1} & \lambda^t_{m,2} & .... & \lambda^t_{m,m} \end{pmatrix} \tag{5.4}$$

The j column of the matrix Ω^t can also be conveniently labelled as Ω^t_j. However, there has been no public transition matrix recorded for country reliability on risk mitigation instruments. Therefore the annual credit rating transition matrix in structured finance is used as proxy for the CRTM (Table 5-3).

Table 5-3: *Moody's rating migration and credit quality correlation 1920-1996 Source: Violi (2004)*

From: To:	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	92.18%	6.51%	1.04%	0.25%	0.02%	0.00%	0.00%	0.00%
Aa	1.29%	91.62%	6.11%	0.70%	0.18%	0.03%	0.00%	0.07%
A	0.08%	2.50%	91.36%	5.11%	0.69%	0.11%	0.02%	0.13%
Baa	0.04%	0.27%	4.22%	89.16%	5.25%	0.68%	0.07%	0.31%
Ba	0.02%	0.09%	0.44%	5.11%	87.08%	5.57%	0.45%	1.24%
B	0.00%	0.04%	0.14%	0.69%	6.52%	85.20%	3.54%	3.87%
Caa-C	0.00%	0.02%	0.04%	0.37%	1.45%	6.00%	78.30%	13.82%

With the CRTM plus the country change indicator Z, it is possible to derive the conditional country reliability transition matrix (CCRTM) as shown in equation 5.5:

$$\lambda_{ij}^{t} = \begin{cases} \Phi(y_j + Z_t) & j = 1 \\ \Phi(y_j + Z_t) - \Phi(y_{j-1} + Z_t) & 1 < j = m-1 \\ 1 - \Phi(y_{m-1} + Z_t) & j = m \end{cases} \qquad (5.5)$$

where y is element of the CRTM and the Z-value is the standardized CRR index. The CRR index is therefore used as country change indicator and a shift of the PDF of ratings towards better or poorer country stages. As shown in Figure 5-3, a positive CRR index shifts the transition towards a better condition of country reliability, while a negative shifts the transition towards a poorer condition of country reliability.

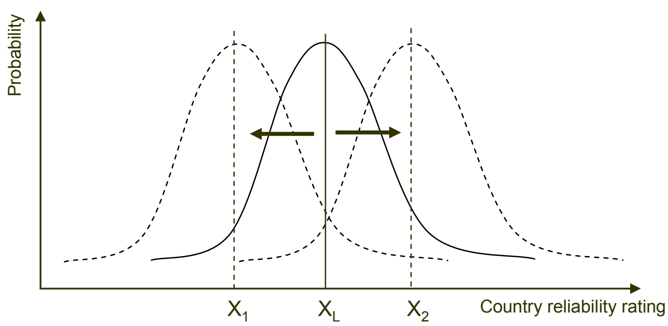

Figure 5-3: *CRR index with effect on country reliability rating transition*

For illustrative purposes, assume that the Philippines' CCR is -1.03 for a particular year. Then, using equation 5.5 and the aggregated distribution of CRR-Philippines, its CCI would be -0.9609. Using equation 5.5, the CCRTM is obtained as shown in Table 5-4.

Table 5-4: *Conditional country rating transition matrix for country change indicator -0.9609*

From: To:	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	67.59%	22.06%	6.91%	2.93%	0.50%	0.00%	0.00%	0.00%
Aa	0.07%	69.36%	22.08%	4.97%	1.86%	0.39%	0.00%	1.28%
A	0.00%	0.18%	72.02%	19.49%	4.97%	1.10%	0.22%	2.02%
Baa	0.00%	0.01%	0.39%	71.11%	19.53%	4.58%	0.59%	3.79%
Ba	0.00%	0.00%	0.02%	0.52%	68.45%	18.73%	2.31%	9.96%
B	0.00%	0.00%	0.00%	0.04%	0.76%	67.81%	10.34%	21.00%
Caa-C	0.00%	0.00%	0.00%	0.02%	0.10%	0.76%	54.19%	44.88%

For another year, the Philippines' CRR is 1.5, then its CCI is 0.3343, and the CCRTM is as shown in Table 5-5:

Table 5-5: *Conditional country rating transition matrix for country change indicator 0.3343*

From: To:	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	96.01%	3.47%	0.44%	0.09%	0.01%	0.00%	0.00%	0.00%
Aa	2.91%	93.53%	3.18%	0.29%	0.06%	0.01%	0.00%	0.02%
A	0.24%	5.11%	91.68%	2.61%	0.28%	0.04%	0.01%	0.04%
Baa	0.13%	0.69%	7.91%	88.16%	2.70%	0.28%	0.03%	0.11%
Ba	0.07%	0.25%	1.04%	9.21%	85.76%	2.96%	0.21%	0.50%
B	0.00%	0.13%	0.37%	1.55%	11.24%	82.96%	1.97%	1.78%
Caa-C	0.00%	0.07%	0.12%	0.91%	2.96%	9.98%	78.23%	7.74%

By comparing Tables 5-4 and 5-5, it can be seen that the CCI causes the shift of the probability density function of rating toward better or poorer states of reliability.

As shown in equation 5.6, the country reliability state α_t depends on the CCRTM and the distribution of the previous state vector.

$$\alpha_t = \alpha_{t-1} \bullet \Omega^{t\text{-}1} \qquad (t = 1,2,\ldots,n) \qquad (5.6)$$

It also follows that:

$$\alpha_t = \alpha_0 \bullet (\prod_{k=0}^{t-1} \Omega^k) \qquad (1 \le t \le n) \qquad (5.7)$$

If α_0 the initial country reliability and Ω^t the CRTM are known, the country reliability can be calculated for every time period.

When the country reliability rating is at default grade at time t (i.e., $R_t = r_1$), it is regarded that it is in the state of default. The probability of occurrence of that event is hereby denoted as $P_d(t)$, assuming that once the country reliability rating is in default, it will always be in default. In other words, if the country defaults on risk mitigation instruments, the instruments are also worthless in the future. As shown in Kong (2008), the probability of default can be computed as follows:

$$P_d(t) = \Pr ob\{R_0 \ne r_1 \cap ... \cap R_{t-1} \ne r_1 \cap R_t = r_1 \cap R_{t+1} = r_1 \cap ... \cap R_n = r_1\}$$

(5.8)

Equation 5.9 can be rewritten as:

$$P_d(t) = \sum_{k=2}^{m} \Pr \text{ob}\{R_t = r_1 \mid R_{t-1} = r_k\} \times \Pr \text{ob}\{R_{t-1} = r_k\} \qquad (5.9)$$

By applying the total probability formula $P_d(t) = p_1^t - p_1^{t-1}$ (t = 1, 2, …, n) using equation 5.9, and since p_1^0 is known at time 0, the probability of default on risk mitigation instruments can be computed as follows:

$$P_d(t) = \begin{cases} \alpha_0 \bullet \Omega_1^0 - p_1^0 & t = 1 \\ \alpha_{t-1} \bullet \Omega_1^{t-1} - \alpha_{t-2} \bullet \Omega_1^{t-2} & t \ge 2 \end{cases} \qquad (5.10)$$

5.2. Validation of the CRR index

The best proxies to validate the CRR index would be actual cases of refinancing and default cases on risk mitigation instruments. During informal discussions, several investors mentioned that they suffered significant losses during the Asian Financial Crises. However, the details of refinancing and default on risk mitigation instruments are highly confidential. Rating agencies have detailed information about default on risk mitigation instruments in structured finance but are unable to publish the data. Therefore, the best proxy to test the index is against the sovereign ratings of foreign currency long-term debt. The index is tested in the case of Indonesia, the Philippines, and Malaysia. However, ratings are not ideal dependent variables since they can remain constant over long time periods and do not change very often. While the CRR index changes immediately if the related macroeconomic factors change, ratings represent an outlook not only driven by immediate macroeconomic changes. Ratings from Standard & Poor, Fitch Rating, and Moodys are obtained. In cases of changes in ratings during the same time period the average between the ratings is used

5.2.1. CRR analysis – Indonesia

Figure 5-4 illustrates the CRR index and the probability of default in the case of Indonesia. Appendix 5-11 to 5-15 shows the individual factors of the CRR index and the computed CRR index as shown in equation (5.1). Positive values of the CRR index illustrate a higher reliability and a lower default probability compared with negative values. Therefore, if the CRR index is negative the default probability should increase. The average default probabilities on sovereign ratings of foreign currency long-term debt are shown on the left side of Figure 5-4.

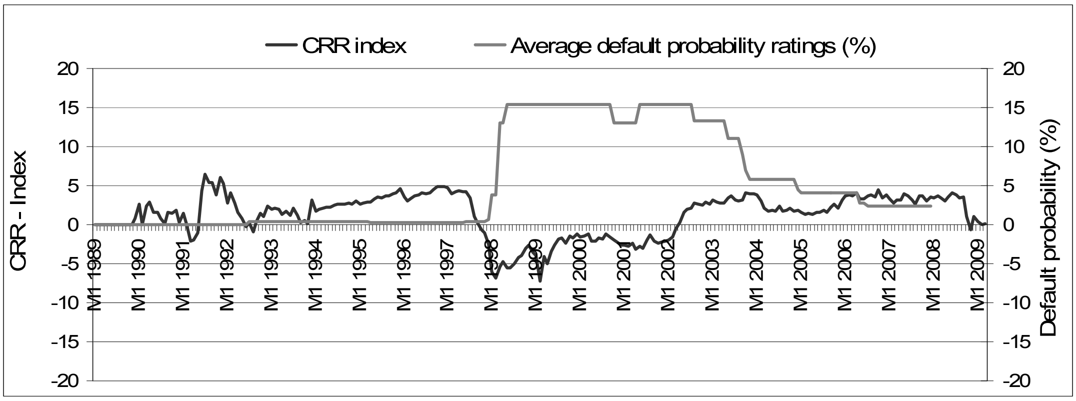

Figure 5-4: *CRR index versus average default probabilities ratings – Indonesia*

Figure 5-5 illustrates the fitted PDF of the CRR index in the case of Indonesia.

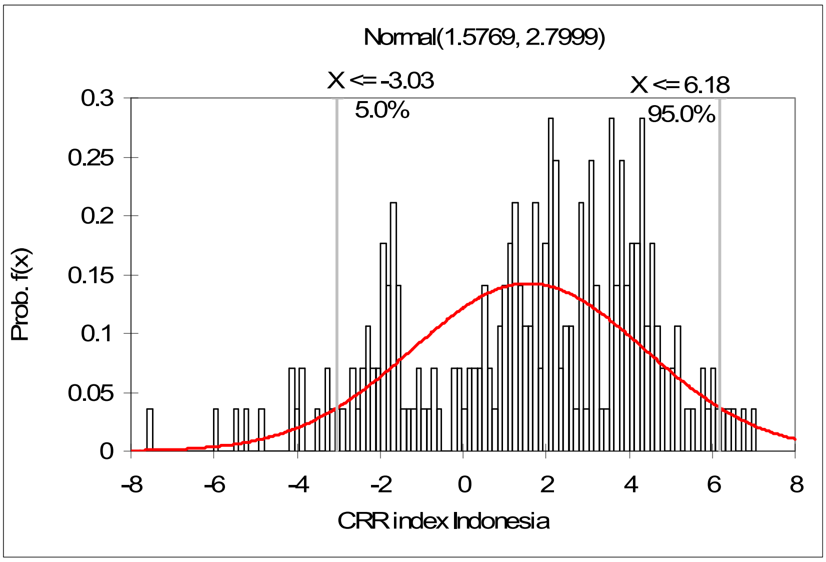

Figure 5-5: *Fitted distribution of the CRR index Indonesia*

The default probabilities on risk mitigation instruments computed by the CCRTM versus the average default probabilities on foreign currency long-term debt by the rating agencies are shown in Figure 5-6. The detailed CCRTM are attached in Appendix 5-46 to 5-49. The CRR index is computed starting in 1998 to 2009. The earliest recorded ratings on Indonesia started in 1993. Prior to 1998, the default probabilities derived by CCRTM are highly correlated to the average default probabilities by the rating agencies. Default probabilities aggregated from CCRTM are able to cover the peak during the Asian financial crises in 1998. However, during the period from1999 to 2005, the default probabilities by CCRTM are much lower than those of the rating agencies.

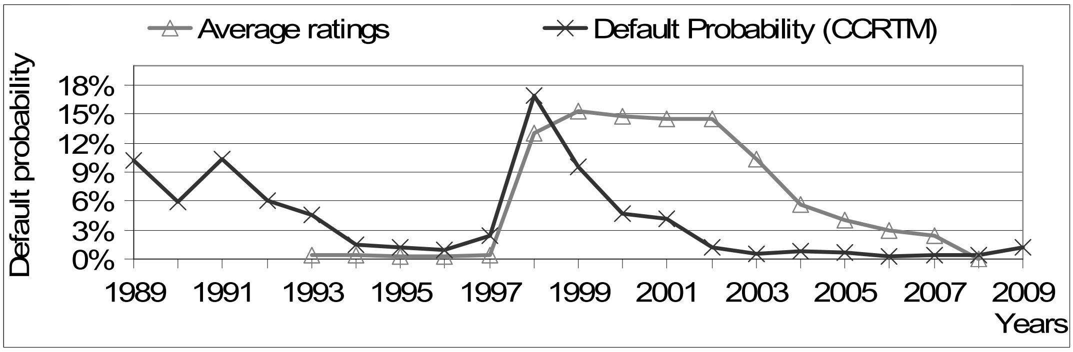

Figure 5-6: *Comparison default probabilities Indonesia*

Ratings always represent an outlook and are not only driven by the macroeconomic changes. They also factor in political risk and the market outlook of the region. This could be one reason for the constant behaviour of default probability during 1998 to 2001. The CCRTM default probabilities indicate the peak in 1998 but also the decreases by the improvements in macroeconomic factors in the following years. The main factors which trigger the decrease in default probabilities are the decrease in M2, the increase in exports, and the decrease in debt, as shown in Figures 5-7 to 5-9.

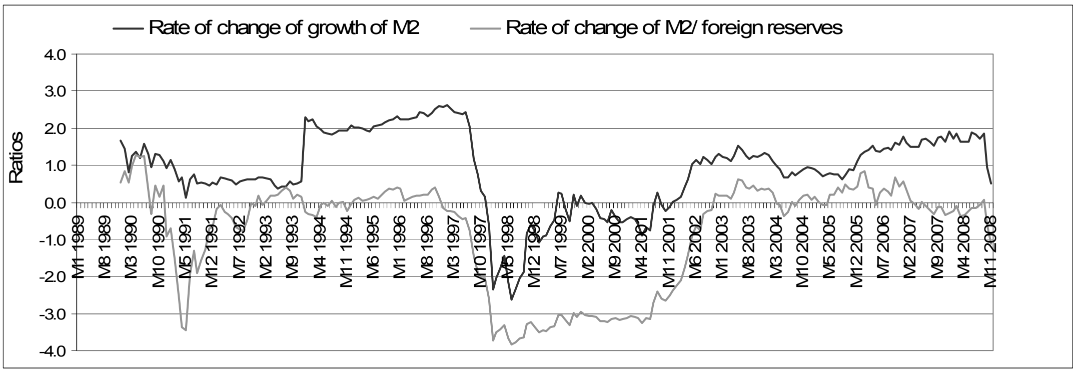

Figure 5-7: *CRR factors of growth of M2 and M2 to foreign reserves – Indonesia*

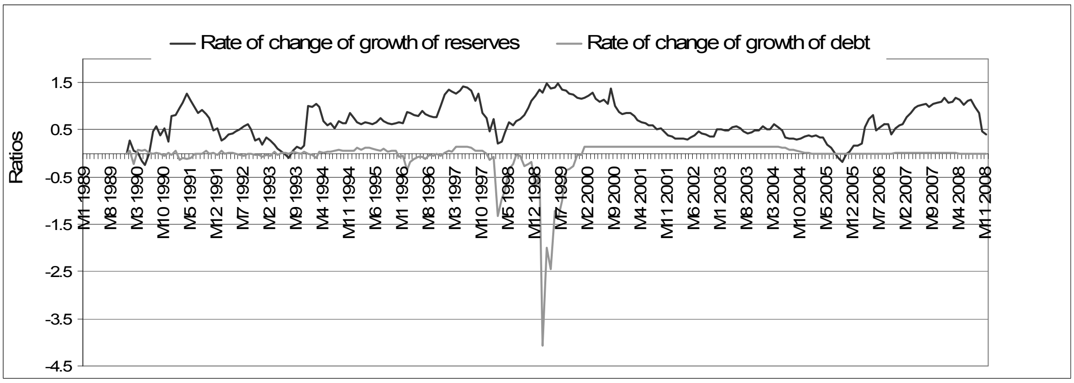

Figure 5-8: *CRR factors of growth of reserves and growth of debt – Indonesia*

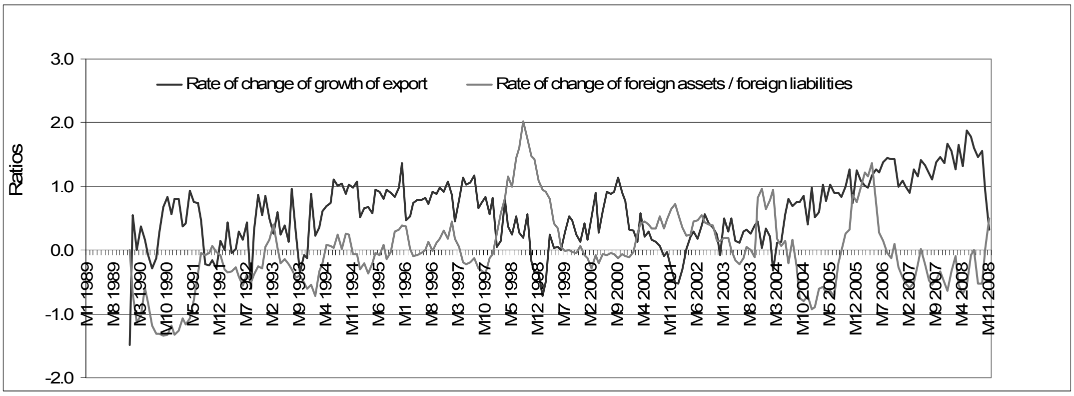

Figure 5-9: *CRR factors of growth of export and foreign assets to foreign liabilities – Indonesia*

5.2.2. CRR regression analysis - Indonesia

The linear regression analysis shows a weak fit, describing 28% of the variance in the default probability of risk mitigation instruments derived by CCRTM (Table 5-6). As explained in section 5.1 and shown in Figure 5-6, the default probabilities in 2000 to 2003 are significant lower compared to those of the rating agencies. The regression is performed on 17 data points during the time period 1993 to 2009, with default probability derived from the CRR index against the average default probability by rating agencies.

Table 5-6: *Regression analysis Indonesia (1)*

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.529[a]	.280	.232	5.32009

a. Predictors: (Constant), Def_Prob_CCRTM

As shown in Table 5-7, the overall relationship is statistically significant $(t_{1,15} = 0.029,\ \ p < 0.1)$.

Table 5-7: *Regression analysis Indonesia (2)*

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	164.799	1	164.799	5.823	.029[a]
	Residual	424.550	15	28.303		
	Total	589.350	16			

a. Predictors: (Constant), Def_Prob_CCRTM

b. Dependent Variable: Def_Prob_Ratings

The default probabilities by CCRTM are positively related to the average default probability by rating agencies. The default probabilities by CCRTM increase by 0.746 units for every extra unit increase by the rating agencies (Table 5-8).

Table 5-8: *Regression analysis Indonesia (3)*

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.880	1.591		2.439	.028
	Def_Prob_CCRTM	.746	.309	.529	2.413	.029

a. Dependent Variable: Def_Prob_Ratings

5.2.3. CRR analysis - Philippines

Similarly to the Indonesian case, both the CRR index and average ratings of foreign long-term debt are negatively correlated. Appendix 5-26 to 5-30 illustrates the individual factors of the CRR index and the computed CRR index. The left side of Figure 5-10 illustrates the country reliability of the CRR index and the right side the default probabilities assessed by rating agencies. A low CRR index indicates high country reliability and a low CRR index lower country reliability. The CRR index is computed starting for the period from 1998 to 2009. Data on default probabilities by rating agencies start in 1993.

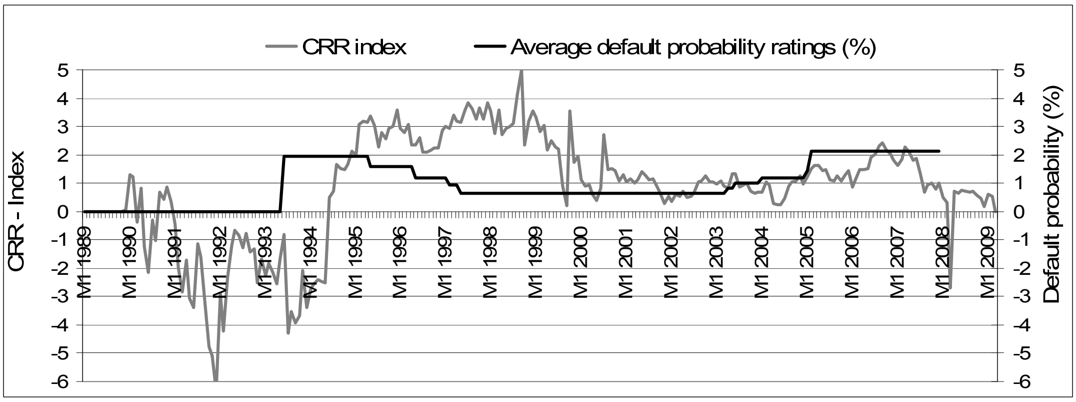

Figure 5-10: *CRR index versus average default probabilities ratings – Philippines*

The fitted PDF of the CRR index in the case of the Philippines is described by Normal (0.847, 1.953) as shown in Figure 5-11.

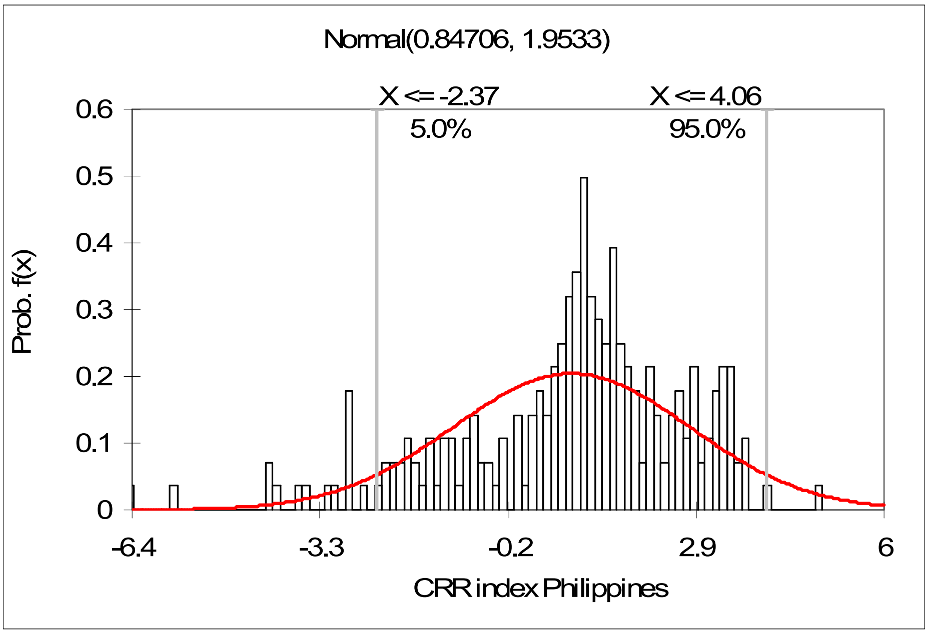

Figure 5-11: *Fitted distribution of the CRR index Philippines*

Figure 5-12 shows the results of default probabilities on RMI computed by CCRTM versus the average default probabilities on foreign currency long-term debt assessed by the rating agencies. The detailed CCRTM are attached in Appendix 5-50 to 5-53. The default probabilities of CCRTM start higher and decrease faster compared with average default probabilities in the years 1993 to 1997. During 1997 to 2004, the probabilities derived from CCRTM are very close to the probabilities of the average ratings. The last four years' default probabilities by CCRTM are less than half of the projected average rating default probabilities.

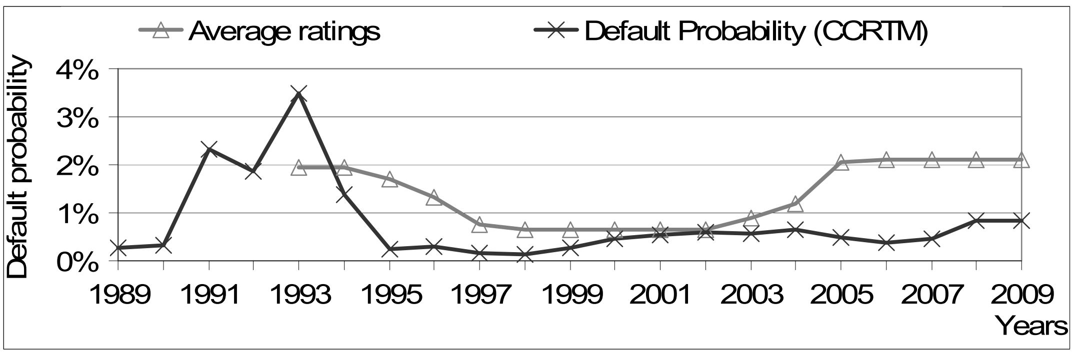

Figure 5-12: *Comparison default probabilities Philippines*

From Figures 5-13 to 5-15, the main factors that trigger the increase of default probabilities are the rate of change of M2 to foreign reserves and rate of change of growth of debt during 1993 to 1994. During 1993 to 1997 the rate of change of growth of M2, foreign reserves, and exports, and the decrease in debt are the main drivers which influence the decrease of default probabilities. During 2005 to 2007 the factors cannot explain the increase of default probability assessed by the rating agencies. Only the rate of change of M2 to foreign reserves decreases slightly in 2005 but is offset by the increase in the rate of change of growth of foreign reserves. In 2008 there is a clear decrease in the rate of change of growth of reserves, foreign assets to foreign liabilities, and the growth of M2. This increase doubles the default probability by CCRTM from 0.5% to nearly 1%.

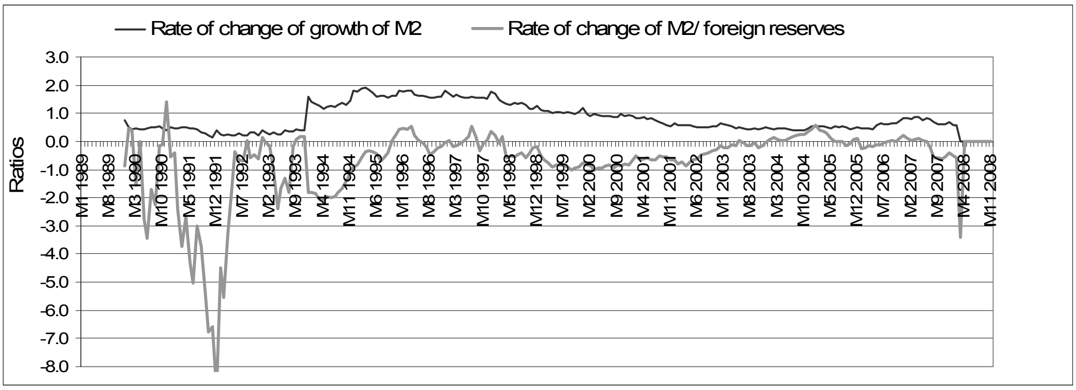

Figure 5-13: *CRR factors of growth of M2 and M2 to foreign reserves – Philippines*

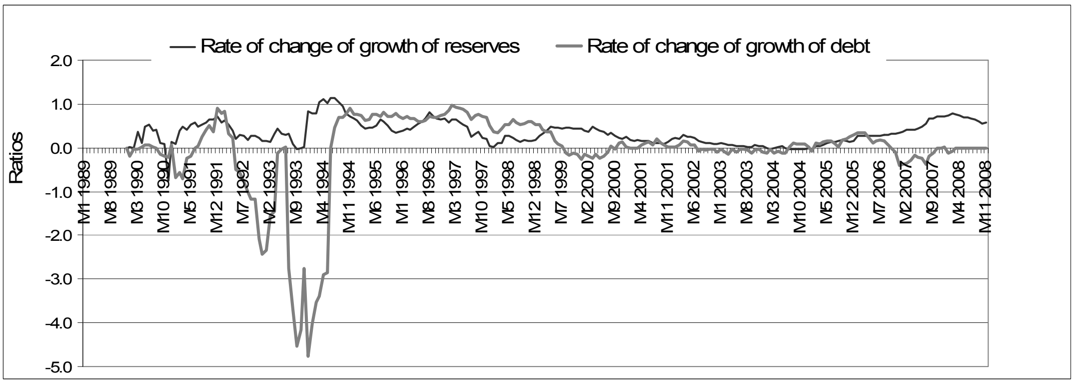

Figure 5-14: *CRR factors of growth of reserves and growth of debt – Philippines*

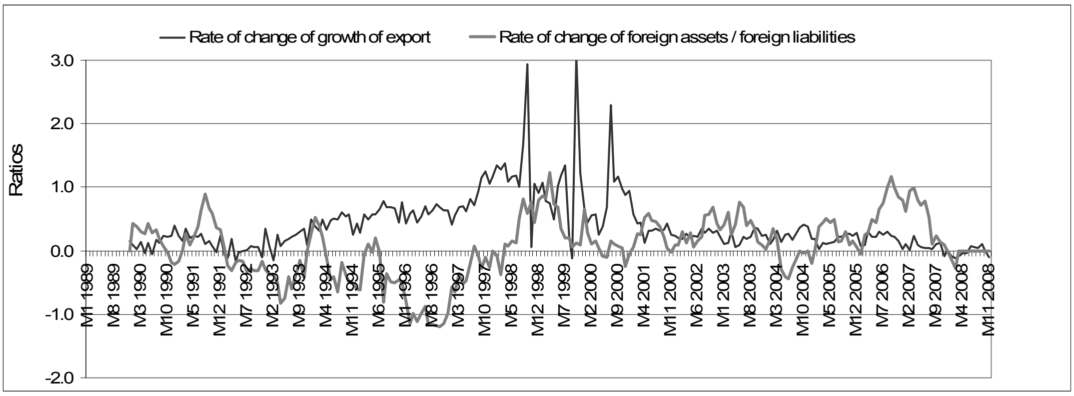

Figure 5-15: *CRR factors of growth of exports and foreign assets to foreign liabilities – Philippines*

5.2.4. CRR regression analysis - Philippines

The regression analysis on default probability derived by CCRTM against the average default probability as assessed by rating agencies shows a lower fit compared with Indonesia. The regression describes 18.7% of the variance in the default probability of risk mitigation instruments derived by CCRTM (Table 5-9). The regression analysis covers the values for the period from 1994 to 2009.

Table 5-9: *Regression analysis - Philippines (1)*

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.432[a]	.187	.129	.60797

a. Predictors: (Constant), Def_Prob_CCRTM

As shown in Table 5-10 the overall relationship is statistically significant $(t_{1,14} = 0.095,\ p < 0.1)$.

Table 5-10: *Regression analysis - Philippines (2)*

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.188	1	1.188	3.214	.095[a]
	Residual	5.175	14	.370		
	Total	6.363	15			

a. Predictors: (Constant), Def_Prob_CCRTM

b. Dependent Variable: Def_Prob_Ratings

The default probabilities by CCRTM are positively related to the average default probability by rating agencies and increase by 0.877 units for every extra unit increase by the rating agencies (Table 5-11).

Table 5-11: *Regression analysis - Philippines (3)*

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.877	.305		2.880	.012
	Def_Prob_CCRTM	.915	.510	.432	1.793	.095

a. Dependent Variable: Def_Prob_Ratings

Figure 5-16 shows the regression analysis of the default probabilities by CCRTM versus the default probabilities of average ratings on sovereign foreign long-term debt.

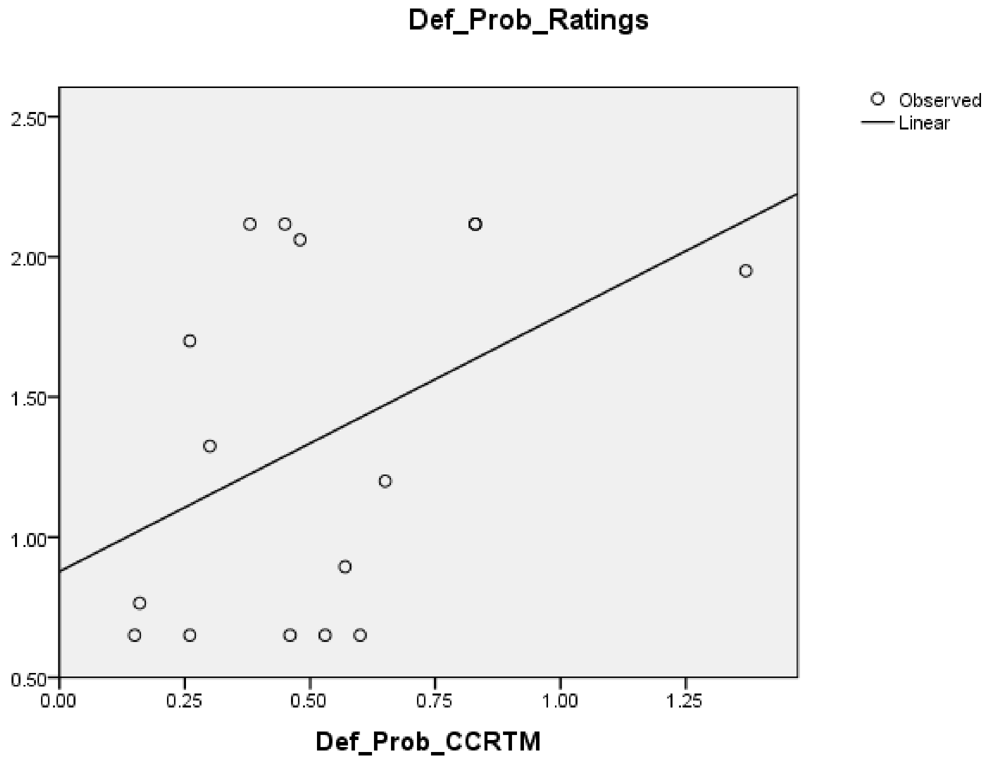

Figure 5-16: *Regression analysis - Philippines*

5.2.5. CRR analysis - Malaysia

The Malaysian CRR index is computed in the same time period as Indonesia and the Philippines, from 1998 to 2009. Figure 5-17 illustrates the negative correlation between the CRR index on the left side of the table and the default probabilities by rating agencies on the right side of the figure.

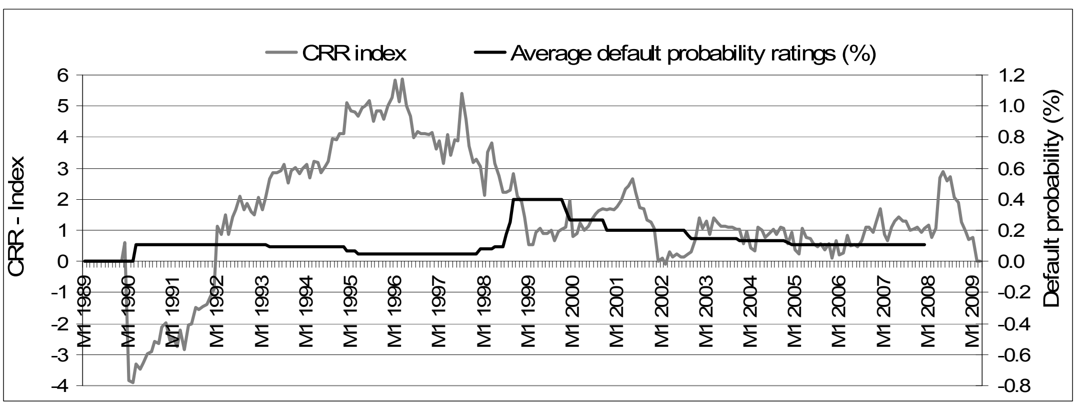

Figure 5-17: *CRR index versus average default probabilities ratings - Malaysia*

The individual factors of the CRR index and the computed CRR index are attached in Appendix 5-41 to 5-45. Figure 5-18 shows the fitted PDF of the CRR index described by Normal (1.5316, 1.9494).

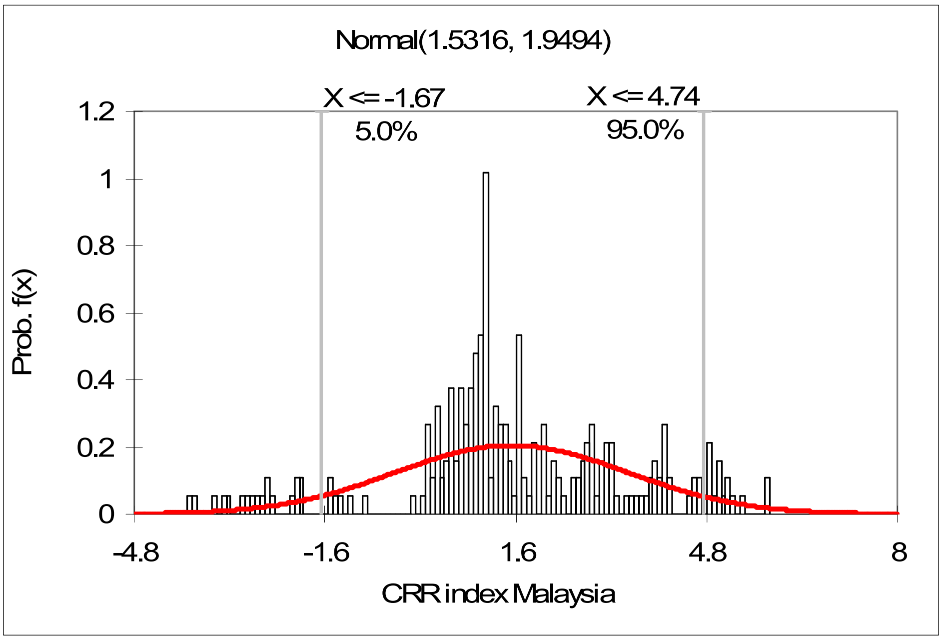

Figure 5-18: *Fitted distribution of the CRR index - Malaysia*

The highest default probabilities are computed during 1990, as shown in Figure 5-19. However, first data on default probabilities by rating agencies starts in 1993. Figure 5-20 shows the comparison of default probabilities on RMI computed by CCRTM versus the average default probabilities on foreign currency long-term debt assessed by the rating agencies during the period from 1992 to 2009. The default probabilities of CCRTM and the rating agencies are very close until 1998. The difference of 0.2% in year 2000 cannot be explained by the selected factors in the CRR computation. During 2001 to 2009, the probabilities by CCRTM are higher compared to the default probabilities of the average ratings. Appendix 5-54 to 5-57 shows the detailed CCRTM during 1989 to 2009.

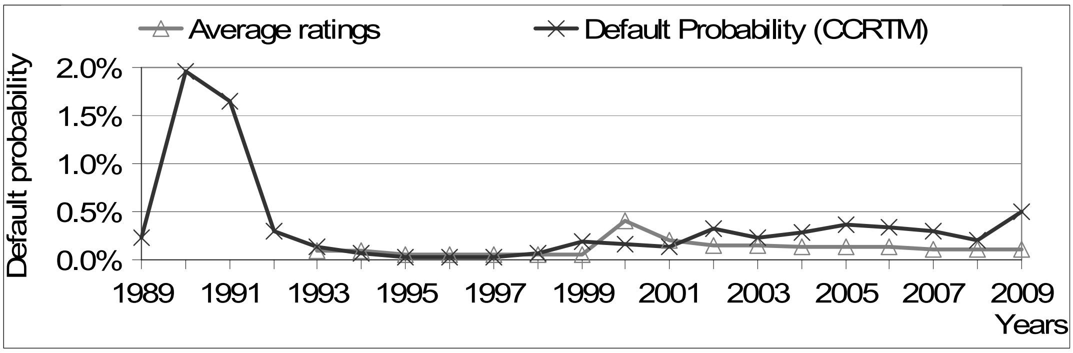

Figure 5-19: *Comparison default probabilities - Malaysia (1998-2009)*

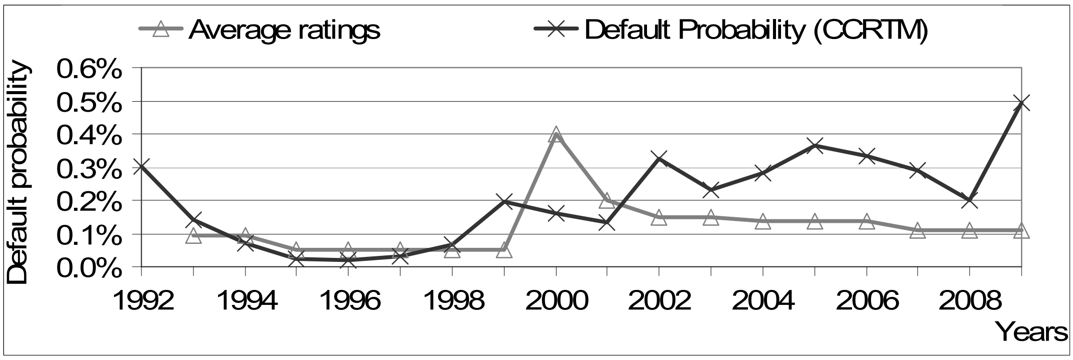

Figure 5-20: *Comparison default probabilities - Malaysia (1992-2009)*

Figures 5-21 to 5-23 show how the factors impact the default probabilities. In year 2000, the only factor which has a negative influence is the rate of change of growth of M2 to foreign reserves. Since the factor is only negative in the first half of 2000 the default probability by CCRTM is lower compared with the assessments of the rating agencies. The increase in year 2002 is driven by the rate of change in growth of debt and low growth of change in foreign reserves and export. From 2004 to 2009, the increase in default probability is mainly triggered by the decrease in rate of change in growth of M2 to foreign reserves.

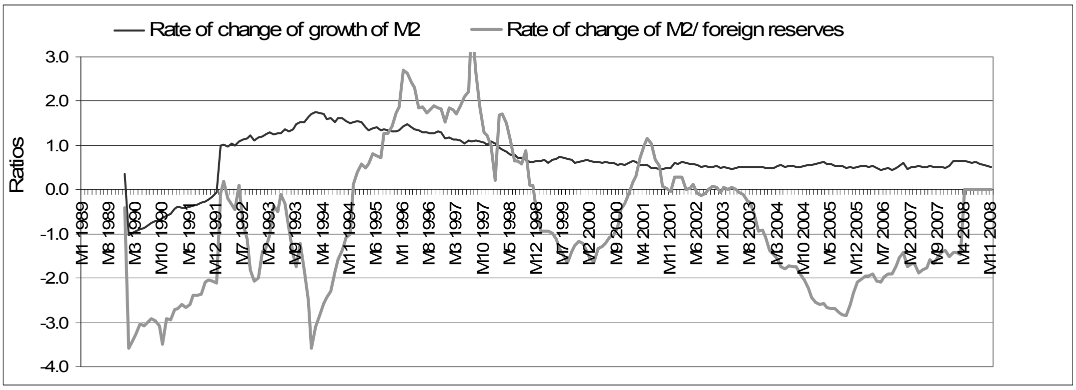

Figure 5-21: *CRR factors of growth of M2 and M2 to foreign reserves – Malaysia*

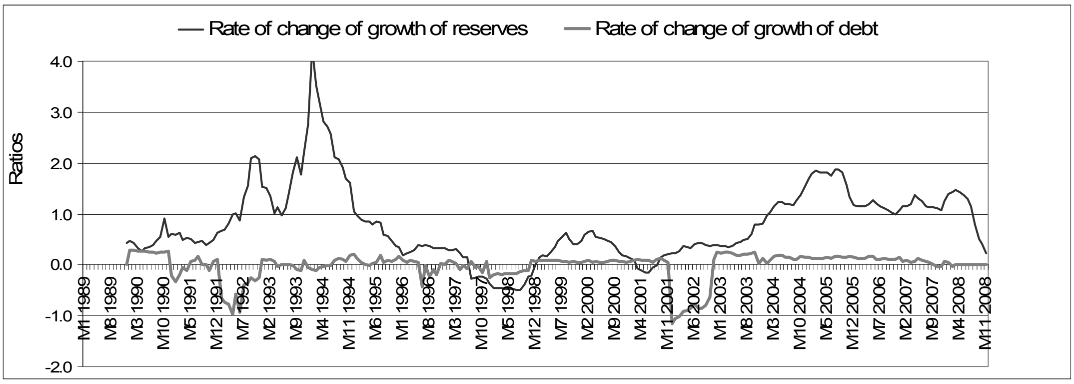

Figure 5-22: *CRR factors of growth of reserves and growth of debt - Malaysia*

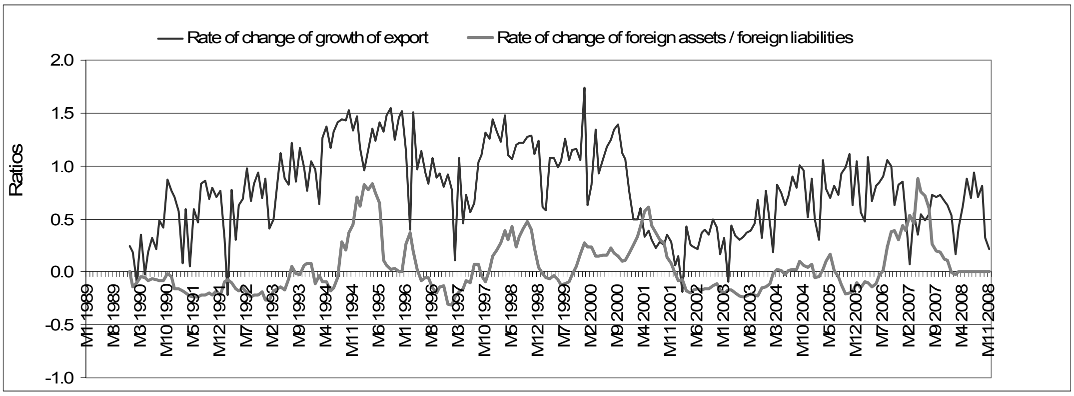

Figure 5-23: *CRR factors of growth of export and foreign assets to foreign liabilities – Philippines*

5.2.6. CRR regression analysis - Malaysia

Table 5-12 shows that a reasonable fit of the regression analysis describes 29.2% of the variance in the default probability of risk mitigation instruments derived by

CCRTM. The regression analysis covers the values of 1993 to 2009 by excluding the peak point in the year 2000. By including this outsider point, R square would decrease to 5.2%.

Table 5-12: *Regression analysis - Malaysia (1)*

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.541[a]	.292	.242	.04020

a. Predictors: (Constant), VAR00001

The overall model is statistically significant, as shown in Table 5-13 $(t_{1,14} = 0.031,\ \ p < 0.1)$.

Table 5-13: *Regression analysis - Malaysia (2)*

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.009	1	.009	5.788	.031[a]
	Residual	.023	14	.002		
	Total	.032	15			

a. Predictors: (Constant), VAR00001

b. Dependent Variable: VAR00002

Similarly to Indonesia and the Philippines, the default probabilities by CCRTM are positively related to the average default probability by rating agencies and increase by 0.177 units for every extra unit increase by the rating agencies.

Table 5-14: *Regression analysis - Malaysia (3)*

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.071	.018		4.004	.001
	VAR00001	.177	.074	.541	2.406	.031

a. Dependent Variable: VAR00002

Figure 5-24 shows the curve estimation of the default probabilities by CCRTM versus the default probabilities of average ratings on sovereign foreign long-term debt.

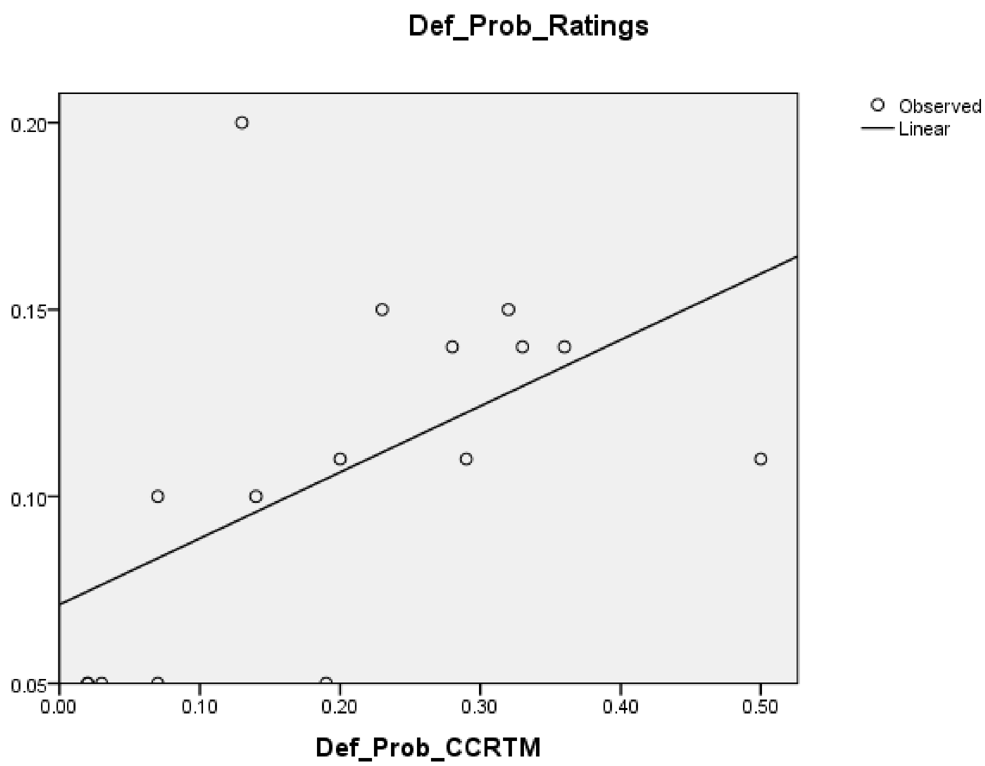

Figure 5-24: *Regression analysis- Malaysia*

5.3. Summary

The aim of proposition 2 is to develop a model to estimate the value of RMIs based on signals that indicate country reliability in terms of the feasibility and willingness to compensate SPCs for FX loss. The CRR index is based on signals and proxies and transferred into a CCRTM to estimate default probabilities on RMIs. The CRR index improves the prediction of government reliability on RMI. The real advantage is that the model has a dynamic framework. It is not based on questionnaires or subjective opinions. All input variables can be frequently updated. The model has been designed to act as an assessment system and can be used as a monitoring tool for screening country reliability risk on RMIs.

The proposition is tested against the sovereign ratings of foreign currency long-term debt in Indonesia, the Philippines, and Malaysia. The CRR index is significant against the sovereign ratings. The methodology can be applied to support financial strategies in funding PPP infrastructure. It helps investors to evaluate RMIs and to estimate the necessary FX protection, and it prevents underestimation of the risk that governments would refuse to readjust the contracts after or during a currency devaluation period by additional information aggregated with the CRR method.

CHAPTER 6

Future work and conclusions

The last chapter concludes the main findings and results of the foreign exchange exposure and country reliability risk model. It presents the limitations and gives recommendations on the areas for future research work.

6.1. Conclusion

The demand of infrastructure in developing countries such as Indonesia, Vietnam or India cannot be covered by governmental funding and multilaterals. The characteristics of infrastructure as a long-term asset with high entry barriers and often regular or stable cash flows indexed to inflation rates and a low correlation to other asset classes in a portfolio makes infrastructure funding and investment attractive for foreign capital. PPP projects must be prepared in a suitable way, and the problem of quantifying economic FX exposure in PPP projects is addressed in this thesis.

Economic FX exposure is particularly relevant in the case of PPP projects, since whilst these typically generate their revenues domestically, and hence earn local currency, their financing costs and operating and maintenance costs are more typically denominated in hard currencies. FX risks exist even before a contract is signed because of FX volatility between bid and award dates. Short-term FX exposure can be hedged in the market. Economic FX exposure (with its focus on the long term) is more difficult to mitigate. The significance of economic FX exposure varies during time and must be monitored during the concession period. Consequently, any party involved in a PPP project would be advised to assess their economic FX exposure in order to protect the resultant costs and revenues from subsequent unanticipated fluctuations.

The first objective of evaluating the best risk mitigation strategies for economic FX exposure is achieved by a literature review on advantages and disadvantages of potential risk mitigation opportunities from the view of the host country government, offtakers, private investors and customers and an analysis of three questionnaire surveys. Various FX risk mitigation techniques commonly used were investigated on their perceived effectiveness and advantages and disadvantages. The findings show that FX exposure is not as very well managed, both in the construction industry and elsewhere, as it might be. FX hedging instruments and other RMIs are sophisticated in practice and SMEs and SPCs remain largely dependent on bank advice as regards their hedging strategies. However, the potential benefits of relevant FX strategies in ensuring certainty of cash flows and the consequent guarantee of liquidity can be significant.

All three surveys demonstrate the significance of FX exposure to commercial success. The questionnaire analysis should enable both sponsors and contractors involved in construction, as well as SME owners/managers, to improve current practice in their FX management. Swaps and forward agreements are the most commonly used hedging techniques in PPP projects, in the construction industry more generally, less complicated instruments such as currency matching, borrowing in local currencies and forward market hedges, are applied. SMEs, whilst apparently using the full range of available derivatives, nevertheless appear to focus on forward and swap agreements. However, in emerging markets, FX hedging tools and financial instruments are often not available or have durations too short for the hedging requirements of PPP projects. Furthermore, the decision to hedge FX risk in the financial markets depends on the amount of risk exposure. If the FX exposure is too low, the costs of implementing hedging strategies will be greater than the benefits from hedging.

This research contributes to the solution of this problem with a methodology to quantify annual economic FX exposure in PPP projects. Additionally, a CRR index is designed to evaluate RMIs in terms of affordability and willingness by the government to compensate unforeseen FX fluctuation in the project.
The quantification of economic FX exposure in PPP infrastructure projects are achieved by the development of the FEE model. The aim of the FEE model is to simulate the uncertainties of FX risk with impact on the cash flow of the PPP project. Exchange rates are correlated with inflation rates and interest rates and theoretically described by interest rate parity and purchasing power parity. Therefore, the FX index is modelled as a system of market variables including inflation rates, interest rates and FX rates with impact on the cash flow of a project. All the variables are fitted to PDFs during a defined time period. The correlations between the variables are aggregated on defined economic cycles. All variables form the ellipsoid in the n-dimensional shape. It is a first-order second-moment reliability method which is adjusted to the characteristics of project finance with the

purpose to analyse economic FX exposure in PPP infrastructure projects. The FX index is modelled via an expanding dispersion ellipsoid and reflects uncertainties of economic FX exposure. A defined surface divides the n-dimensional space of variables into two sets of an investability domain and non-investability domain. The limit is described in terms of a minimum DSCR requirement defined by the feasibility function g(x). One set contains points in the model which are below a certain minimum DSCR requirement and one set for which the points behave above a DSCR requirement. The FX index is equivalent to the distance from the ellipsoidal centre to the most probable point of non-investability grade. The index illustrates how well the project is prepared to cover FX fluctuations. The more the ellipsoid can disperse without exceeding the non-investability surface, the more FX exposure can be absorbed by the project. An FX index above 2.0 is equivalent 2% probability of reaching non-investability and a good minimum benchmark. But the base line will vary based on the risk appetite.

The FX exposure index is unit independent and allows comparisons of different projects in different markets. The index can be used as a monitoring tool for performing FX exposure and return analysis. The index has been designed to act as an assessment system to evaluate the sponsor's FX exposure by monitoring changes in the market condition. It accounts for the particular features of a project through adjustments to input data based on the specific project variables.

The FEE model's contribution to science is a consistent process to evaluate FX exposure in PPP infrastructure projects. The developed FEE model is a new, structured approach to estimate the FX exposure in PPP projects. This research work contributes to the field of risk analysis, and management due to enhanced FX risk impact analysis. It provides a methodology of better understanding as well as responding to FX risk. Currently, assessment tools for FX risk exposure in project finance are not simulated as a structure including influence and impact relationships between the risk components. No research works have been carried out to model holistically the FX risk exposure under the dispersion ellipsoid methodology in PPP projects. The process has never been applied in project finance risk modelling before.

Furthermore, the FEE methodology is an extra tool which is linked to the financial models. Therefore, the methodology needs to be developed just once, and only the input variables are linked to the financial models. As a result, the whole modelling process becomes much simpler compared with Monte Carlo simulation. A Monte Carlo simulation is normally built up and integrated in the financial models. It is an alternative method to Monte Carlo simulation with a computation time advantage. The computation time of the two methods showed a significant advantage of around six minutes for the FEE methodology, compared with 30 minutes for the Monte Carlo simulation. The trend shows that the Monte Carlo simulation takes much more computation time if the dependencies between the variables increase. The time advantage becomes even more significant when comparing several economic cycles. Consequently, the aggregated time advantage of three cycles in the case study is 17 minutes for the FEE methodology and 89 minutes for the Monte Carlo simulation. Due to the stochastic character of both methods, the probability of reaching non-investability grade depends on the numbers of simulation trials with the Monte Carlo simulation. Under the assumptions of the case study, proposition one is validated with a comparison of both methods which shows a maximum variation of 4% in the results of the probability of non-investability.

Proposition 1 was further proved in a case study applied to the Malaysian, Philippine and Indonesian markets. The range of economic FX exposure in all markets on the net operating revenue was compared. The FX exposure includes the values with FX index below 2.0. Indonesia shows the highest potential of economic FX exposure as well as the highest differences between the cycles. Investors can decide if they should price the most negative scenario of cycle 2, indicating the Asian financial crises, or if they should follow the pattern of the last five years by adopting the lower end of the computed economic FX exposure. The Philippines scenario illustrates much lower economic FX exposure as well as a narrower range compared to Indonesia. In Malaysia the project only shows economic FX exposure from 2008 to 2012. After this period the FX index is above 2.0 for all cycles. In all three cases investors would have an indicator of how deeply currency devaluation can affect the project and they can compute a most likely case by replicating the history.

A further case study shows the predicted FX exposure versus the actual FX exposure. Overall the applied cycles showed the trend of the actual FX exposure in the project. To increase the accuracy it is necessary to scale the model in annual, monthly or weekly cycles by applying daily rates.

Based on the information aggregated by the FX index, investors have a means to estimate the length of time the project could withstand a FX loss and how well the project is prepared to capture FX exposure. The model can be applied to infrastructure projects such as power, water supply and transportation. It will also assist project sponsors in evaluating critical variables that they need to control. The case studies show that the FX index is a contribution to the traditional risk modelling framework and a fast and robust way to determine the economic FX risk exposure.

Proposition 2 was proved with the development and application of the CRR model. The focus of the CRR model derived in this research is to estimate default probabilities on RMIs such as tariff adjustment or guarantees. RMIs are often applied in PPP projects. The values of these instruments depend on the affordability and willingness by the issuers to honour the obligations.

Past experience during the Asian financial crises showed that government exchange rate guarantees have not been very sustainable for infrastructure projects. If currency devaluation occurs, the guarantee will put an additional burden on the host government's FX reserves and hence increases the costs for the host country. A similar context applies for tariff adjustment mechanisms. Tariff indexation becomes commercially and politically unsustainable as soon as exchange rates are subject to excessively high volatility. In this case, tariffs could increase to a very high level and therefore make the infrastructure unaffordable for the customers. Therefore, both guarantees and tariff adjustment mechanisms can reduce economic FX exposure but their value depends on the issuers' affordability and willingness to honour the obligations. Investors and sponsors need to assess the probability of default on applied RMIs.

The developed CRR index is based on signals and proxies and transferred into a conditional credit rating transition matrix to estimate default probabilities. A major advantage is the dynamic framework of the CRR model. It is not based on questionnaires or subjective opinions. All input variables can be updated frequently with the published macroeconomic input variables. The CRR model has been designed to act as an assessment system and can be used as a monitoring tool for screening country reliability risk in terms of RMIs. Proposition 2 is tested against the sovereign ratings of foreign currency long-term debt in Indonesia, the Philippines, and Malaysia. The CRR index is significant against the sovereign ratings in all three countries and the methodology can be applied to support financial strategies in funding PPP infrastructure.

In a general sense, both models can be applied to infrastructure projects such as power, water or transportation and will help to quantify economic FX exposure and to evaluate RMIs. The FEE model will help to design and monitor the necessary FX protection, and the CRR model will provide additional information in terms of default probabilities on RMIs to prevent underestimation of the risk that governments would refuse to honour obligations after or during a currency devaluation period.

6.2. Limitations of the research

In a quantitative model it is never possible to capture reality as it exists. Both models use historical data to replicate the future. However currencies and country reliability are influenced by many macroeconomic factors and events and it would be impractical to incorporate all the factors that influence FX exposure in PPP projects. On the other hand reality will not be captured and extreme situations could be missed in the modelling methodology. Therefore, in particular, social economic variables are important for further exploration since they are not included in the FEE model.

All case studies used to test the CRR and FEE models are privately financed power supply projects. A comparison of the two models in different sectors and the same regions would lead to interesting findings. It would show sector characteristics on procurement and life-cycle costs. It would be also important to test the model for applicability.

The first-order second-moment reliability method has limitations of accuracy for finding the design point if the feasibility functions become very curved. However, these extreme situations were not discovered in the project finance application. Shortcomings in the methodology can be seen in the difficulty of constraint modelling. If the SD of the fitted distributions is high compared with the initial mean value, it is possible to achieve an unreasonable combination of variables. In this case, the upper boundary must be set close to the initial mean values. If the constraint of the feasibility function g(x) is set too low, the input variables will not be able to reach the non-investability surface. If the FX indices are larger than 20 it will show unreasonable combinations of input variables. Furthermore, the FX index can only be calculated during the time period of principal and interest payments because of the link between DSCR and the current definition of feasibility function g(x).

6.3. Recommendations for future research

This dissertation leaves some open interesting questions for further investigation.

The FEE methodology could be addressed to different infrastructure sectors to explore dependencies on life-cycle costs. From there the impact of economic FX exposure on different life-cycle maintenance strategies could be explored. The FEE model could provide the framework to argue on the use and abuse of FX hedging and FX risk mitigation in different sectors.

Currently the model is limited to project finance. Another avenue to further research is the application of the FEE methodology to trade finance. The FEE model could be a very useful methodology to quantify the FX exposure, especially if a variety of currencies are involved.

The methodology of the CRR risk model is worth further studies. Especially, further variables to derive the CRR index could be explored. Until now factors influencing country reliability were identified in the government's ability to repay debt obligations, liquidity difficulties and political difficulties. The impact of social variables might improve the CRR index and default probabilities on RMIs. Furthermore the annual credit rating transition matrix in structured finance is used as proxy for the CRTM formulation. This matrix could be rebuilt in empirical research on a regional and updated scale.

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Appendices

Appendix I: Monthly data series Indonesia

Appendix 1 – 01: *Monthly data series used to aggregate PDFs -Indonesia , (Source: IFS)*

DESCRIPTOR	CPI:17 CAPITAL CITIES	PPI / WPI	CALL MONEY RATE	DESCRIPTOR	CPI:17 CAPITAL CITIES	PPI / WPI	CALL MONEY RATE
UNITS	Index number	Index number	Percent per annum	UNITS	Index number	Index number	Percent per annum
SCALE	Units	Units	Units	SCALE	Units	Units	Units
SERIESCODE	53664...ZF..	53663...ZF..	53660B..ZF..	SERIESCODE	53664...ZF..	53663...ZF..	53660B..ZF..
M1 1989	25.76	21.95	14.07	M7 1993	37.25	29.03	6.68
M2 1989	26.09	22.23	13.74	M8 1993	37.37	29.03	5.68
M3 1989	26.15	22.37	13.66	M9 1993	37.47	29.17	7.70
M4 1989	26.56	22.66	13.30	M10 1993	37.70	29.17	7.06
M5 1989	26.73	22.94	11.08	M11 1993	37.85	29.03	7.09
M6 1989	26.67	23.08	11.79	M12 1993	38.06	28.89	6.13
M7 1989	26.79	23.22	12.85	M1 1994	38.53	29.17	7.13
M8 1989	26.82	23.08	12.01	M2 1994	39.21	29.31	7.57
M9 1989	26.87	23.08	12.02	M3 1994	39.48	29.31	7.07
M10 1989	27.08	23.22	12.02	M4 1994	39.58	29.59	9.46
M11 1989	27.21	23.50	12.04	M5 1994	39.78	29.88	9.14
M12 1989	27.20	23.50	12.23	M6 1994	39.83	30.16	9.33
M1 1990	27.45	23.93	10.56	M7 1994	40.38	30.73	10.58
M2 1990	27.72	24.21	9.72	M8 1994	40.74	31.15	10.63
M3 1990	27.61	24.07	10.12	M9 1994	40.95	31.15	11.06
M4 1990	27.92	23.93	11.16	M10 1994	41.32	31.43	11.48
M5 1990	28.16	23.79	10.71	M11 1994	41.51	31.72	11.45
M6 1990	28.53	23.79	14.50	M12 1994	41.72	32.00	11.93
M7 1990	29.16	23.79	16.87	M1 1995	42.21	32.57	11.78
M8 1990	29.33	24.64	16.44	M2 1995	42.76	33.13	13.45
M9 1990	29.48	26.62	13.67	M3 1995	43.00	33.27	12.94
M10 1990	29.79	28.18	17.05	M4 1995	43.73	33.84	15.27
M11 1990	29.88	28.04	15.58	M5 1995	43.94	34.12	15.33
M12 1990	29.90	27.47	21.20	M6 1995	44.02	33.98	14.78
M1 1991	30.12	26.90	17.61	M7 1995	44.33	33.98	13.51
M2 1991	30.22	26.62	20.38	M8 1995	44.47	34.12	11.84
M3 1991	30.23	25.63	26.90	M9 1995	44.64	34.27	13.84
M4 1991	30.80	25.35	17.73	M10 1995	44.92	34.27	13.65
M5 1991	30.86	26.05	11.28	M11 1995	45.11	34.55	13.13
M6 1991	31.00	26.19	11.29	M12 1995	45.47	35.12	14.14
M7 1991	31.59	26.34	11.51	M1 1996	46.87	35.68	13.08
M8 1991	32.18	26.48	12.16	M2 1996	47.49	35.82	13.21
M9 1991	32.22	26.76	12.72	M3 1996	47.18	35.96	12.66
M10 1991	32.47	27.04	12.20	M4 1996	47.32	36.25	14.96
M11 1991	32.82	27.33	12.69	M5 1996	47.62	36.25	14.73
M12 1991	32.88	27.33	12.43	M6 1996	47.27	36.53	13.65
M1 1992	33.03	27.33	12.88	M7 1996	47.60	36.53	14.15
M2 1992	33.11	27.47	12.58	M8 1996	47.58	36.53	15.39
M3 1992	33.33	27.33	12.84	M9 1996	47.66	36.96	14.95
M4 1992	33.63	27.33	12.16	M10 1996	47.86	37.38	14.96
M5 1992	33.67	27.61	11.90	M11 1996	48.05	37.52	12.70
M6 1992	33.89	27.89	11.87	M12 1996	48.21	37.81	13.04
M7 1992	33.96	28.32	12.06	M1 1997	49.03	38.23	12.85
M8 1992	34.02	28.18	11.52	M2 1997	49.40	37.95	12.66
M9 1992	34.08	28.18	11.37	M3 1997	49.42	37.66	10.88
M10 1992	34.22	28.32	11.65	M4 1997	49.62	37.52	13.59
M11 1992	34.31	28.32	11.40	M5 1997	49.77	37.52	13.48
M12 1992	34.54	28.18	11.70	M6 1997	49.75	37.38	13.67
M1 1993	35.55	28.74	11.49	M7 1997	50.15	37.66	15.87
M2 1993	36.27	28.89	10.78	M8 1997	50.61	38.66	65.02
M3 1993	36.81	29.03	11.35	M9 1997	51.16	40.50	52.61
M4 1993	36.86	29.03	10.72	M10 1997	51.88	43.47	40.34
M5 1993	36.91	29.03	11.04	M11 1997	52.29	43.75	42.15
M6 1993	37.00	29.03	8.17	M12 1997	53.18	48.28	40.67

Appendix 1 – 02: *Monthly data series used to aggregate PDFs -Indonesia , (Source:IFS)*

DESCRIPTOR	CPI:17 CAPITAL CITIES	PPI / WPI	CALL MONEY RATE	DESCRIPTOR	CPI:17 CAPITAL CITIES	PPI / WPI	CALL MONEY RATE
UNITS	Index number	Index number	Percent per annum	UNITS	Index number	Index number	Percent per annum
SCALE	Units	Units	Units	SCALE	Units	Units	Units
SERIESCODE	53664...ZF..	53663...ZF..	53660B..ZF..	SERIESCODE	53664...ZF..	53663...ZF..	53660B..ZF..
M1 1998	56.84	64.00	57.18	M7 2002	124.78	116.51	14.20
M2 1998	64.09	68.96	64.81	M8 2002	125.13	116.23	12.81
M3 1998	67.61	71.50	51.76	M9 2002	125.81	117.08	10.89
M4 1998	70.69	70.09	70.80	M10 2002	126.48	118.78	8.49
M5 1998	74.49	77.31	63.54	M11 2002	128.82	119.35	11.10
M6 1998	77.94	86.51	64.59	M12 2002	130.37	120.20	8.89
M7 1998	84.62	93.45	75.32	M1 2003	131.44	121.90	10.77
M8 1998	89.95	90.76	81.01	M2 2003	131.68	122.75	11.04
M9 1998	93.32	90.90	66.21	M3 2003	131.40	122.18	12.70
M10 1998	93.07	86.37	59.35	M4 2003	131.56	119.92	9.12
M11 1998	93.15	84.48	65.49	M5 2003	131.83	117.65	6.81
M12 1998	94.47	83.06	33.44	M6 2003	131.93	117.08	8.95
M1 1999	97.28	87.31	37.92	M7 2003	131.98	118.33	5.91
M2 1999	98.50	89.02	39.97	M8 2003	133.12	118.54	7.10
M3 1999	98.26	89.87	41.98	M9 2003	133.59	118.59	4.89
M4 1999	97.66	90.15	35.54	M10 2003	134.38	119.61	7.18
M5 1999	97.38	89.02	28.76	M11 2003	135.68	119.97	3.99
M6 1999	97.05	87.60	22.55	M12 2003	137.00	121.06	4.65
M7 1999	96.03	85.33	14.84	M1 2004	137.78	122.56	7.21
M8 1999	95.14	88.16	12.45	M2 2004	137.75	122.98	5.31
M9 1999	94.36	91.85	12.34	M3 2004	138.25	124.65	5.87
M10 1999	94.41	89.87	12.32	M4 2004	139.60	126.03	4.53
M11 1999	94.64	88.16	12.28	M5 2004	140.83	130.39	4.71
M12 1999	96.28	90.43	12.06	M6 2004	141.51	131.54	4.24
M1 2000	97.55	92.13	9.58	M7 2004	142.05	130.79	4.82
M2 2000	97.62	93.27	9.39	M8 2004	142.18	132.97	4.87
M3 2000	97.18	94.12	9.42	M9 2004	142.20	134.80	4.13
M4 2000	97.72	94.69	9.49	M10 2004	143.00	136.07	10.92
M5 2000	98.55	98.09	9.88	M11 2004	144.28	134.09	4.16
M6 2000	99.04	100.92	11.12	M12 2004	145.77	133.52	3.76
M7 2000	100.30	103.76	10.71	M1 2005	147.86	138.06	5.21
M8 2000	100.82	101.49	10.31	M2 2005	147.61	139.48	5.20
M9 2000	100.76	103.19	10.62	M3 2005	150.31	145.15	5.95
M10 2000	101.93	104.61	10.85	M4 2005	150.94	147.00	6.21
M11 2000	103.27	107.16	11.07	M5 2005	151.25	146.00	6.07
M12 2000	105.28	106.59	11.41	M6 2005	152.01	147.00	6.95
M1 2001	105.63	107.16	11.85	M7 2005	153.19	149.00	5.29
M2 2001	106.55	108.58	22.06	M8 2005	154.03	150.00	8.55
M3 2001	107.50	111.41	12.73	M9 2005	155.09	153.00	6.92
M4 2001	107.99	114.53	13.15	M10 2005	168.59	167.00	7.79
M5 2001	109.21	117.36	13.98	M11 2005	170.80	167.00	7.73
M6 2001	111.03	119.06	13.95	M12 2005	170.72	167.00	9.44
M7 2001	113.39	117.93	15.59	M1 2006	173.04	164.00	9.32
M8 2001	113.15	112.54	14.88	M2 2006	174.05	165.00	10.09
M9 2001	113.87	113.96	15.47	M3 2006	174.10	165.00	10.28
M10 2001	114.64	114.81	15.38	M4 2006	174.19	165.88	10.59
M11 2001	116.60	116.80	15.64	M5 2006	174.84	171.19	10.35
M12 2001	118.49	115.66	15.66	M6 2006	175.62	173.20	10.23
M1 2002	120.85	117.36	19.82	M7 2006	176.41	174.49	10.95
M2 2002	122.67	117.93	15.94	M8 2006	176.98	175.80	11.00
M3 2002	122.64	116.51	15.41	M9 2006	177.66	176.45	8.90
M4 2002	122.35	115.38	15.38	M10 2006	179.19	176.15	6.75
M5 2002	123.32	117.93	15.02	M11 2006	179.80	175.17	5.74
M6 2002	123.77	115.21	14.47	M12 2006	181.98	177.72	5.97

Appendix 1 – 03: *Monthly data series used to aggregate PDFs - Indonesia , (Source: IFS)*

DESCRIPTOR	CPI:17 CAPITAL CITIES	PPI / WPI	CALL MONEY RATE
UNITS	Index number	Index number	Percent per annum
SCALE	Units	Units	Units
SERIESCODE	53664...ZF..	53663...ZF..	53660B..ZF..
M1 2007	183.88	178.62	4.96
M2 2007	185.02	181.04	5.17
M3 2007	185.45	184.78	7.52
M4 2007	185.15	187.92	8.53
M5 2007	185.34	191.92	6.93
M6 2007	185.76	192.92	5.58
M7 2007	187.10	195.52	5.75
M8 2007	188.50	197.20	4.94
M9 2007	190.01	200.26	6.83
M10 2007	191.51	204.29	5.14
M11 2007	191.86	211.02	6.51
M12 2007	193.97	216.60	4.33
M1 2008	197.41	222.44	6.08
M2 2008	198.70	223.90	7.28
M3 2008	200.60	n.a.	8.01

Appendix I: Monthly data series USA

Appendix 1 – 04: *Monthly data series used to aggregate PDFs - USA, (Source: IFS)*

DESCRIPTOR	CPI ALL ITEMS CITY AVERAGE	PPI / WPI	BANK PRIME LOAN RATE	DESCRIPTOR	CPI ALL ITEMS CITY AVERAGE	PPI / WPI	BANK PRIME LOAN RATE
UNITS	Index number	Index number	Percent per annum	UNITS	Index number	Index number	Percent per annum
SCALE	Units	Units	Units	SCALE	Units	Units	Units
SERIESCODE	11164...ZF...	11163...ZF..	11160P..ZF	SERIESCODE	11164...ZF...	11163...ZF..	11160P..ZF
M1 1989	70.33	83.26	10.50	M7 1993	83.86	89.81	6.00
M2 1989	70.62	83.48	10.93	M8 1993	84.09	89.43	6.00
M3 1989	71.02	84.01	11.50	M9 1993	84.26	89.43	6.00
M4 1989	71.49	84.61	11.50	M10 1993	84.61	89.73	6.00
M5 1989	71.89	85.29	11.50	M11 1993	84.67	89.66	6.00
M6 1989	72.07	85.06	11.07	M12 1993	84.67	89.36	6.00
M7 1989	72.24	84.99	10.98	M1 1994	84.90	89.73	6.00
M8 1989	72.36	84.39	10.50	M2 1994	85.19	89.89	6.00
M9 1989	72.59	84.69	10.50	M3 1994	85.48	90.19	6.06
M10 1989	72.94	84.99	10.50	M4 1994	85.60	90.19	6.45
M11 1989	73.11	84.91	10.50	M5 1994	85.66	90.34	6.99
M12 1989	73.23	85.14	10.50	M6 1994	85.95	90.79	7.25
M1 1990	73.98	86.57	10.11	M7 1994	86.18	90.94	7.25
M2 1990	74.33	86.19	10.00	M8 1994	86.53	91.32	7.51
M3 1990	74.74	86.04	10.00	M9 1994	86.76	91.17	7.75
M4 1990	74.86	85.89	10.00	M10 1994	86.82	91.09	7.75
M5 1990	75.03	86.27	10.00	M11 1994	86.93	91.54	8.15
M6 1990	75.44	86.12	10.00	M12 1994	86.93	91.84	8.50
M7 1990	75.73	86.12	10.00	M1 1995	87.28	92.60	8.50
M8 1990	76.42	87.78	10.00	M2 1995	87.63	93.05	9.00
M9 1990	77.06	89.13	10.00	M3 1995	87.92	93.35	9.00
M10 1990	77.53	91.02	10.00	M4 1995	88.21	93.88	9.00
M11 1990	77.70	90.49	10.00	M5 1995	88.39	94.10	9.00
M12 1990	77.70	89.36	10.00	M6 1995	88.56	94.41	9.00
M1 1991	78.17	89.66	9.52	M7 1995	88.56	94.41	8.80
M2 1991	78.28	88.30	9.05	M8 1995	88.79	94.26	8.75
M3 1991	78.40	87.47	9.00	M9 1995	88.97	94.33	8.75
M4 1991	78.51	87.40	9.00	M10 1995	89.26	94.41	8.75
M5 1991	78.75	87.78	8.50	M11 1995	89.20	94.48	8.75
M6 1991	78.98	87.63	8.50	M12 1995	89.14	94.71	8.65
M7 1991	79.09	87.40	8.50	M1 1996	89.66	95.16	8.50
M8 1991	79.33	87.55	8.50	M2 1996	89.95	95.08	8.25
M9 1991	79.68	87.40	8.20	M3 1996	90.42	95.24	8.25
M10 1991	79.79	87.70	8.00	M4 1996	90.77	95.99	8.25
M11 1991	80.02	87.70	7.58	M5 1996	90.94	96.52	8.25
M12 1991	80.08	87.32	7.21	M6 1996	91.00	96.44	8.25
M1 1992	80.20	87.10	6.50	M7 1996	91.17	96.44	8.25
M2 1992	80.49	87.40	6.50	M8 1996	91.35	96.67	8.25
M3 1992	80.89	87.47	6.50	M9 1996	91.64	96.59	8.25
M4 1992	81.01	87.63	6.50	M10 1996	91.93	96.44	8.25
M5 1992	81.13	88.30	6.50	M11 1996	92.10	96.59	8.25
M6 1992	81.42	88.91	6.50	M12 1996	92.10	97.27	8.25
M7 1992	81.59	88.83	6.02	M1 1997	92.39	97.72	8.25
M8 1992	81.82	88.68	6.00	M2 1997	92.68	96.82	8.25
M9 1992	82.06	88.91	6.00	M3 1997	92.92	95.91	8.30
M10 1992	82.35	88.98	6.00	M4 1997	93.03	95.69	8.50
M11 1992	82.46	88.76	6.00	M5 1997	92.97	95.99	8.50
M12 1992	82.40	88.60	6.00	M6 1997	93.09	95.84	8.50
M1 1993	82.81	88.91	6.00	M7 1997	93.21	95.61	8.50
M2 1993	83.10	89.21	6.00	M8 1997	93.38	95.84	8.50
M3 1993	83.39	89.43	6.00	M9 1997	93.61	96.06	8.50
M4 1993	83.62	89.89	6.00	M10 1997	93.84	96.29	8.50
M5 1993	83.74	90.19	6.00	M11 1997	93.79	96.37	8.50
M6 1993	83.86	90.04	6.00	M12 1997	93.67	95.54	8.50

***Appendix 1 – 05:** Monthly data series used to aggregate PDFs - USA, (Source: IFS)*

DESCRIPTOR	CPI ALL ITEMS CITY AVERAGE	PPI / WPI	BANK PRIME LOAN RATE	DESCRIPTOR	CPI ALL ITEMS CITY AVERAGE	PPI / WPI	BANK PRIME LOAN RATE
UNITS	Index number	Index number	Percent per annum	UNITS	Index number	Index number	Percent per annum
SCALE	Units	Units	Units	SCALE	Units	Units	Units
SERIESCODE	11164...ZF...	11163...ZF..	11160P..ZF	SERIESCODE	11164...ZF...	11163...ZF..	11160P..ZF
M1 1998	93.84	94.48	8.50	M7 2002	104.59	98.85	4.75
M2 1998	94.02	94.18	8.50	M8 2002	104.94	99.08	4.75
M3 1998	94.19	93.95	8.50	M9 2002	105.11	99.68	4.75
M4 1998	94.37	94.10	8.50	M10 2002	105.29	100.36	4.75
M5 1998	94.54	94.26	8.50	M11 2002	105.29	100.28	4.35
M6 1998	94.66	94.03	8.50	M12 2002	105.05	100.13	4.25
M7 1998	94.77	94.10	8.50	M1 2003	105.52	101.94	4.25
M8 1998	94.89	93.58	8.50	M2 2003	106.33	103.67	4.25
M9 1998	95.01	93.28	8.49	M3 2003	106.97	106.39	4.25
M10 1998	95.24	93.43	8.12	M4 2003	106.74	103.07	4.25
M11 1998	95.24	93.13	7.89	M5 2003	106.56	103.00	4.25
M12 1998	95.18	92.52	7.75	M6 2003	106.68	103.97	4.22
M1 1999	95.41	92.60	7.75	M7 2003	106.79	103.75	4.00
M2 1999	95.53	92.15	7.75	M8 2003	107.20	103.97	4.00
M3 1999	95.82	92.37	7.75	M9 2003	107.55	104.35	4.00
M4 1999	96.52	93.13	7.75	M10 2003	107.43	104.95	4.00
M5 1999	96.52	93.95	7.75	M11 2003	107.14	104.65	4.00
M6 1999	96.52	94.33	7.75	M12 2003	107.03	105.11	4.00
M7 1999	96.81	94.71	8.00	M1 2004	107.55	106.54	4.00
M8 1999	97.04	95.61	8.06	M2 2004	108.13	107.06	4.00
M9 1999	97.50	96.44	8.25	M3 2004	108.83	107.82	4.00
M10 1999	97.68	96.21	8.25	M4 2004	109.18	109.10	4.00
M11 1999	97.74	96.67	8.37	M5 2004	109.81	110.61	4.00
M12 1999	97.74	96.29	8.50	M6 2004	110.16	110.91	4.00
M1 2000	98.03	96.67	8.50	M7 2004	109.99	111.06	4.25
M2 2000	98.61	97.80	8.73	M8 2004	110.05	111.51	4.42
M3 2000	99.42	98.55	8.83	M9 2004	110.28	111.28	4.59
M4 2000	99.48	98.47	9.00	M10 2004	110.86	113.02	4.75
M5 2000	99.59	99.15	9.24	M11 2004	110.92	114.00	4.92
M6 2000	100.12	100.81	9.50	M12 2004	110.51	113.09	5.15
M7 2000	100.35	100.74	9.50	M1 2005	110.74	113.69	5.25
M8 2000	100.35	100.13	9.50	M2 2005	111.38	114.22	5.49
M9 2000	100.87	101.34	9.50	M3 2005	112.25	115.80	5.59
M10 2000	101.05	102.02	9.50	M4 2005	113.01	116.78	5.75
M11 2000	101.10	101.71	9.50	M5 2005	112.89	116.26	5.99
M12 2000	101.05	102.62	9.50	M6 2005	112.95	116.26	6.01
M1 2001	101.68	105.48	9.05	M7 2005	113.47	117.76	6.25
M2 2001	102.09	103.52	8.50	M8 2005	114.05	118.74	6.43
M3 2001	102.32	102.39	8.32	M9 2005	115.45	122.21	6.60
M4 2001	102.73	102.77	7.80	M10 2005	115.68	125.22	6.75
M5 2001	103.19	103.07	7.24	M11 2005	114.75	123.34	7.00
M6 2001	103.37	102.09	6.98	M12 2005	114.29	122.81	7.16
M7 2001	103.08	100.51	6.75	M1 2006	115.16	123.79	7.26
M8 2001	103.08	100.51	6.67	M2 2006	115.39	121.91	7.50
M9 2001	103.54	100.43	6.28	M3 2006	116.03	122.21	7.54
M10 2001	103.19	98.17	5.53	M4 2006	117.02	123.79	7.75
M11 2001	103.02	97.80	5.10	M5 2006	117.60	124.92	7.92
M12 2001	102.61	96.52	4.84	M6 2006	117.83	125.15	8.02
M1 2002	102.85	96.82	4.75	M7 2006	118.18	125.67	8.25
M2 2002	103.25	96.74	4.75	M8 2006	118.41	126.50	8.25
M3 2002	103.83	97.80	4.75	M9 2006	117.83	124.62	8.25
M4 2002	104.41	98.55	4.75	M10 2006	117.19	122.21	8.25
M5 2002	104.41	98.55	4.75	M11 2006	117.02	124.02	8.25
M6 2002	104.47	98.63	4.75	M12 2006	117.19	124.77	8.25

Appendix 1 – 06: *Monthly data series used to aggregate PDFs - USA, (Source: IFS)*

DESCRIPTOR	CPI ALL ITEMS CITY AVERAGE	PPI / WPI	BANK PRIME LOAN RATE
UNITS	Index number	Index number	Percent per annum
SCALE	Units	Units	Units
SERIESCODE	11164...ZF...	11163...ZF..	11160P..ZF
M1 2007	117.55	123.56	8.25
M2 2007	118.18	125.67	8.25
M3 2007	119.25	127.56	8.25
M4 2007	120.03	129.14	8.25
M5 2007	120.76	130.57	8.25
M6 2007	120.99	130.95	8.25
M7 2007	120.96	131.93	8.25
M8 2007	120.74	129.89	8.25
M9 2007	121.07	130.72	8.03
M10 2007	121.33	131.63	7.74
M11 2007	122.05	135.17	7.50
M12 2007	121.97	134.56	7.33
M1 2008	122.58	136.22	6.98
M2 2008	122.93	137.43	6.00

Appendix I: Monthly data series Philippines

Appendix 1 – 07: *Monthly data series used to aggregate PDFs - Philippines , (Source: IFS)*

DESCRIPTOR	CPI:ALL INC H'HLDS-459 ITEMS	PPI / WPI	MONEY MARKET RATE	DESCRIPTOR	CPI:ALL INC H'HLDS-459 ITEMS	PPI / WPI	MONEY MARKET RATE
UNITS	Index number	Index number	Percent per annum	UNITS	Index number	Index number	Percent per annum
SCALE	Units	Units	Units	SCALE	Units	Units	Units
SERIESCODE	56664...ZF...	56663...ZF...	56660B..ZF...	SERIESCODE	56664...ZF...	56663...ZF...	56660B..ZF...
M1 1989	38.98	n.a.	14.06	M7 1993	63.52	64.38	10.97
M2 1989	39.15	n.a.	13.40	M8 1993	63.94	64.24	19.51
M3 1989	39.08	n.a.	13.60	M9 1993	64.69	64.59	11.95
M4 1989	39.30	n.a.	12.70	M10 1993	65.17	65.31	15.25
M5 1989	39.70	n.a.	17.60	M11 1993	65.31	65.20	14.92
M6 1989	40.48	n.a.	15.30	M12 1993	65.58	65.50	24.08
M7 1989	40.96	n.a.	13.60	M1 1994	66.89	65.23	12.94
M8 1989	41.65	n.a.	11.40	M2 1994	67.64	65.08	20.11
M9 1989	41.97	n.a.	26.50	M3 1994	67.64	65.73	15.00
M10 1989	42.36	n.a.	21.80	M4 1994	67.78	65.98	20.25
M11 1989	42.81	n.a.	10.50	M5 1994	68.12	66.66	23.30
M12 1989	43.78	n.a.	10.30	M6 1994	68.46	66.69	12.90
M1 1990	43.97	n.a.	11.35	M7 1994	68.94	66.96	13.52
M2 1990	44.11	n.a.	10.13	M8 1994	69.42	67.38	10.28
M3 1990	44.32	n.a.	16.50	M9 1994	69.56	67.42	8.68
M4 1990	44.66	n.a.	17.01	M10 1994	69.56	67.69	8.61
M5 1990	44.93	n.a.	17.61	M11 1994	69.56	67.57	10.33
M6 1990	45.41	n.a.	8.38	M12 1994	69.63	68.27	11.96
M7 1990	46.10	n.a.	10.13	M1 1995	71.28	67.73	9.17
M8 1990	46.24	n.a.	16.94	M2 1995	71.62	68.26	11.11
M9 1990	46.72	n.a.	15.11	M3 1995	71.89	68.70	20.51
M10 1990	47.54	n.a.	9.46	M4 1995	72.17	69.02	21.38
M11 1990	48.36	n.a.	10.29	M5 1995	72.85	69.18	11.22
M12 1990	50.01	n.a.	36.21	M6 1995	73.47	69.33	9.86
M1 1991	51.59	n.a.	11.97	M7 1995	74.02	70.07	8.84
M2 1991	52.62	n.a.	12.58	M8 1995	75.12	70.21	7.43
M3 1991	53.10	n.a.	14.72	M9 1995	76.70	70.33	8.38
M4 1991	53.44	n.a.	10.40	M10 1995	76.76	70.27	9.22
M5 1991	53.71	n.a.	18.00	M11 1995	76.63	70.52	11.87
M6 1991	54.33	n.a.	11.43	M12 1995	76.83	71.01	14.13
M7 1991	54.88	n.a.	16.52	M1 1996	79.03	71.43	14.05
M8 1991	55.57	n.a.	21.16	M2 1996	79.58	72.12	14.07
M9 1991	56.12	n.a.	20.44	M3 1996	79.85	72.16	13.95
M10 1991	56.12	n.a.	15.87	M4 1996	80.13	72.09	13.16
M11 1991	56.39	n.a.	20.03	M5 1996	80.26	72.39	13.08
M12 1991	56.66	n.a.	14.85	M6 1996	80.81	72.61	14.36
M1 1992	57.08	n.a.	14.51	M7 1996	80.95	72.52	12.17
M2 1992	57.35	n.a.	14.94	M8 1996	81.63	72.37	11.40
M3 1992	57.69	n.a.	14.89	M9 1996	81.57	72.29	11.68
M4 1992	58.04	n.a.	14.06	M10 1996	81.63	72.45	11.58
M5 1992	58.58	n.a.	17.74	M11 1996	81.70	72.90	12.54
M6 1992	59.20	n.a.	15.53	M12 1996	82.32	73.30	11.21
M7 1992	59.68	n.a.	17.55	M1 1997	83.35	73.42	10.59
M8 1992	60.09	n.a.	16.90	M2 1997	83.69	73.72	10.55
M9 1992	60.57	n.a.	20.08	M3 1997	84.10	74.43	10.22
M10 1992	60.71	n.a.	15.17	M4 1997	84.24	74.18	10.20
M11 1992	60.85	n.a.	14.41	M5 1997	84.38	74.07	15.05
M12 1992	60.92	n.a.	23.21	M6 1997	85.41	73.75	14.38
M1 1993	61.40	63.09	13.23	M7 1997	85.61	73.69	24.79
M2 1993	61.60	63.12	12.56	M8 1997	86.09	74.79	18.21
M3 1993	61.74	63.03	11.27	M9 1997	86.85	75.58	15.74
M4 1993	61.95	63.34	10.88	M10 1997	87.26	76.38	33.87
M5 1993	62.08	63.62	10.45	M11 1997	87.81	77.27	16.65
M6 1993	62.70	63.52	10.12	M12 1997	88.29	78.01	13.61

Appendix 1 – 08: *Monthly data series used to aggregate PDFs - Philippines , (Source: IFS)*

DESCRIPTOR	CPI:ALL INC H'HLDS-459 ITEMS	PPI / WPI	MONEY MARKET RATE	DESCRIPTOR	CPI:ALL INC H'HLDS-459 ITEMS	PPI / WPI	MONEY MARKET RATE
UNITS	Index number	Index number	Percent per annum	UNITS	Index number	Index number	Percent per annum
SCALE	Units	Units	Units	SCALE	Units	Units	Units
SERIESCODE	56664...ZF...	56663...ZF...	56660B..ZF...	SERIESCODE	56664...ZF...	56663...ZF...	56660B..ZF...
M1 1998	89.18	83.93	13.00	M7 2002	110.20	120.53	7.10
M2 1998	90.48	83.44	13.50	M8 2002	110.70	121.87	7.08
M3 1998	91.24	82.10	13.30	M9 2002	110.70	122.65	7.05
M4 1998	91.79	82.73	13.20	M10 2002	110.70	123.15	7.05
M5 1998	92.88	83.16	13.60	M11 2002	110.80	123.15	7.06
M6 1998	94.53	82.95	13.30	M12 2002	111.20	125.48	7.08
M7 1998	94.74	83.09	13.20	M1 2003	112.30	127.10	7.07
M8 1998	95.22	82.73	15.80	M2 2003	112.60	129.72	7.06
M9 1998	95.56	83.30	15.90	M3 2003	112.50	129.86	7.08
M10 1998	96.11	83.44	14.00	M4 2003	113.00	127.53	7.20
M11 1998	97.62	83.37	14.10	M5 2003	113.10	128.80	7.14
M12 1998	97.41	82.80	13.90	M6 2003	114.20	128.73	7.07
M1 1999	99.47	83.30	13.20	M7 2003	114.30	130.35	6.85
M2 1999	99.40	85.98	12.70	M8 2003	114.60	129.43	6.82
M3 1999	99.20	85.98	12.30	M9 2003	114.70	131.34	6.82
M4 1999	99.06	86.83	11.10	M10 2003	114.70	134.03	6.81
M5 1999	99.06	87.68	10.10	M11 2003	115.10	133.32	6.84
M6 1999	99.95	88.95	9.50	M12 2003	115.50	132.75	6.88
M7 1999	100.02	89.73	9.10	M1 2004	116.50	135.16	6.84
M8 1999	100.36	90.51	9.00	M2 2004	116.70	136.50	6.89
M9 1999	100.91	91.35	8.80	M3 2004	117.10	137.21	7.07
M10 1999	101.25	92.06	8.79	M4 2004	117.70	136.00	7.13
M11 1999	101.39	92.55	8.65	M5 2004	118.30	138.12	7.11
M12 1999	101.53	92.06	8.75	M6 2004	120.30	138.34	7.20
M1 2000	97.70	95.73	8.70	M7 2004	121.80	139.25	7.14
M2 2000	98.00	96.02	8.75	M8 2004	122.30	138.69	7.11
M3 2000	98.00	97.43	8.84	M9 2004	123.00	139.61	7.02
M4 2000	98.30	97.50	8.87	M10 2004	123.50	146.18	7.00
M5 2000	98.50	97.64	9.69	M11 2004	124.50	147.24	7.06
M6 2000	99.50	98.49	10.34	M12 2004	125.40	147.80	7.00
M7 2000	100.00	100.75	10.40	M1 2005	126.30	148.86	7.00
M8 2000	100.50	102.09	10.25	M2 2005	126.60	147.94	7.04
M9 2000	100.90	102.37	10.94	M3 2005	127.00	149.15	7.04
M10 2000	101.70	103.58	14.17	M4 2005	127.70	152.89	7.25
M11 2000	103.00	104.21	15.06	M5 2005	128.30	152.82	7.18
M12 2000	103.80	104.21	14.03	M6 2005	129.40	154.52	7.20
M1 2001	105.00	112.41	12.45	M7 2005	130.50	154.87	7.26
M2 2001	105.30	112.83	11.23	M8 2005	131.10	155.36	7.17
M3 2001	105.40	113.18	10.57	M9 2005	131.60	162.71	7.31
M4 2001	105.60	113.47	9.82	M10 2005	132.20	160.73	7.64
M5 2001	105.80	114.39	9.42	M11 2005	133.30	154.30	7.94
M6 2001	106.70	115.52	9.06	M12 2005	133.80	166.81	7.74
M7 2001	107.40	116.36	9.17	M1 2006	134.80	178.18	7.69
M8 2001	107.50	116.79	9.44	M2 2006	136.20	176.49	8.20
M9 2001	107.80	116.93	9.22	M3 2006	136.70	173.24	7.83
M10 2001	107.90	116.93	9.00	M4 2006	136.80	174.93	7.85
M11 2001	108.20	116.72	8.69	M5 2006	137.10	175.50	7.91
M12 2001	108.50	116.29	8.95	M6 2006	138.10	177.34	8.02
M1 2002	108.90	116.86	7.81	M7 2006	138.80	179.03	8.03
M2 2002	108.70	116.58	7.48	M8 2006	139.30	177.19	8.05
M3 2002	109.10	117.78	6.90	M9 2006	139.10	176.63	8.10
M4 2002	109.30	118.84	6.97	M10 2006	139.30	175.92	8.02
M5 2002	109.50	119.05	7.06	M11 2006	139.50	175.64	7.02
M6 2002	109.80	119.05	7.13	M12 2006	139.60	176.70	7.38

Appendix 1 – 09: *Monthly data series used to aggregate PDFs -Philippines , (Source: IFS)*

DESCRIPTOR	CPI:ALL INC H'HLDS-459 ITEMS	PPI / WPI	MONEY MARKET RATE
UNITS	Index number	Index number	Percent per annum
SCALE	Units	Units	Units
SERIESCODE	56664...ZF...	56663...ZF...	56660B..ZF...
M1 2007	140.00	177.62	7.52
M2 2007	139.80	176.98	7.17
M3 2007	139.70	177.83	7.88
M4 2007	140.00	179.17	7.99
M5 2007	140.40	179.38	7.47
M6 2007	141.30	179.88	7.03
M7 2007	142.40	180.23	7.04
M8 2007	142.60	179.60	6.69
M9 2007	142.80	179.81	6.56
M10 2007	143.10	179.95	6.35
M11 2007	144.00	178.96	6.32
M12 2007	145.10	178.25	6.26
M1 2008	146.80	n.a.	5.74
M2 2008	147.30	n.a.	5.32
M3 2008	n.a.	n.a.	5.19
M4 2008			5.16
M5 2008			5.13
M6 2008			5.27
M7 2008			5.54
M8 2008			5.87
M9 2008			5.52
M10 2008			5.63
M11 2008			5.63
M12 2008			5.77
M1 2009			5.47
M2 2009			5.24
M3 2009			n.a.

Appendix I: Monthly data series Malaysia

Appendix 1 – 10: *Monthly data series used to aggregate PDFs - Malaysia, (Source: IFS)*

DESCRIPTOR	CPI:ALL INC H'HLDS-459 ITEMS	PPI / WPI	MONEY MARKET RATE	DESCRIPTOR	CPI:ALL INC H'HLDS-459 ITEMS	PPI / WPI	MONEY MARKET RATE
UNITS	Index number	Index number	Percent per annum	UNITS	Index number	Index number	Percent per annum
SCALE	Units	Units	Units	SCALE	Units	Units	Units
SERIESCODE	56664...ZF..	56663...ZF..	56660B..ZF..	SERIESCODE	56664...ZF..	56663...ZF..	56660B..ZF..
M1 1989	38.98	n.a.	14.06	M7 1993	63.52	64.38	10.97
M2 1989	39.15	n.a.	13.40	M8 1993	63.94	64.24	19.51
M3 1989	39.08	n.a.	13.60	M9 1993	64.69	64.59	11.95
M4 1989	39.30	n.a.	12.70	M10 1993	65.17	65.31	15.25
M5 1989	39.70	n.a.	17.60	M11 1993	65.31	65.20	14.92
M6 1989	40.48	n.a.	15.30	M12 1993	65.58	65.50	24.08
M7 1989	40.96	n.a.	13.60	M1 1994	66.89	65.23	12.94
M8 1989	41.65	n.a.	11.40	M2 1994	67.64	65.08	20.11
M9 1989	41.97	n.a.	26.50	M3 1994	67.64	65.73	15.00
M10 1989	42.36	n.a.	21.80	M4 1994	67.78	65.98	20.25
M11 1989	42.81	n.a.	10.50	M5 1994	68.12	66.66	23.30
M12 1989	43.78	n.a.	10.30	M6 1994	68.46	66.69	12.90
M1 1990	43.97	n.a.	11.35	M7 1994	68.94	66.96	13.52
M2 1990	44.11	n.a.	10.13	M8 1994	69.42	67.38	10.28
M3 1990	44.32	n.a.	16.50	M9 1994	69.56	67.42	8.68
M4 1990	44.66	n.a.	17.01	M10 1994	69.56	67.69	8.61
M5 1990	44.93	n.a.	17.61	M11 1994	69.56	67.57	10.33
M6 1990	45.41	n.a.	8.38	M12 1994	69.63	68.27	11.96
M7 1990	46.10	n.a.	10.13	M1 1995	71.28	67.73	9.17
M8 1990	46.24	n.a.	16.94	M2 1995	71.62	68.26	11.11
M9 1990	46.72	n.a.	15.11	M3 1995	71.89	68.70	20.51
M10 1990	47.54	n.a.	9.46	M4 1995	72.17	69.02	21.38
M11 1990	48.36	n.a.	10.29	M5 1995	72.85	69.18	11.22
M12 1990	50.01	n.a.	36.21	M6 1995	73.47	69.33	9.86
M1 1991	51.59	n.a.	11.97	M7 1995	74.02	70.07	8.84
M2 1991	52.62	n.a.	12.58	M8 1995	75.12	70.21	7.43
M3 1991	53.10	n.a.	14.72	M9 1995	76.70	70.33	8.38
M4 1991	53.44	n.a.	10.40	M10 1995	76.76	70.27	9.22
M5 1991	53.71	n.a.	18.00	M11 1995	76.63	70.52	11.87
M6 1991	54.33	n.a.	11.43	M12 1995	76.83	71.01	14.13
M7 1991	54.88	n.a.	16.52	M1 1996	79.03	71.43	14.05
M8 1991	55.57	n.a.	21.16	M2 1996	79.58	72.12	14.07
M9 1991	56.12	n.a.	20.44	M3 1996	79.85	72.16	13.95
M10 1991	56.12	n.a.	15.87	M4 1996	80.13	72.09	13.16
M11 1991	56.39	n.a.	20.03	M5 1996	80.26	72.39	13.08
M12 1991	56.66	n.a.	14.85	M6 1996	80.81	72.61	14.36
M1 1992	57.08	n.a.	14.51	M7 1996	80.95	72.52	12.17
M2 1992	57.35	n.a.	14.94	M8 1996	81.63	72.37	11.40
M3 1992	57.69	n.a.	14.89	M9 1996	81.57	72.29	11.68
M4 1992	58.04	n.a.	14.06	M10 1996	81.63	72.45	11.58
M5 1992	58.58	n.a.	17.74	M11 1996	81.70	72.90	12.54
M6 1992	59.20	n.a.	15.53	M12 1996	82.32	73.30	11.21
M7 1992	59.68	n.a.	17.55	M1 1997	83.35	73.42	10.59
M8 1992	60.09	n.a.	16.90	M2 1997	83.69	73.72	10.55
M9 1992	60.57	n.a.	20.08	M3 1997	84.10	74.43	10.22
M10 1992	60.71	n.a.	15.17	M4 1997	84.24	74.18	10.20
M11 1992	60.85	n.a.	14.41	M5 1997	84.38	74.07	15.05
M12 1992	60.92	n.a.	23.21	M6 1997	85.41	73.75	14.38
M1 1993	61.40	63.09	13.23	M7 1997	85.61	73.69	24.79
M2 1993	61.60	63.12	12.56	M8 1997	86.09	74.79	18.21
M3 1993	61.74	63.03	11.27	M9 1997	86.85	75.58	15.74
M4 1993	61.95	63.34	10.88	M10 1997	87.26	76.38	33.87
M5 1993	62.08	63.62	10.45	M11 1997	87.81	77.27	16.65
M6 1993	62.70	63.52	10.12	M12 1997	88.29	78.01	13.61

Appendix 1 – 11: *Monthly data series used to aggregate PDFs - Malaysia, (Source: IFS)*

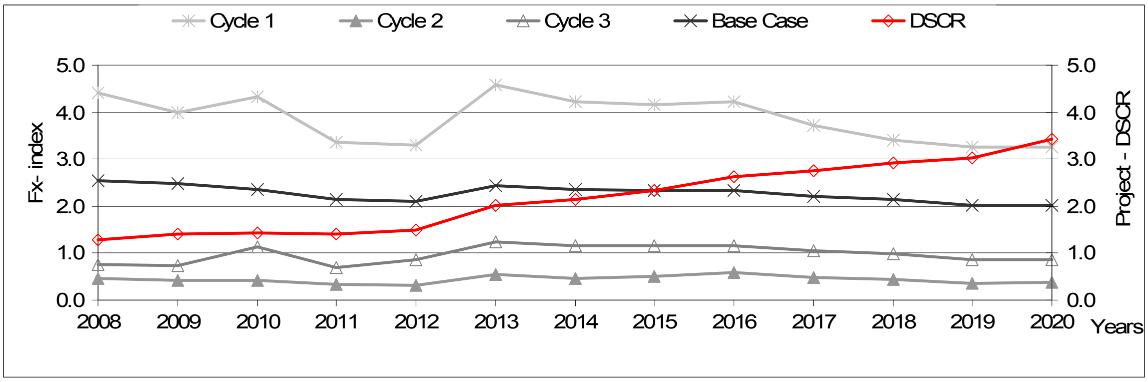
DESCRIPTOR	CPI:ALL INC H'HLDS-459 ITEMS	PPI / WPI	MONEY MARKET RATE	DESCRIPTOR	CPI:ALL INC H'HLDS-459 ITEMS	PPI / WPI	MONEY MARKET RATE
UNITS	Index number	Index number	Percent per annum	UNITS	Index number	Index number	Percent per annum
SCALE	Units	Units	Units	SCALE	Units	Units	Units
SERIESCODE	56664...ZF...	56663...ZF...	56660B..ZF...	SERIESCODE	56664...ZF...	56663...ZF...	56660B..ZF...
M1 1998	89.18	83.93	13.00	M7 2002	110.20	120.53	7.10
M2 1998	90.48	83.44	13.50	M8 2002	110.70	121.87	7.08
M3 1998	91.24	82.10	13.30	M9 2002	110.70	122.65	7.05
M4 1998	91.79	82.73	13.20	M10 2002	110.70	123.15	7.05
M5 1998	92.88	83.16	13.60	M11 2002	110.80	123.15	7.06
M6 1998	94.53	82.95	13.30	M12 2002	111.20	125.48	7.08
M7 1998	94.74	83.09	13.20	M1 2003	112.30	127.10	7.07
M8 1998	95.22	82.73	15.80	M2 2003	112.60	129.72	7.06
M9 1998	95.56	83.30	15.90	M3 2003	112.50	129.86	7.08
M10 1998	96.11	83.44	14.00	M4 2003	113.00	127.53	7.20
M11 1998	97.62	83.37	14.10	M5 2003	113.10	128.80	7.14
M12 1998	97.41	82.80	13.90	M6 2003	114.20	128.73	7.07
M1 1999	99.47	83.30	13.20	M7 2003	114.30	130.35	6.85
M2 1999	99.40	85.98	12.70	M8 2003	114.60	129.43	6.82
M3 1999	99.20	85.98	12.30	M9 2003	114.70	131.34	6.82
M4 1999	99.06	86.83	11.10	M10 2003	114.70	134.03	6.81
M5 1999	99.06	87.68	10.10	M11 2003	115.10	133.32	6.84
M6 1999	99.95	88.95	9.50	M12 2003	115.50	132.75	6.88
M7 1999	100.02	89.73	9.10	M1 2004	116.50	135.16	6.84
M8 1999	100.36	90.51	9.00	M2 2004	116.70	136.50	6.89
M9 1999	100.91	91.35	8.80	M3 2004	117.10	137.21	7.07
M10 1999	101.25	92.06	8.79	M4 2004	117.70	136.00	7.13
M11 1999	101.39	92.55	8.65	M5 2004	118.30	138.12	7.11
M12 1999	101.53	92.06	8.75	M6 2004	120.30	138.34	7.20
M1 2000	97.70	95.73	8.70	M7 2004	121.80	139.25	7.14
M2 2000	98.00	96.02	8.75	M8 2004	122.30	138.69	7.11
M3 2000	98.00	97.43	8.84	M9 2004	123.00	139.61	7.02
M4 2000	98.30	97.50	8.87	M10 2004	123.50	146.18	7.00
M5 2000	98.50	97.64	9.69	M11 2004	124.50	147.24	7.06
M6 2000	99.50	98.49	10.34	M12 2004	125.40	147.80	7.00
M7 2000	100.00	100.75	10.40	M1 2005	126.30	148.86	7.00
M8 2000	100.50	102.09	10.25	M2 2005	126.60	147.94	7.04
M9 2000	100.90	102.37	10.94	M3 2005	127.00	149.15	7.04
M10 2000	101.70	103.58	14.17	M4 2005	127.70	152.89	7.25
M11 2000	103.00	104.21	15.06	M5 2005	128.30	152.82	7.18
M12 2000	103.80	104.21	14.03	M6 2005	129.40	154.52	7.20
M1 2001	105.00	112.41	12.45	M7 2005	130.50	154.87	7.26
M2 2001	105.30	112.83	11.23	M8 2005	131.10	155.36	7.17
M3 2001	105.40	113.18	10.57	M9 2005	131.60	162.71	7.31
M4 2001	105.60	113.47	9.82	M10 2005	132.20	160.73	7.64
M5 2001	105.80	114.39	9.42	M11 2005	133.30	154.30	7.94
M6 2001	106.70	115.52	9.06	M12 2005	133.80	166.81	7.74
M7 2001	107.40	116.36	9.17	M1 2006	134.80	178.18	7.69
M8 2001	107.50	116.79	9.44	M2 2006	136.20	176.49	8.20
M9 2001	107.80	116.93	9.22	M3 2006	136.70	173.24	7.83
M10 2001	107.90	116.93	9.00	M4 2006	136.80	174.93	7.85
M11 2001	108.20	116.72	8.69	M5 2006	137.10	175.50	7.91
M12 2001	108.50	116.29	8.95	M6 2006	138.10	177.34	8.02
M1 2002	108.90	116.86	7.81	M7 2006	138.80	179.03	8.03
M2 2002	108.70	116.58	7.48	M8 2006	139.30	177.19	8.05
M3 2002	109.10	117.78	6.90	M9 2006	139.10	176.63	8.10
M4 2002	109.30	118.84	6.97	M10 2006	139.30	175.92	8.02
M5 2002	109.50	119.05	7.06	M11 2006	139.50	175.64	7.02
M6 2002	109.80	119.05	7.13	M12 2006	139.60	176.70	7.38

Appendix 1 – 12: *Monthly data series used to aggregate PDFs - Malaysia, (Source: IFS)*

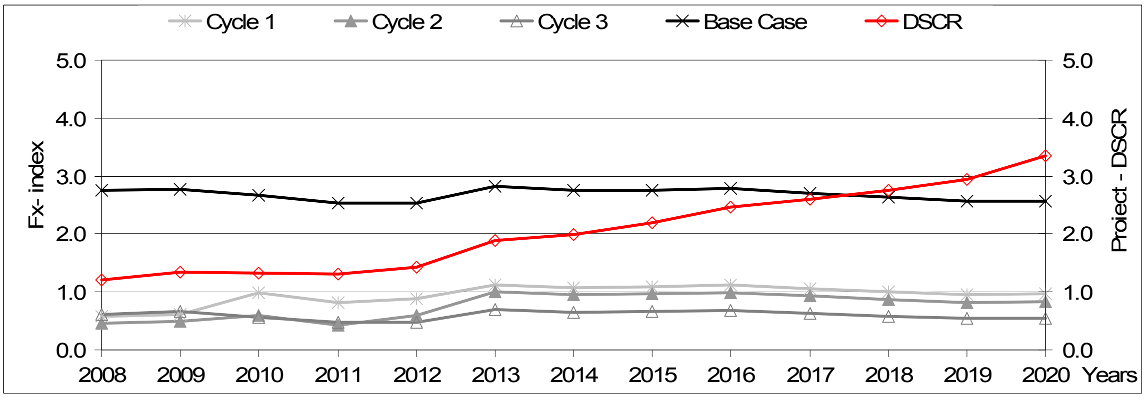
DESCRIPTOR	CPI:ALL INC H'HLDS-459 ITEMS	PPI / WPI	MONEY MARKET RATE
UNITS	Index number	Index number	Percent per annum
SCALE	Units	Units	Units
SERIESCODE	56664...ZF..	56663...ZF..	56660B..ZF..
M1 2007	140.00	177.62	7.52
M2 2007	139.80	176.98	7.17
M3 2007	139.70	177.83	7.88
M4 2007	140.00	179.17	7.99
M5 2007	140.40	179.38	7.47
M6 2007	141.30	179.88	7.03
M7 2007	142.40	180.23	7.04
M8 2007	142.60	179.60	6.69
M9 2007	142.80	179.81	6.56
M10 2007	143.10	179.95	6.35
M11 2007	144.00	178.96	6.32
M12 2007	145.10	178.25	6.26
M1 2008	146.80	n.a.	5.74
M2 2008	147.30	n.a.	5.32
M3 2008	n.a.	n.a.	5.19
M4 2008			5.16
M5 2008			5.13
M6 2008			5.27
M7 2008			5.54
M8 2008			5.87
M9 2008			5.52
M10 2008			5.63
M11 2008			5.63
M12 2008			5.77
M1 2009			5.47
M2 2009			5.24
M3 2009			n.a.

Appendix II: FX exposure index versus DSCR

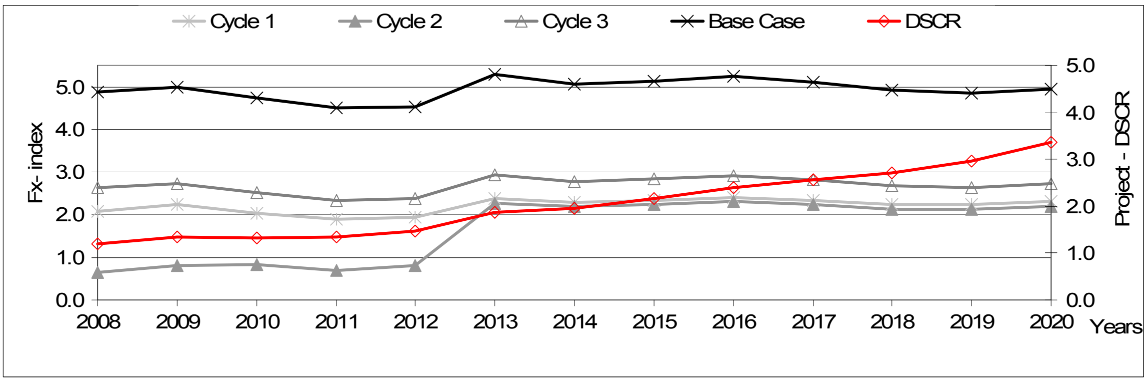
Appendix 2 – 1: *FX exposure index versus DSCR-Indonesia*



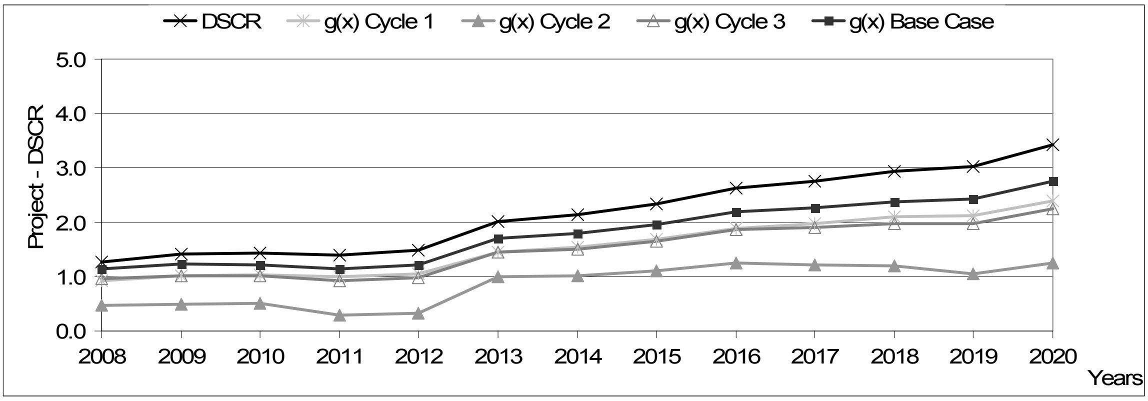
Appendix 2 – 2: *FX exposure index versus DSCR-Philippines*



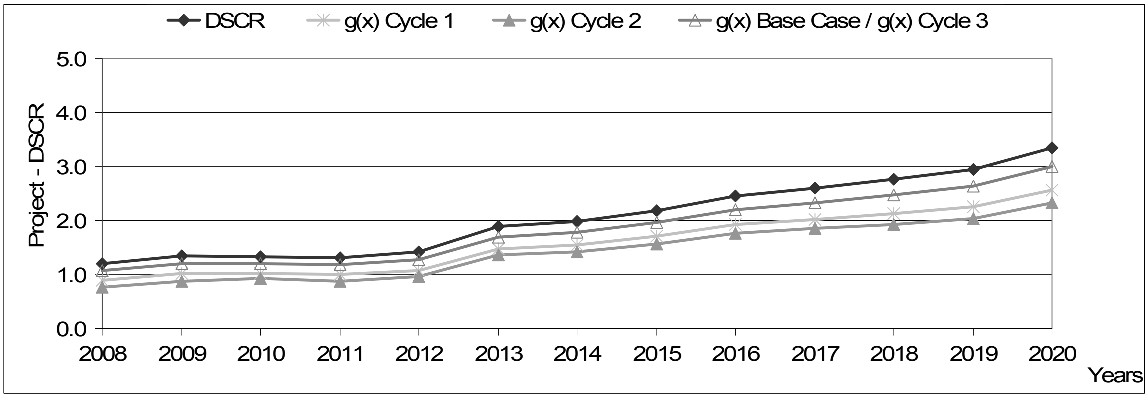
Appendix 2 – 3: *FX exposure index versus DSCR-Malaysia*



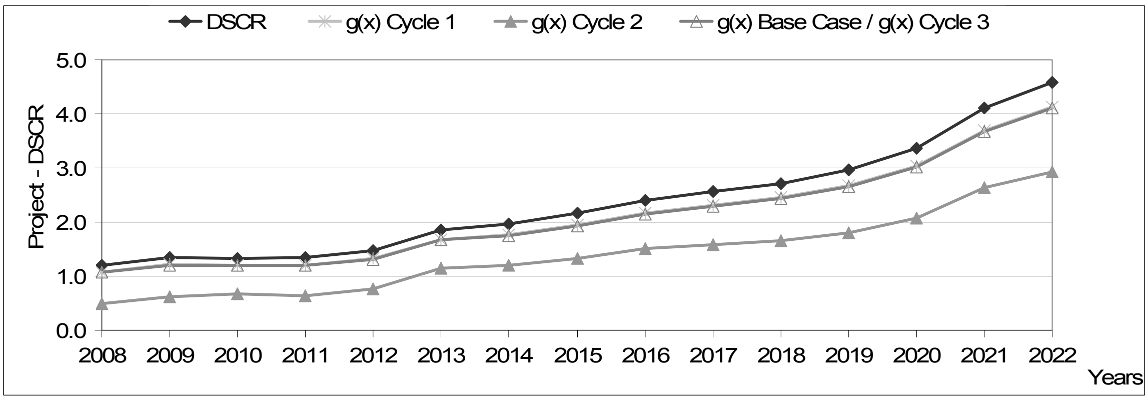
Appendix 2 – 4: *Feasibility function g(x)-Indonesia*



Appendix 2 – 5: *Feasibility function g(x)-Philippines*



Appendix 2 – 6: *Feasibility function g(x)-Malaysia*



Appendix 3: Financial statements – Case Study A

Appendix 3 – 1: Profit & Loss statement

(All figures in US$Million)

Profit & Loss statement

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Revenue	0.00	0.00	0.00	0.00	11.17	90.02	91.55	93.20	96.13	118.65	112.64
VAT Receivable	0.00	0.00	0.00	0.00	1.12	9.00	9.15	9.32	9.61	11.87	11.26
Interest on Reserves	0.00	0.00	0.00	0.00	0.00	0.38	1.18	1.74	1.70	1.63	1.56
Operating Costs	0.00	0.00	0.00	0.00	5.42	44.14	46.69	48.85	51.69	75.32	70.20
VAT Payable	0.00	0.00	0.00	0.00	0.00	0.00	0.60	9.32	9.61	11.87	11.26
Net operating revenue	0.00	0.00	0.00	0.00	6.87	55.26	54.58	46.08	46.13	44.96	44.00
Local currency debt interest	0.00	0.00	0.00	0.00	0.00	4.87	3.87	4.09	4.21	3.81	3.32
USD Debt Interest T2	0.00	0.00	0.00	0.00	0.00	8.87	8.48	8.09	7.70	7.31	6.92
USD Debt Interest T1	0.00	0.00	0.00	0.00	0.00	17.99	17.20	16.41	15.62	14.83	14.04
Tax / Book Depreciation	0.00	0.00	0.00	0.00	2.33	18.65	18.65	18.65	18.65	18.65	18.65
Profit Before Tax	0.00	0.00	0.00	0.00	4.54	4.88	6.38	-1.16	-0.05	0.36	1.06
Current Income Tax	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.37
Retained Earnings b/f	0.00	0.00	0.00	0.00	0.00	4.54	9.42	14.31	8.63	2.61	-2.05
Max Available for Book Distributions	0.00	0.00	0.00	0.00	4.54	9.42	15.80	13.15	8.58	2.84	0.00
Cash Amount Available & Paid as Dividend:	0.00	0.00	0.00	0.00	0.00	0.00	1.49	4.52	5.97	4.88	7.39

Appendix 3 – 2: *Profit & Loss statement*

(All figures in US$Million)
Profit & Loss statement

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Revenue	112.64	117.48	123.91	172.12	177.14	176.58	188.60	194.55	200.84	207.51	214.59
VAT Receivable	11.26	11.75	12.39	17.21	17.71	17.66	18.86	19.45	20.08	20.75	21.46
Interest on Reserves	1.56	1.51	1.45	1.40	1.34	1.26	1.23	1.17	1.11	1.06	1.00
Operating Costs	70.20	75.56	80.36	125.35	133.60	139.40	151.76	155.71	141.27	149.96	153.81
VAT Payable	11.26	11.75	12.39	17.21	17.71	17.66	18.86	19.45	20.08	20.75	21.46
Net operating revenue	44.00	43.43	45.01	48.17	44.89	38.44	38.06	40.00	60.69	58.61	61.78
Local currency debt interest	3.32	3.35	3.15	2.95	2.75	2.21	2.35	2.15	1.95	1.75	1.55
USD Debt Interest T2	6.92	6.53	6.14	5.75	5.36	4.97	4.58	4.19	3.80	3.41	3.02
USD Debt Interest T1	14.04	13.25	12.46	11.66	10.87	10.08	9.29	8.50	7.71	6.92	6.13
Tax / Book Depreciation	18.65	18.65	18.65	18.65	17.57	10.03	10.03	10.03	10.03	10.03	10.03
Profit Before Tax	1.06	1.65	4.61	9.16	8.33	11.14	11.81	15.13	37.19	36.49	41.05
Current Income Tax	0.37	0.58	1.61	3.20	2.91	3.90	4.13	5.30	13.02	12.77	14.37
Retained Earnings b/f	-2.05	-8.75	-14.44	-19.93	-21.81	-27.26	-25.05	-21.61	-18.49	-13.94	-10.93
Max Available for Book Distributions	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.68	9.78	15.75
Cash Amount Available & Paid as Dividend:	7.39	6.77	8.49	7.83	10.87	5.02	4.24	6.71	19.62	20.71	23.36

Appendix 3 – 3: *Profit & Loss statement*

(All figures in US$Million)

Profit & Loss statement

Year	2016	2017	2018	2019	2020	2021	2022	2023	2024
Revenue	222.10	230.08	238.56	247.59	257.21	267.47	278.42	290.12	264.80
VAT Receivable	22.21	23.01	23.86	24.76	25.72	26.75	27.84	29.01	26.48
Interest on Reserves	0.94	0.89	0.83	0.77	0.71	0.66	0.60	0.00	0.00
Operating Costs	156.27	167.49	175.79	189.01	193.46	186.88	196.15	213.64	197.79
VAT Payable	22.21	23.01	23.86	24.76	25.72	26.75	27.84	29.01	26.48
Net operating revenue	66.77	63.47	63.59	59.35	64.46	81.25	82.88	76.48	67.01
Local currency debt interest	1.35	1.15	0.95	0.75	0.55	0.35	0.15	0.00	0.00
USD Debt Interest T2	2.63	2.24	1.85	1.46	1.07	0.68	0.29	0.00	0.00
USD Debt Interest T1	5.34	4.55	3.76	2.97	2.17	1.38	0.59	0.00	0.00
Tax / Book Depreciation	10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03	8.78
Profit Before Tax	47.42	45.50	47.01	44.15	50.64	68.80	71.81	66.45	58.23
Current Income Tax	16.60	15.93	16.45	15.45	17.72	24.08	25.13	23.26	20.38
Retained Earnings b/f	-7.61	-4.10	-1.44	1.94	4.80	8.50	12.99	6.86	-2.67
Max Available for Book Distributions	23.21	25.47	29.11	30.63	37.72	53.22	59.67	50.05	35.19
Cash Amount Available & Paid as Dividend:	27.31	26.91	27.18	25.83	29.22	40.23	52.81	52.72	77.50

Appendix 3 – 4: *Balance Sheet*

(All figures in US$Million)

Balance Sheet

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Fixed Assets											
Civil	0.00	0.00	17.86	46.92	50.57	50.57	50.57	50.57	50.57	50.57	50.57
Plant	0.00	0.00	22.81	181.26	200.20	200.20	200.20	200.20	200.20	200.20	200.20
Financing Costs	0.00	0.00	21.06	44.73	86.21	86.21	86.21	86.21	86.21	86.21	86.21
Development Costs	0.00	0.00	13.34	39.44	48.63	48.63	48.63	48.63	48.63	48.63	48.63
Depreciation	0.00	0.00	0.00	0.00	-2.33	-20.98	-39.64	-58.29	-76.94	-95.59	-114.24
Net Book Value	0.00	0.00	75.07	312.34	383.28	364.63	345.97	327.32	308.67	290.02	271.37
Cash in Reserve Account	0.00	0.00	0.00	0.00	6.87	21.43	31.57	30.85	29.62	28.28	27.48
Working Capital	0.00	0.00	0.00	0.00	16.00	11.35	11.39	11.58	11.84	13.63	12.96
Current Liabilities:											
Local currency debt	0.00	0.00	0.00	0.00	1.50	1.25	1.39	1.50	1.43	1.32	1.40
USD Bank Debt T2	0.00	0.00	0.00	0.00	3.62	3.62	3.62	3.62	3.62	3.62	3.62
USD Bank Debt T1	0.00	0.00	0.00	0.00	8.49	8.49	8.49	8.49	8.49	8.49	8.49
Income Tax	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Net Current Assets	0.00	0.00	75.07	312.34	392.53	384.05	375.44	356.15	336.59	318.50	298.29
Equity	0.00	0.00	38.54	66.75	93.00	93.00	93.00	93.00	93.00	93.00	93.00
USD Bank Debt T1	0.00	0.00	34.06	155.48	186.77	178.28	169.79	161.30	152.81	144.32	135.83
Local currency debt	0.00	0.00	0.50	30.00	28.50	27.25	25.86	24.37	22.94	21.62	20.22
USD Bank Debt T2	0.00	0.00	1.97	60.11	79.72	76.10	72.48	68.85	65.23	61.61	57.98
Retained Earnings	0.00	0.00	0.00	0.00	4.54	9.42	14.31	8.63	2.61	-2.05	-8.75
FINANCED BY	0.00	0.00	75.07	312.34	392.53	384.05	375.44	356.15	336.59	318.50	298.29

Appendix 3 – 5: Balance Sheet

(All figures in US$Million)

Balance Sheet

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Fixed Assets										
Civil	50.57	50.57	50.57	50.57	50.57	50.57	50.57	50.57	50.57	50.57
Plant	200.20	200.20	200.20	200.20	200.20	200.20	200.20	200.20	200.20	200.20
Financing Costs	86.21	86.21	86.21	86.21	86.21	86.21	86.21	86.21	86.21	86.21
Development Costs	48.63	48.63	48.63	48.63	48.63	48.63	48.63	48.63	48.63	48.63
Depreciation	-132.90	-151.55	-170.20	-187.77	-197.81	-207.84	-217.87	-227.90	-237.93	-247.96
Net Book Value	252.71	234.06	215.41	197.83	187.80	177.77	167.74	157.71	147.68	137.65
Cash in Reserve Account	26.45	25.41	24.38	22.95	22.30	21.27	20.23	19.20	18.16	17.13
Working Capital	13.43	14.11	18.40	18.43	17.99	18.97	19.64	21.75	22.30	23.17
Current Liabilities:										
Local currency debt	1.40	1.40	1.40	1.22	1.40	1.40	1.40	1.40	1.40	1.40
USD Bank Debt T2	3.62	3.62	3.62	3.62	3.62	3.62	3.62	3.62	3.62	3.62
USD Bank Debt T1	8.49	8.49	8.49	8.49	8.49	8.49	8.49	8.49	8.49	8.49
Income Tax	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Net Current Assets	279.07	260.07	244.67	225.88	214.58	204.50	194.10	185.14	174.63	164.43
Equity	93.00	93.00	93.00	93.00	93.00	93.00	93.00	93.00	93.00	93.00
USD Bank Debt T1	127.34	118.85	110.36	101.88	93.39	84.90	76.41	67.92	59.43	50.94
Local currency debt	18.81	17.41	16.01	14.79	13.38	11.98	10.57	9.17	7.77	6.36
USD Bank Debt T2	54.36	50.73	47.11	43.49	39.86	36.24	32.61	28.99	25.37	21.74
Retained Earnings	-14.44	-19.93	-21.81	-27.26	-25.05	-21.61	-18.49	-13.94	-10.93	-7.61
FINANCED BY	279.07	260.07	244.67	225.88	214.58	204.50	194.10	185.14	174.63	164.43

Appendix 3 – 6: *Balance Sheet*

(All figures in US$Million)

Balance Sheet

Year	2016	2017	2018	2019	2020	2021	2022	2023	2024
Fixed Assets									
Civil	50.57	50.57	50.57	50.57	50.57	50.57	50.57	50.57	50.57
Plant	200.20	200.20	200.20	200.20	200.20	200.20	200.20	200.20	200.20
Financing Costs	86.21	86.21	86.21	86.21	86.21	86.21	86.21	86.21	86.21
Development Costs	48.63	48.63	48.63	48.63	48.63	48.63	48.63	48.63	48.63
Depreciation	-257.99	-268.02	-278.05	-288.08	-298.11	-308.14	-318.18	-328.21	-336.98
Net Book Value	127.62	117.59	107.56	97.53	87.50	77.46	67.43	57.40	48.63
Cash in Reserve Account	16.09	15.06	14.02	12.99	11.95	10.91	0.00	0.00	0.00
Working Capital	24.23	24.44	25.37	25.78	27.03	29.07	30.36	30.87	0.00
Current Liabilities:									
Local currency debt	1.40	1.40	1.40	1.40	1.40	1.40	0.00	0.00	0.00
USD Bank Debt T2	3.62	3.62	3.62	3.62	3.62	3.62	0.00	0.00	0.00
USD Bank Debt T1	8.49	8.49	8.49	8.49	8.49	8.49	0.00	0.00	0.00
Income Tax	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Net Current Assets	154.42	143.57	133.43	122.78	112.95	103.93	97.80	88.27	48.63
Equity	93.00	93.00	93.00	93.00	93.00	93.00	93.00	93.00	93.00
USD Bank Debt T1	42.45	33.96	25.47	16.98	8.49	0.00	0.00	0.00	0.00
Local currency debt	4.96	3.55	2.15	0.75	-0.66	-2.06	-2.06	-2.06	-2.06
USD Bank Debt T2	18.12	14.50	10.87	7.25	3.62	-0.00	-0.00	-0.00	-0.00
Retained Earnings	-4.10	-1.44	1.94	4.80	8.50	12.99	6.86	-2.67	-42.31
FINANCED BY	154.42	143.57	133.43	122.78	112.95	103.93	97.80	88.27	48.63

Appendix 3 – 7: *Cash flow*

(All figures in US$Million)

Cash flow

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Capital Expenditure	0.00	0.00	54.01	213.61	47.78						
Interest & Fees	0.00	0.00	21.06	23.66	41.49						
Capital Recovery Fee (A)	0.00	0.00	0.00	0.00	1.25	10.03	10.03	10.03	10.03	10.03	10.03
Fixed Operating Fee (B)	0.00	0.00	0.00	0.00	1.81	14.99	16.20	17.50	18.38	19.30	20.85
Service Fee (C)	0.00	0.00	0.00	0.00	4.05	32.41	32.41	32.41	32.41	32.41	32.41
Infrastructure Fee (D)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Energy Fee (E)	0.00	0.00	0.00	0.00	4.06	32.59	32.91	33.26	35.30	56.91	49.35
Total Revenue	0.00	0.00	0.00	0.00	11.17	90.02	91.55	93.20	96.13	118.65	112.64
VAT Receivable	0.00	0.00	0.00	0.00	1.12	9.00	9.15	9.32	9.61	11.87	11.26
Interest on Reserves	0.00	0.00	0.00	0.00	0.00	0.38	1.18	1.74	1.70	1.63	1.56
Passthrough Fixed Costs	0.00	0.00	0.00	0.00	1.41	11.76	13.88	14.76	15.59	17.46	20.91
Passthrough Variable Costs	0.00	0.00	0.00	0.00	4.01	32.39	32.81	34.09	36.10	57.86	49.29
Non Passthrough Fixed & Variable Costs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VAT Payable	0.00	0.00	0.00	0.00	0.00	0.00	0.60	9.32	9.61	11.87	11.26
Increase/(Decrease) in W/C	0.00	0.00	0.00	0.00	0.00	-4.65	0.04	0.19	0.26	1.79	-0.68
Net Operating Revenue	0.00	0.00	0.00	0.00	6.87	59.91	54.54	45.90	45.88	43.17	44.68
Equity Drawing	0.00	0.00	38.54	28.21	26.25						
USD Debt Drawing T1	0.00	0.00	34.06	121.42	39.78						
Local Currency Debt Drawing	0.00	0.00	0.50	29.50	0.00						
USD Debt Drawing T2	0.00	0.00	1.97	58.14	23.24						
Local Currency Debt Interest	0.00	0.00	0.00	0.00	0.00	4.87	3.87	4.09	4.21	3.81	3.32
USD Bank Debt T2 Interest	0.00	0.00	0.00	0.00	0.00	8.87	8.48	8.09	7.70	7.31	6.92
USD Bank Debt T1 Interest	0.00	0.00	0.00	0.00	0.00	17.99	17.20	16.41	15.62	14.83	14.04
Local currency debt Principal	0.00	0.00	0.00	0.00	0.00	1.50	1.25	1.39	1.50	1.43	1.32
USD debt T2 principal	0.00	0.00	0.00	0.00	0.00	3.62	3.62	3.62	3.62	3.62	3.62
USD debt T1 principal	0.00	0.00	0.00	0.00	0.00	8.49	8.49	8.49	8.49	8.49	8.49
Total Debt Interest and Principal	0.00	0.00	0.00	0.00	0.00	45.35	42.91	42.09	41.14	39.49	37.71
Income Tax	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.37
Net Cash Flow	0.00	0.00	0.00	0.00	6.87	14.56	11.63	3.81	4.74	3.55	6.59
Cash Available	0.00	0.00	0.00	0.00	6.87	21.43	33.06	35.37	35.59	33.17	34.88
Distributions	0.00	0.00	0.00	0.00	0.00	0.00	1.49	4.52	5.97	4.88	7.39
Reserve Account	0.00	0.00	0.00	0.00	6.87	21.43	31.57	30.85	29.62	28.28	27.48
Cash Amount Available & Paid as Dividends	0.00	0.00	0.00	0.00	0.00	0.00	1.49	4.52	5.97	4.88	7.39
W/H Tax on Dividends	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.20	0.27	0.22	0.33
Dividends Paid	0.00	0.00	0.00	0.00	0.00	0.00	1.42	4.32	5.70	4.66	7.06

Appendix 3 – 8: *Cash flow*

(All figures in US$Million)

Cash flow

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Capital Expenditure											
Interest & Fees											
Capital Recovery Fee (A)	10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03
Fixed Operating Fee (B)	22.95	24.60	26.38	28.32	29.63	32.93	35.43	38.14	41.09	44.29	47.77
Service Fee (C)	32.41	32.41	32.41	32.41	31.75	32.41	32.41	32.41	32.41	32.41	32.41
Infrastructure Fee (D)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Energy Fee (E)	52.09	56.88	103.30	106.39	105.17	113.23	116.68	120.26	123.99	127.86	131.89
Total Revenue	117.48	123.91	172.12	177.14	176.58	188.60	194.55	200.84	207.51	214.59	222.10
VAT Receivable	11.75	12.39	17.21	17.71	17.66	18.86	19.45	20.08	20.75	21.46	22.21
Interest on Reserves	1.51	1.45	1.40	1.34	1.26	1.23	1.17	1.11	1.06	1.00	0.94
Passthrough Fixed Costs	22.04	21.91	22.80	31.94	34.59	46.05	49.02	35.42	41.04	43.61	44.69
Passthrough Variable Costs	53.52	58.45	102.55	101.66	104.81	105.71	106.69	105.85	108.93	110.20	111.58
Non Passthrough Fixed & Variable Costs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VAT Payable	11.75	12.39	17.21	17.71	17.66	18.86	19.45	20.08	20.75	21.46	22.21
Increase/(Decrease) in W/C	0.48	0.68	4.29	0.02	-0.44	0.98	0.67	2.10	0.56	0.87	1.06
Net Operating Revenue	42.95	44.33	43.88	44.86	38.88	37.08	39.33	58.58	58.05	60.91	65.71
Equity Drawing											
USD Debt Drawing T1											
Local Currency Debt Drawing											
USD Debt Drawing T2											
Local Currency Debt Interest	3.35	3.15	2.95	2.75	2.21	2.35	2.15	1.95	1.75	1.55	1.35
USD Bank Debt T2 Interest	6.53	6.14	5.75	5.36	4.97	4.58	4.19	3.80	3.41	3.02	2.63
USD Bank Debt T1 Interest	13.25	12.46	11.66	10.87	10.08	9.29	8.50	7.71	6.92	6.13	5.34
Local currency debt Principal	1.40	1.40	1.40	1.40	1.22	1.40	1.40	1.40	1.40	1.40	1.40
USD debt T2 principal	3.62	3.62	3.62	3.62	3.62	3.62	3.62	3.62	3.62	3.62	3.62
USD debt T1 principal	8.49	8.49	8.49	8.49	8.49	8.49	8.49	8.49	8.49	8.49	8.49
Total Debt Interest and Principal	36.64	35.26	33.88	32.50	30.60	29.74	28.36	26.98	25.60	24.22	22.84
Income Tax	0.58	1.61	3.20	2.91	3.90	4.13	5.30	13.02	12.77	14.37	16.60
Net Cash Flow	5.73	7.45	6.79	9.45	4.37	3.21	5.68	18.59	19.68	22.33	26.28
Cash Available	33.21	33.90	32.20	33.82	27.33	25.51	26.95	38.82	38.88	40.49	43.41
Distributions	6.77	8.49	7.83	10.87	5.02	4.24	6.71	19.62	20.71	23.36	27.31
Reserve Account	26.45	25.41	24.38	22.95	22.30	21.27	20.23	19.20	18.16	17.13	16.09
Cash Amount Available & Paid as Dividend	6.77	8.49	7.83	10.87	5.02	4.24	6.71	19.62	20.71	23.36	27.31
W/H Tax on Dividends	0.30	0.38	0.35	0.49	0.23	0.19	0.30	0.88	0.93	1.05	1.23
Dividends Paid	6.46	8.11	7.48	10.38	4.80	4.05	6.41	18.74	19.78	22.31	26.08

Appendix 3 – 9: *Cash flow*

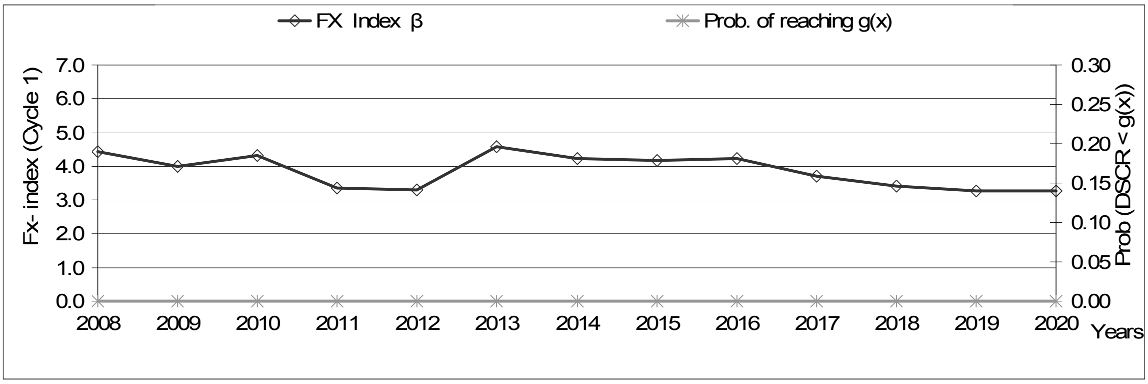
(All figures in US$Million)

Cash flow

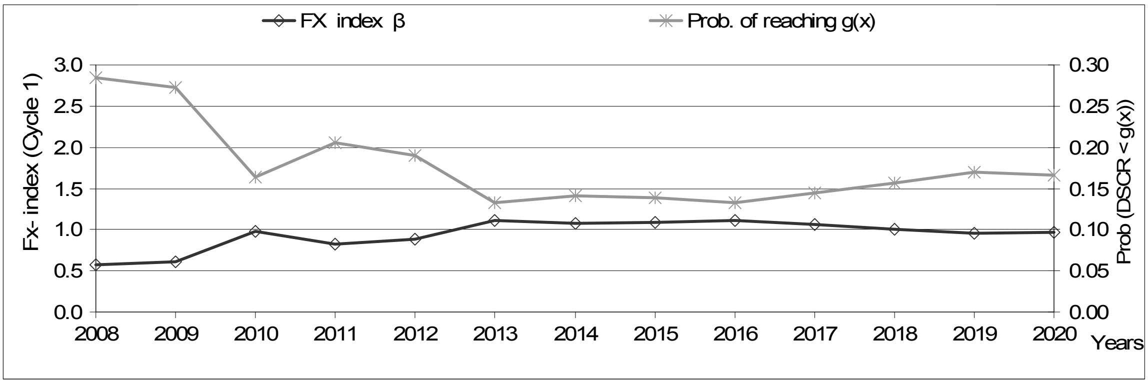
Year	2017	2018	2019	2020	2021	2022	2023	2024
Capital Expenditure								
Interest & Fees								
Capital Recovery Fee (A)	10.03	10.03	10.03	10.03	10.03	10.03	10.03	8.78
Fixed Operating Fee (B)	51.55	55.66	60.14	65.01	70.30	76.07	82.34	78.03
Service Fee (C)	32.41	32.41	32.41	32.41	32.41	32.41	32.41	28.36
Infrastructure Fee (D)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Energy Fee (E)	136.09	140.46	145.01	149.77	154.73	159.92	165.34	149.64
Total Revenue	230.08	238.56	247.59	257.21	267.47	278.42	290.12	264.80
VAT Receivable	23.01	23.86	24.76	25.72	26.75	27.84	29.01	26.48
Interest on Reserves	0.89	0.83	0.77	0.71	0.66	0.60	0.00	0.00
Passthrough Fixed Costs	56.69	61.06	72.49	74.99	69.00	73.21	88.16	85.57
Passthrough Variable Costs	110.80	114.73	116.52	118.48	117.88	122.94	125.48	112.22
Non Passthrough Fixed & Variable Costs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VAT Payable	23.01	23.86	24.76	25.72	26.75	27.84	29.01	26.48
Increase/(Decrease) in W/C	0.22	0.92	0.42	1.24	2.04	1.29	0.51	-30.87
Net Operating Revenue	63.26	62.67	58.94	63.22	79.20	81.58	75.97	97.88
Equity Drawing								
USD Debt Drawing T1								
Local Currency Debt Drawing								
USD Debt Drawing T2								
Local Currency Debt Interest	1.15	0.95	0.75	0.55	0.35	0.15	0.00	0.00
USD Bank Debt T2 Interest	2.24	1.85	1.46	1.07	0.68	0.29	0.00	0.00
USD Bank Debt T1 Interest	4.55	3.76	2.97	2.17	1.38	0.59	0.00	0.00
Local currency debt Principal	1.40	1.40	1.40	1.40	1.40	1.40		
USD debt T2 principal	3.62	3.62	3.62	3.62	3.62	3.62		
USD debt T1 principal	8.49	8.49	8.49	8.49	8.49	8.49		
Total Debt Interest and Principal	21.46	20.08	18.69	17.31	15.93	14.55	0.00	0.00
Income Tax	15.93	16.45	15.45	17.72	24.08	25.13	23.26	20.38
Net Cash Flow	25.88	26.14	24.79	28.18	39.19	41.90	52.72	77.50
Cash Available	41.97	41.20	38.81	41.17	51.14	52.81	52.72	77.50
Distributions	26.91	27.18	25.83	29.22	40.23	52.81	52.72	77.50
Reserve Account	15.06	14.02	12.99	11.95	10.91	0.00	0.00	0.00
Cash Amount Available & Paid as Dividend:	26.91	27.18	25.83	29.22	40.23	52.81	52.72	77.50
W/H Tax on Dividends	1.21	1.22	1.16	1.31	1.81	2.38	2.37	3.49
Dividends Paid	25.70	25.96	24.67	27.90	38.42	50.43	50.35	74.01

Appendix IV: FX exposure index

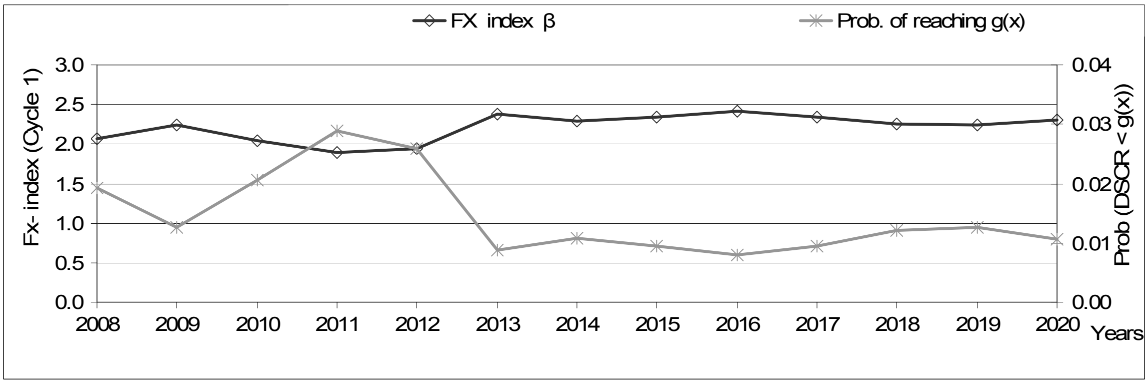
Appendix 4 – 01: *FX exposure index in cycle 1 – Indonesia*



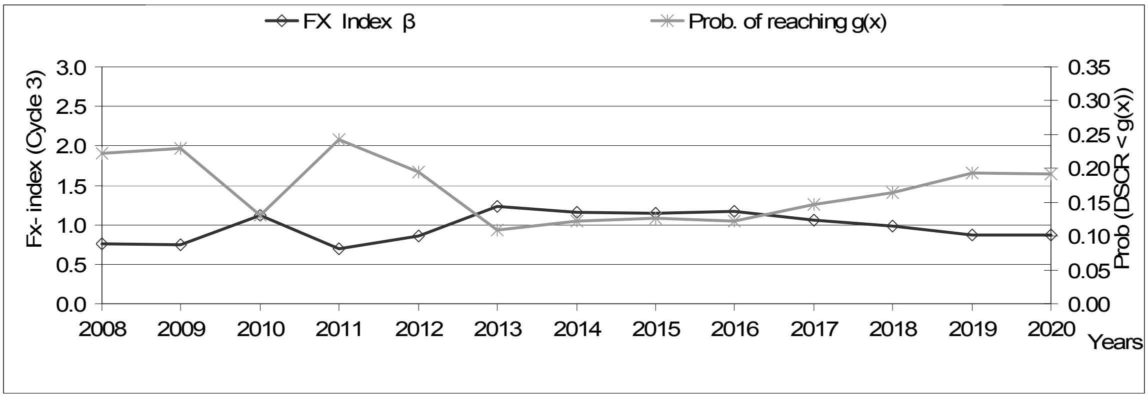
Appendix 4 – 02: *FX exposure index in cycle 1 – Philippines*



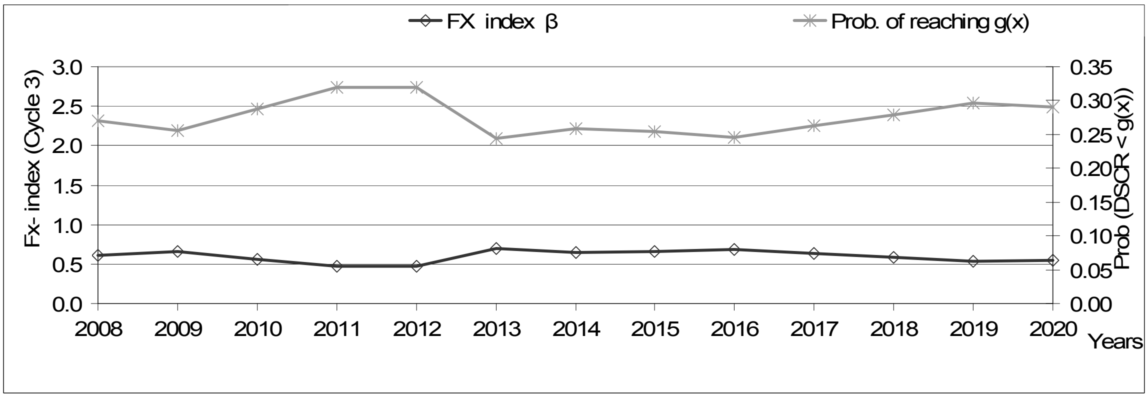
Appendix 4 – 03: *FX exposure index in cycle 1 – Malaysia*



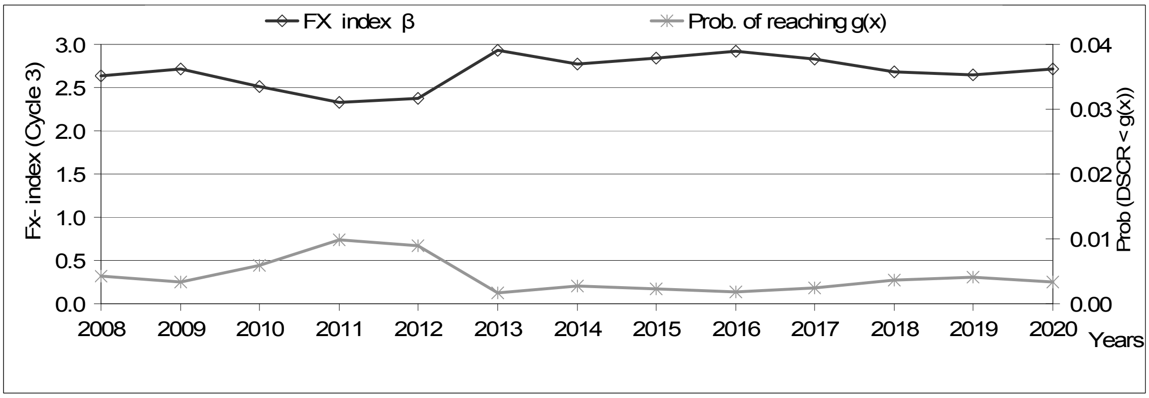
Appendix 4 – 04: *FX exposure index in cycle 3 – Indonesia*



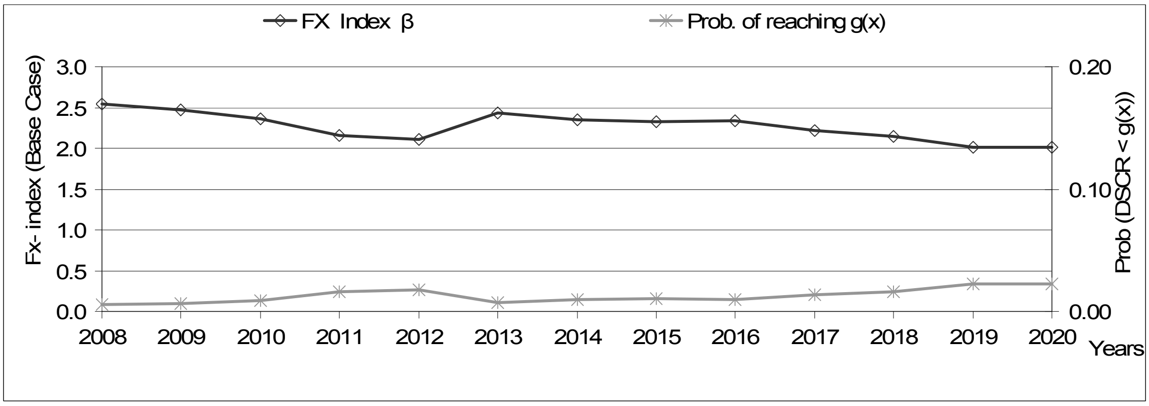
Appendix 4 – 05: *FX exposure index in cycle 3 – Philippines*



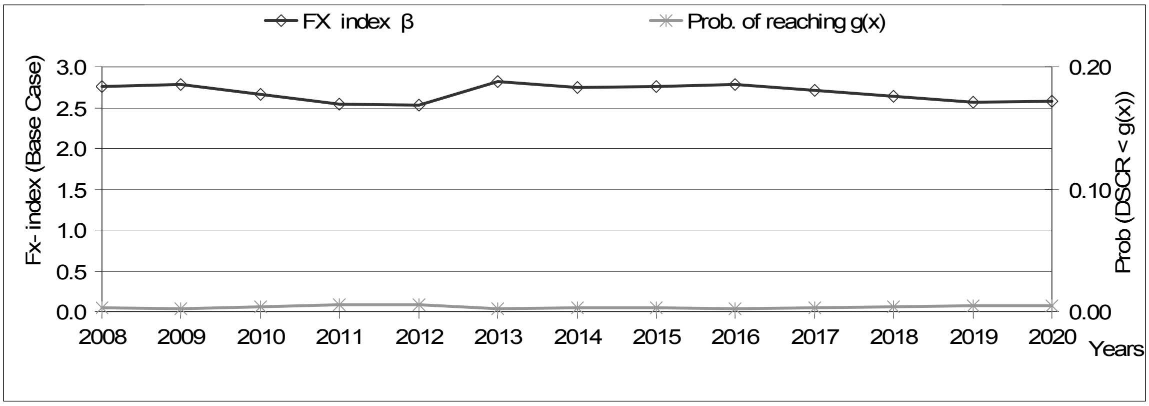
Appendix 4 – 06: *FX exposure index in cycle 3 – Malaysia*



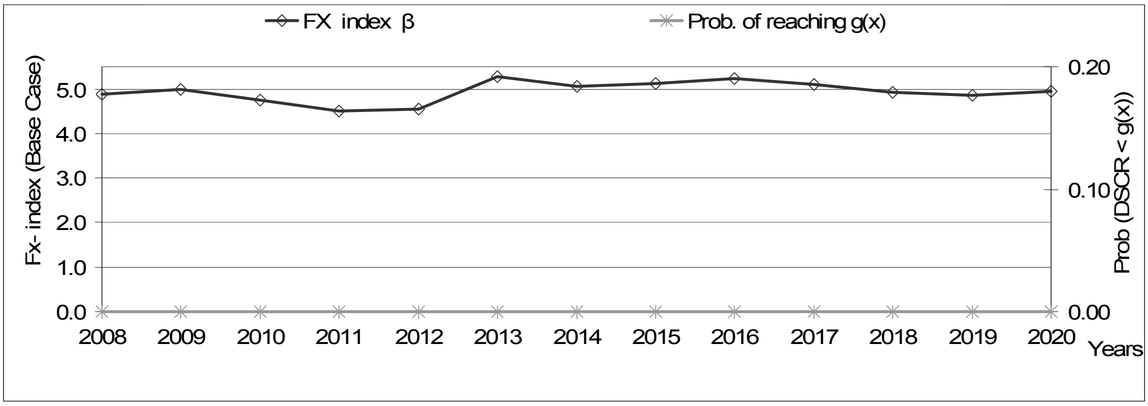
***Appendix 4 – 07:** FX exposure index base case – Indonesia*



***Appendix 4 – 08:** FX exposure index base case – Philippines*

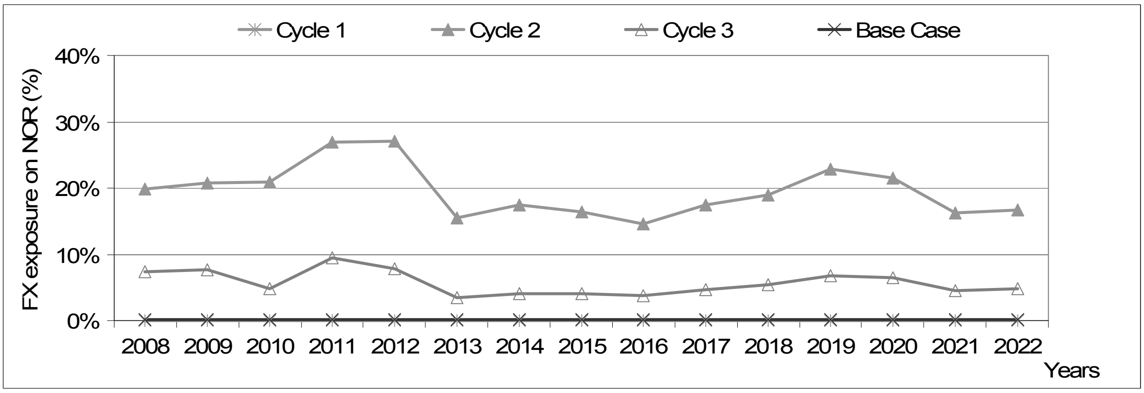


***Appendix 4 – 09:** FX exposure index base case – Malaysia*

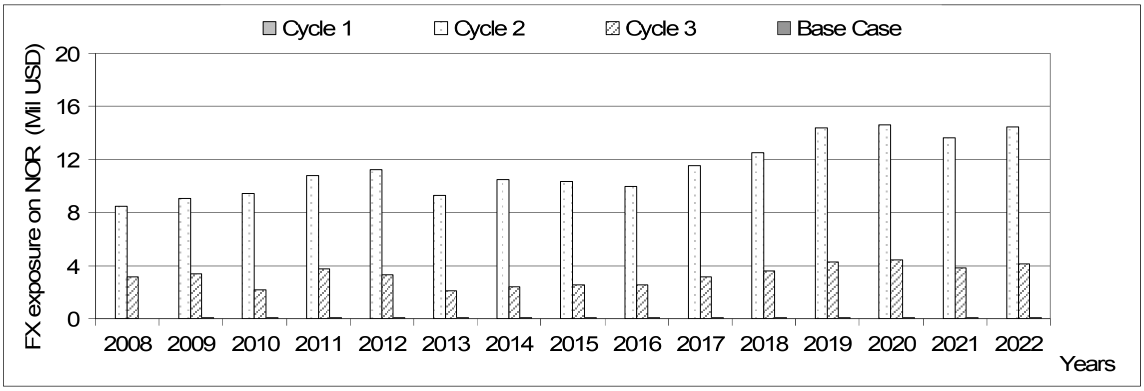


Appendix IV: FX exposure Indonesia

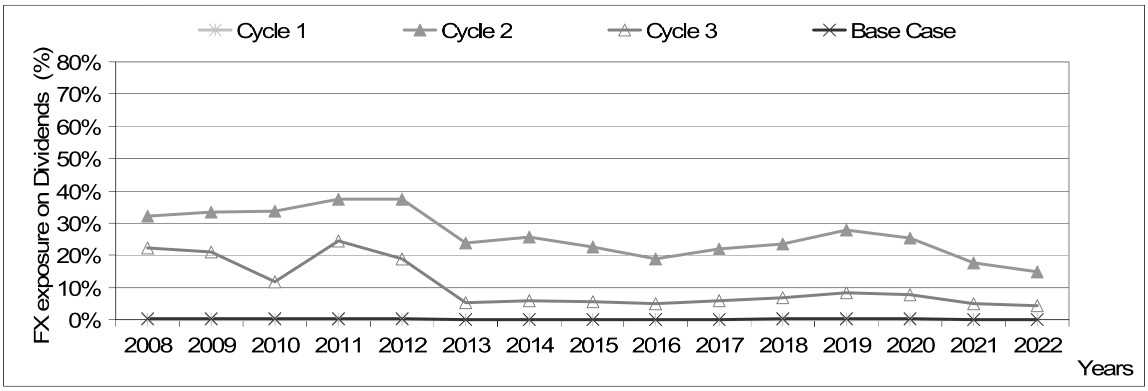
Appendix 4 – 10: *FX exposure on net operating revenue – Indonesia*



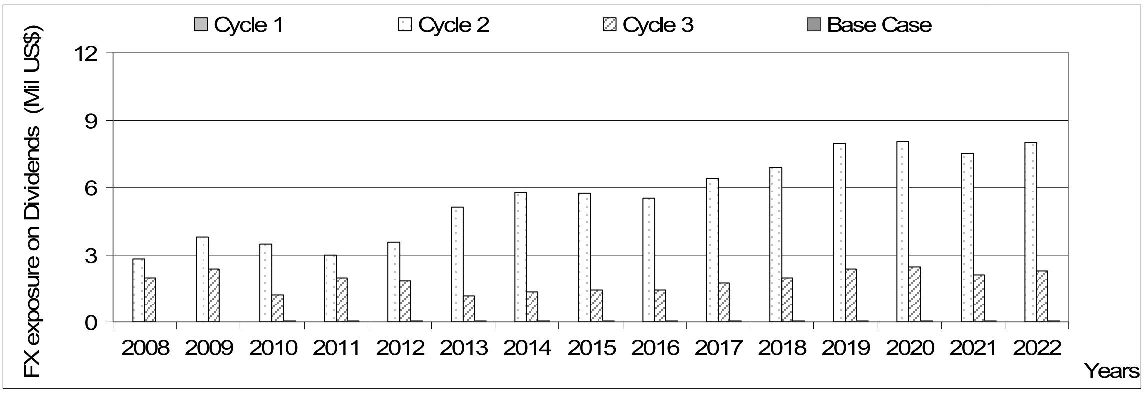
Appendix 4 – 11: *FX exposure on net operating revenue – Indonesia*



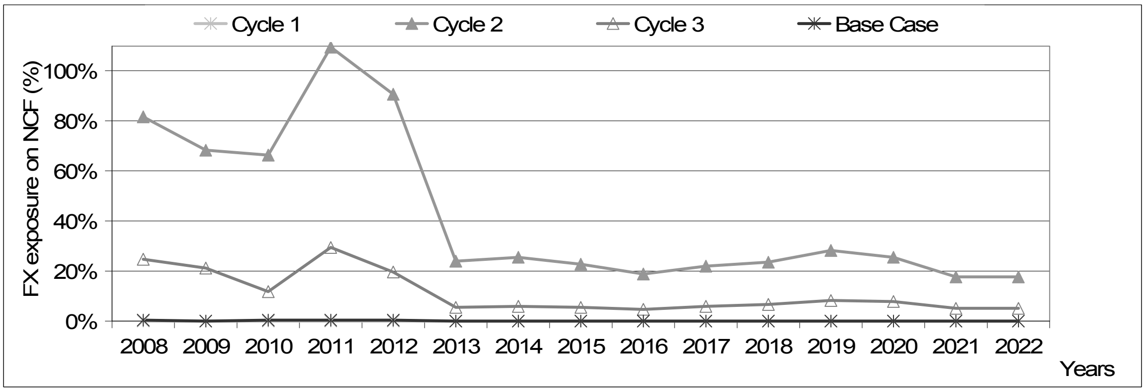
Appendix 4 – 12: *FX exposure on dividends – Indonesia*



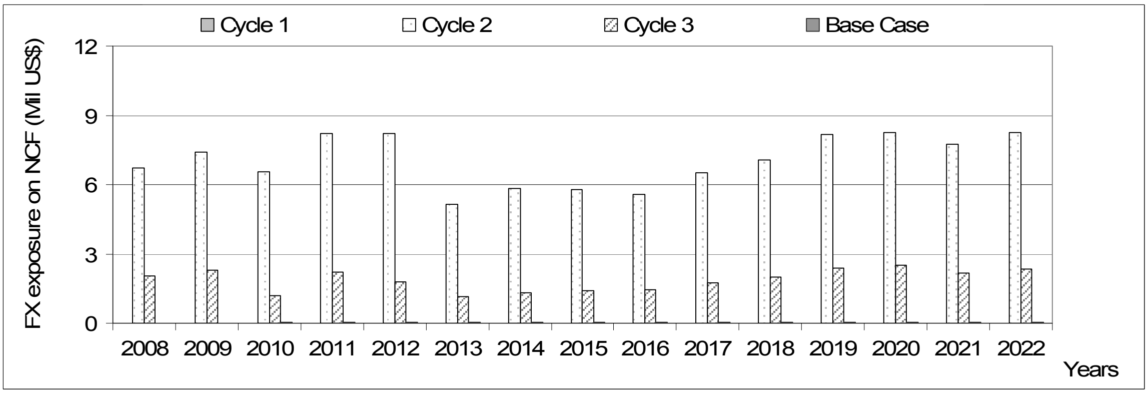
Appendix 4 – 13: *FX exposure on dividends – Indonesia*



Appendix 4 – 14: *FX exposure on net cash flow – Indonesia*

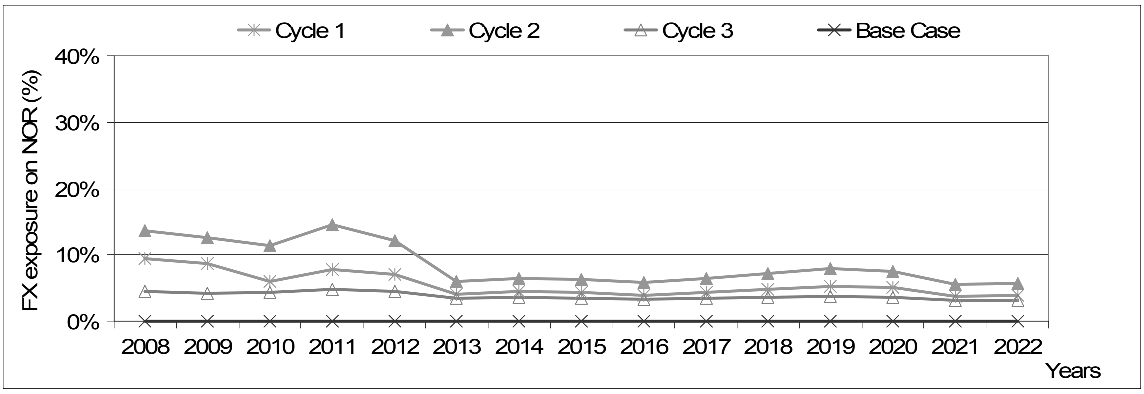


Appendix 4 – 15: *FX exposure on net cash flow – Indonesia*

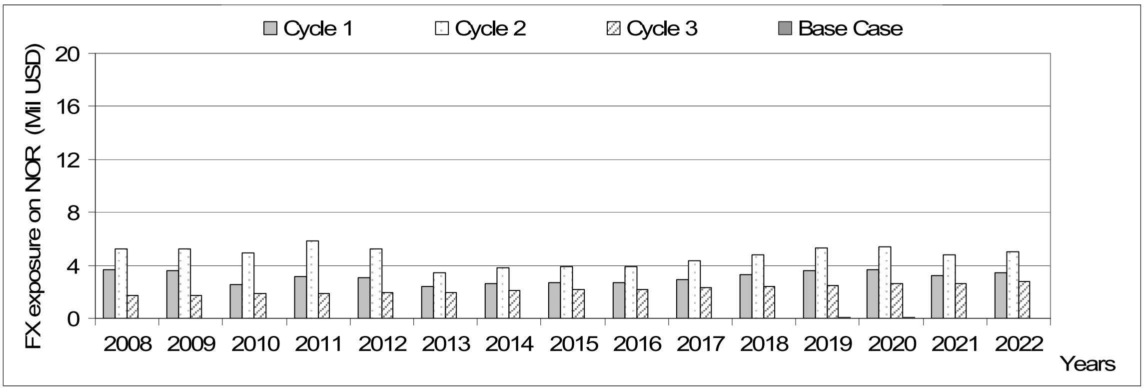


Appendix IV: FX exposure Philippines

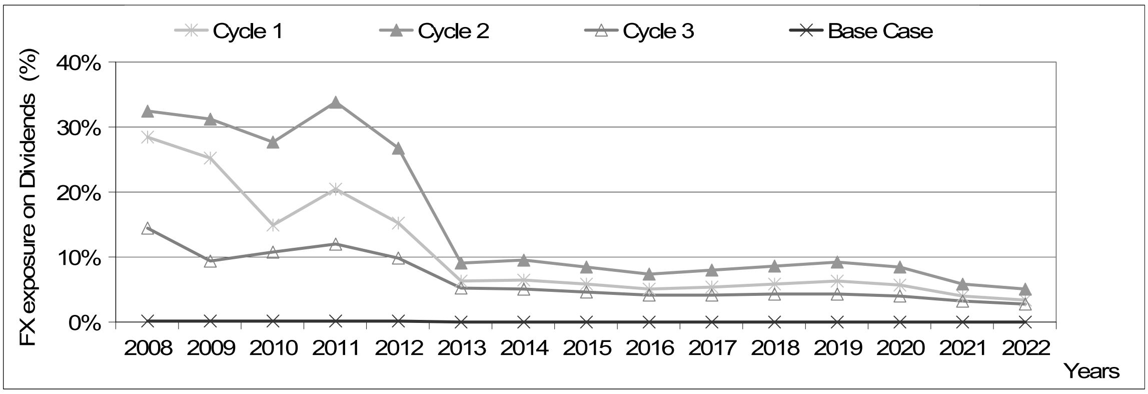
Appendix 4 – 16: FX exposure on net operating revenue – Philippines



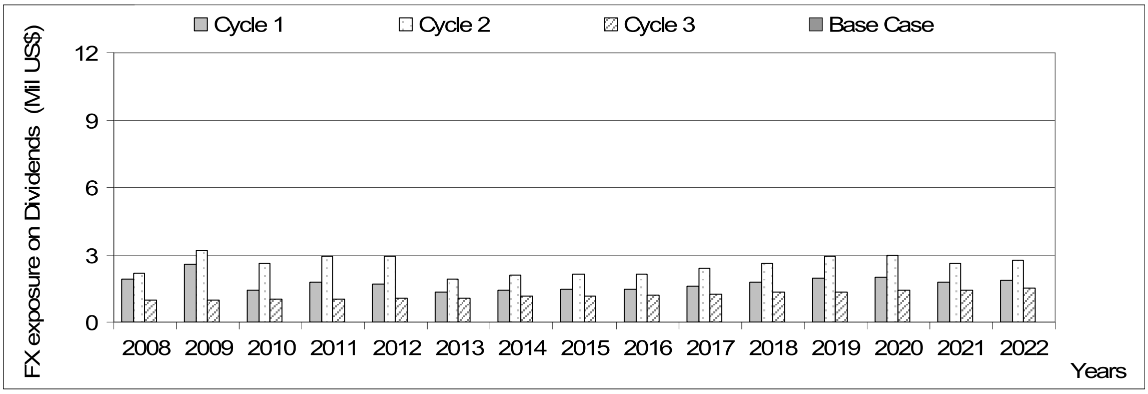
Appendix 4 – 17: *FX exposure on net operating revenue – Philippines*



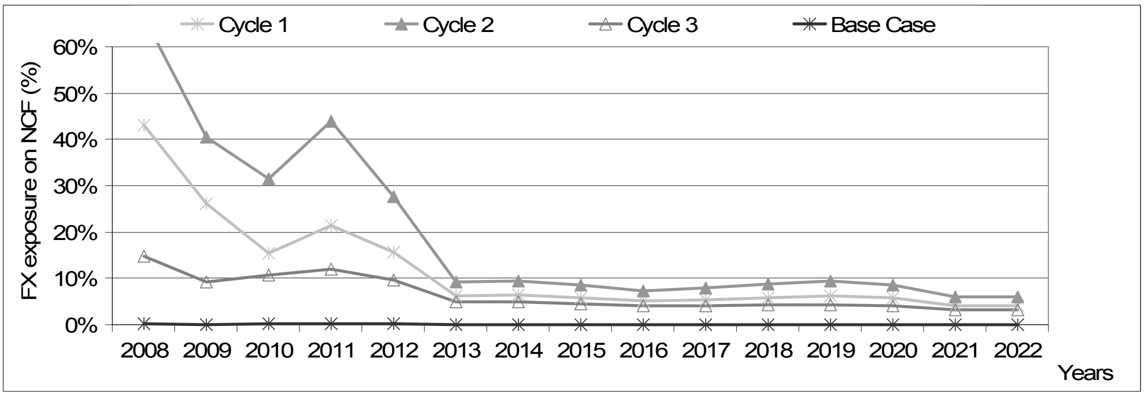
Appendix 4 – 18: *FX exposure on dividends – Philippines*



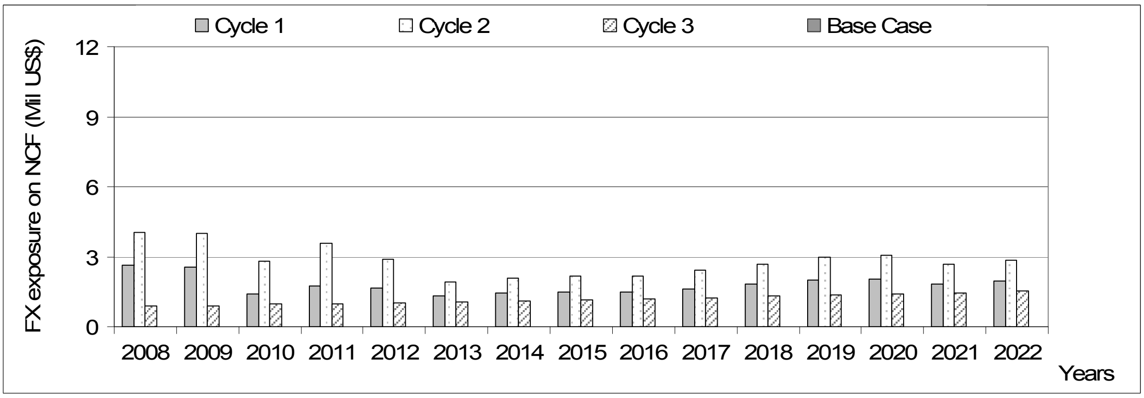
***Appendix 4 – 19:** FX exposure on dividends – Philippines*



***Appendix 4 – 20:** FX exposure on net cash flow – Philippines*

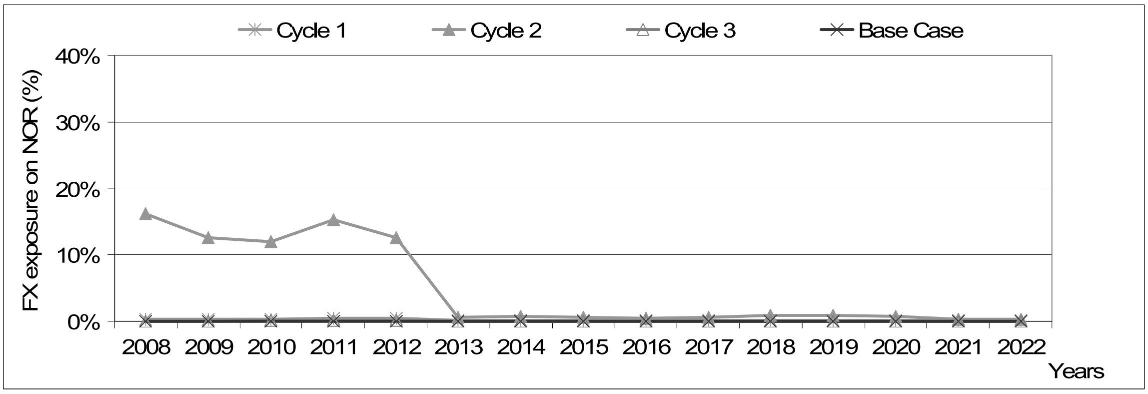


***Appendix 4 – 21:** FX exposure on net cash flow – Philippines*

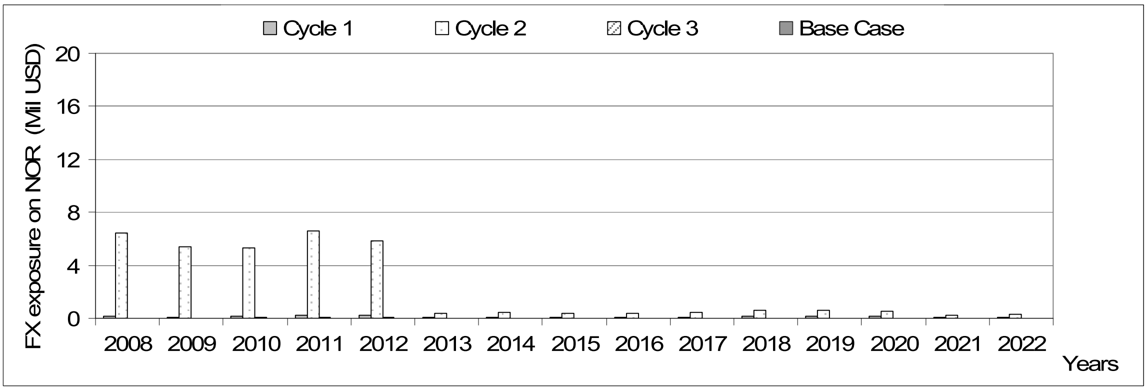


Appendix IV: FX exposure Malaysia

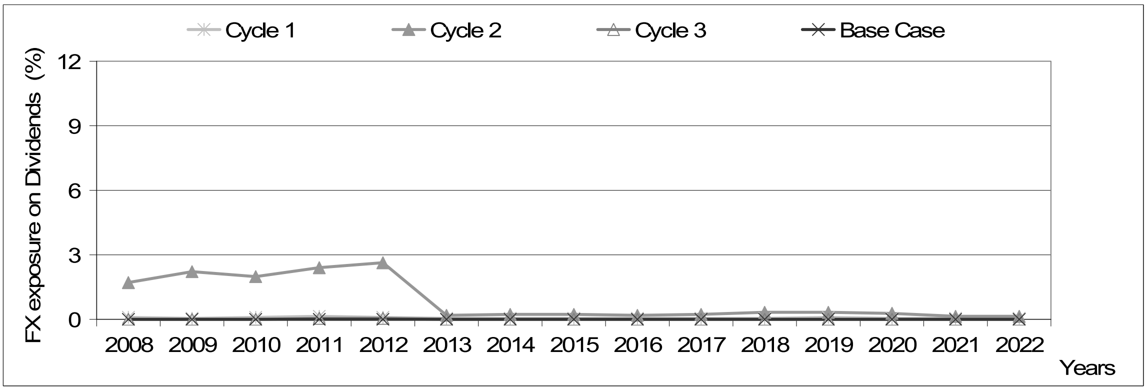
Appendix 4 – 22: *FX exposure on net operating revenue – Malaysia*



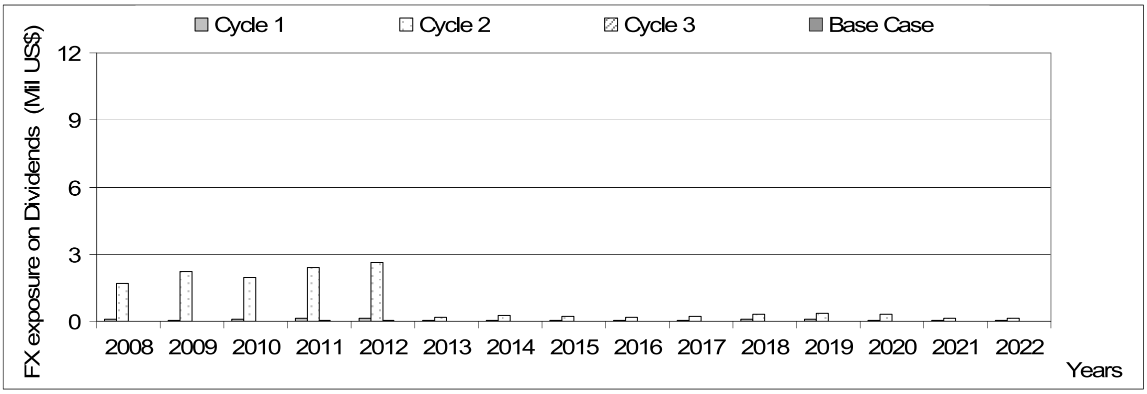
Appendix 4 – 23: *FX exposure on net operating revenue – Malaysia*



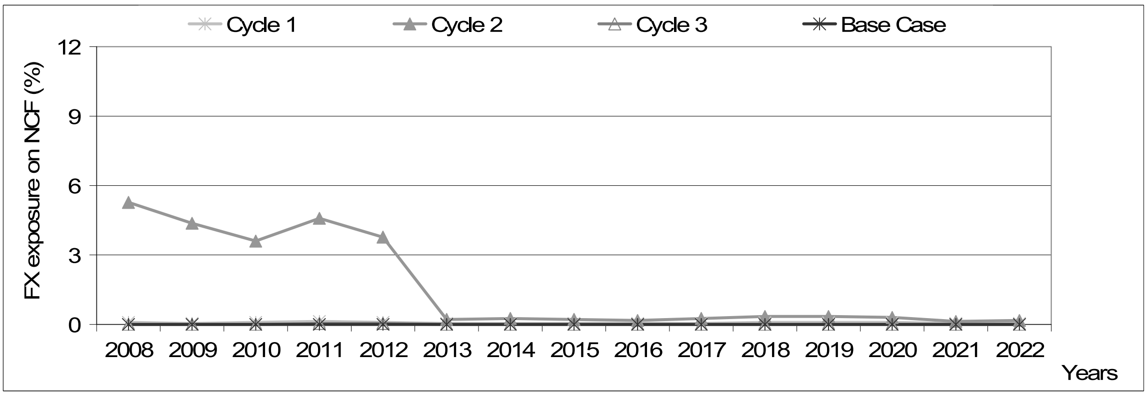
Appendix 4 – 24: *FX exposure on dividends – Malaysia*



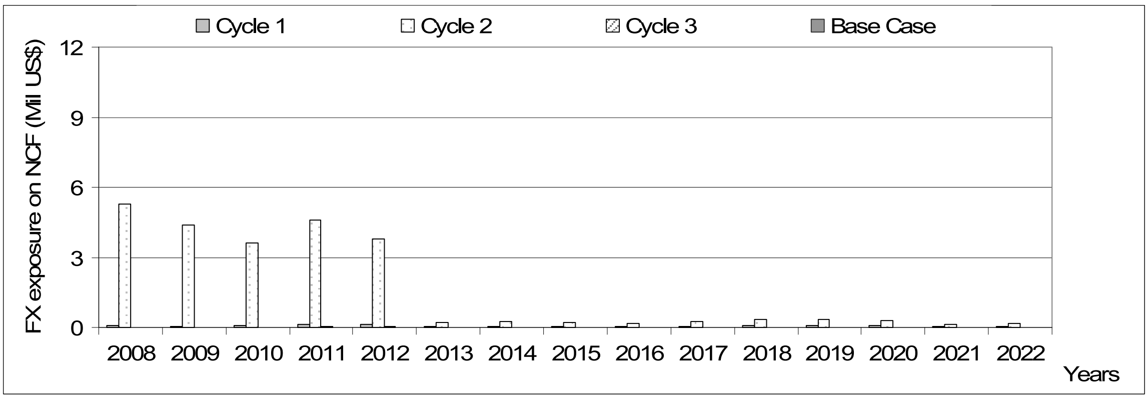
***Appendix 4 – 25:** FX exposure on dividends – Malaysia*



***Appendix 4 – 26:** FX exposure on net cash flow – Malaysia*



***Appendix 4 – 27:** FX exposure on net cash flow – Malaysia*



Appendix V: Monthly data series CRR index Indonesia

Appendix 5 – 01: *Monthly data series used to compute the CRR factors – Indonesia, (Source: IFS)*

DESCRIPTOR	FX rate IDR/USD	CLAIMS ON CENTRAL GOVERNMENT (NET)	CLAIMS ON STATE & LOCAL GOVERNMENT	CLAIMS ON PUBLIC NONFINANCIAL CORPOR	FOREIGN EXCHANGE	MONEY
UNITS	National Currency per U.S	National Currency	National Currency	National Currency	U.S. dollars	National Currency
SCALE	Units	Billions	Billions	Billions	Millions	Billions
SERIESCODE	536..AE.ZF...	53632AN.ZF...	53632B..ZF...	53632C..ZF...	536.1D.DZF...	53634...ZF..
M1 1989	1740.00	-7022.30	0.00	6739.30	4595.90	13960.50
M2 1989	1745.00	-6624.10	0.00	6463.60	4511.80	14267.10
M3 1989	1756.00	-7961.00	0.00	5761.10	4755.70	14608.70
M4 1989	1759.00	-7299.20	0.00	4975.80	5127.20	15345.70
M5 1989	1771.00	-6484.02	0.00	5179.90	4814.10	15013.40
M6 1989	1773.00	-7635.50	0.00	5754.30	4285.10	16686.70
M7 1989	1774.00	-7130.30	0.00	5952.60	4589.50	15668.20
M8 1989	1785.00	-7647.50	0.00	7060.20	4279.50	16314.80
M9 1989	1783.00	-7617.60	0.00	8093.30	4285.50	17310.80
M10 1989	1791.00	-7984.50	0.00	8130.50	4489.80	18108.90
M11 1989	1791.00	-8345.10	0.00	7925.90	4410.30	18088.50
M12 1989	1797.00	-8705.80	0.00	8559.90	5357.40	20788.40
M1 1990	1805.00	-8253.50	0.00	8484.80	5040.60	19134.30
M2 1990	1812.00	-7319.70	0.00	8331.10	4851.00	19597.00
M3 1990	1823.00	-10563.00	0.00	8516.00	5143.00	22542.10
M4 1990	1829.00	-8974.60	0.00	7884.30	4523.50	22739.40
M5 1990	1836.00	-9434.40	0.00	8314.90	3909.30	21642.60
M6 1990	1844.00	-9948.90	0.00	8450.20	4593.90	23534.40
M7 1990	1849.00	-9367.30	0.00	7822.50	5266.90	22935.60
M8 1990	1858.00	-8970.80	0.00	8245.60	5575.90	21333.30
M9 1990	1864.00	-10858.80	0.00	8395.00	5318.70	23277.10
M10 1990	1872.00	-10212.70	0.00	9050.50	5607.40	22863.50
M11 1990	1884.00	-11978.30	0.00	7649.20	5959.20	22981.50
M12 1990	1901.00	-12023.10	0.00	7708.50	7352.70	23803.40
M1 1991	1912.00	-11573.10	0.00	6813.00	7207.60	23009.80
M2 1991	1920.00	-12310.70	0.00	6529.80	8388.30	26249.40
M3 1991	1932.00	-12772.20	0.00	6520.10	7969.80	23560.20
M4 1991	1939.00	-12933.20	0.00	6868.70	7977.80	23384.10
M5 1991	1947.00	-13856.60	0.00	9092.10	8313.30	23869.40
M6 1991	1954.00	-14269.60	0.00	7635.10	8575.80	24596.20
M7 1991	1959.00	-15292.00	0.00	10226.10	8425.90	24263.40
M8 1991	1965.00	-14903.70	0.00	10415.50	8366.60	24831.70
M9 1991	1968.00	-13512.80	0.00	9395.20	8375.70	25790.30
M10 1991	1977.00	-14052.70	0.00	10650.00	8453.70	25149.10
M11 1991	1985.00	-21510.10	0.00	10013.80	9181.30	25811.70
M12 1991	1992.00	-13491.20	0.00	9705.80	9150.70	26676.30
M1 1992	2004.00	-14963.30	0.00	10369.60	9383.90	26218.60
M2 1992	2010.00	-14495.60	0.00	10290.60	9147.80	26238.90
M3 1992	2017.00	-31577.30	0.00	10407.10	9518.50	27318.80
M4 1992	2022.00	-15610.30	0.00	9013.60	9980.70	25831.20
M5 1992	2027.00	-15721.40	0.00	10300.70	10526.90	26154.90
M6 1992	2033.00	-15800.30	0.00	9334.50	10608.10	26865.10
M7 1992	2035.00	-15501.20	0.00	10185.30	10914.50	27002.80
M8 1992	2034.00	-15889.10	0.00	10346.00	11104.10	27417.10
M9 1992	2038.00	-15571.70	0.00	10355.40	10616.40	27632.90
M10 1992	2050.00	-15274.00	0.00	10332.70	10306.10	27837.50
M11 1992	2059.00	-17009.10	0.00	11035.20	10476.20	28344.40
M12 1992	2062.00	-6190.00	1032.00	6019.00	10181.20	28426.00
M1 1993	2066.00	-6395.00	1036.00	6375.00	10605.00	28698.00
M2 1993	2067.00	-7244.00	1014.00	6376.00	10668.10	28240.00
M3 1993	2071.00	-7215.00	1099.00	6542.00	10774.50	28763.00
M4 1993	2074.00	-19855.00	325.00	7463.00	10918.50	27423.00
M5 1993	2078.00	-20993.00	220.00	7314.00	10746.40	27847.00
M6 1993	2088.00	-18090.00	347.00	7434.00	10787.90	28717.00

***Appendix 5 – 02:** Monthly data series used to compute the CRR factors – Indonesia, (Source: IFS)*

DESCRIPTOR	QUASI-MONEY	EXPORTS,F.O.B.	IMPORTS,C.I.F.	CLAIMS ON CENTRAL GOVERNMENT	FOREIGN ASSETS	FOREIGN LIABILITIES
UNITS	National Currency	U.S. dollars	U.S. dollars	National Currency	National Currency	National Currency
SCALE	Billions	Millions	Millions	Billions	Billions	Billions
SERIESCODE	53635...ZF...	53670..DZF...	53671..DZF...	53612A..ZF...	53621...ZF...	53626C..ZF...
M1 1989	28013.30	1683.40	1221.40	4203.10	8444.80	1211.00
M2 1989	28619.20	1540.00	1278.50	5263.70	8808.20	1153.00
M3 1989	33604.90	1840.10	1391.80	3396.30	9351.20	738.90
M4 1989	30293.80	1785.00	1294.80	4587.10	8621.80	1224.60
M5 1989	31366.80	1703.00	1317.40	5016.80	8379.00	1695.10
M6 1989	31613.30	1852.00	1395.60	5891.40	9106.60	1716.00
M7 1989	34680.40	1927.00	1116.80	5018.00	9695.40	1634.10
M8 1989	33735.40	1892.00	1425.50	4938.20	9549.00	1566.60
M9 1989	38835.20	1918.00	1601.10	5279.50	10089.50	1933.20
M10 1989	35644.10	1988.00	1227.90	4701.10	9813.30	1820.60
M11 1989	36897.50	1876.00	1491.60	4683.70	9671.70	1811.00
M12 1989	38256.30	2155.00	1809.70	4588.50	10730.60	3193.20
M1 1990	45800.60	1909.00	1314.80	4795.00	9598.20	2139.40
M2 1990	40996.40	1845.20	1492.20	5063.10	9897.20	2435.80
M3 1990	42474.00	2055.00	1694.30	3732.60	11237.50	4173.30
M4 1990	45347.90	1803.00	1067.60	3795.20	9699.40	3024.90
M5 1990	46148.10	1802.00	1796.10	4112.30	9933.80	3726.80
M6 1990	56012.60	1750.00	1686.90	4007.10	10910.80	6333.50
M7 1990	49438.10	1812.00	1756.70	4941.50	10149.70	7785.40
M8 1990	52351.40	2124.00	2042.40	4940.90	10787.10	9686.70
M9 1990	54674.30	2603.00	2259.00	4517.20	10401.50	10087.10
M10 1990	56539.30	2639.00	1847.70	6276.50	11033.00	10079.80
M11 1990	58498.60	2681.20	2383.30	4887.70	10417.20	10732.30
M12 1990	61550.10	2650.50	2426.80	5221.10	11681.30	12645.40
M1 1991	62067.20	2554.00	1942.00	4961.00	10971.00	11239.80
M2 1991	58885.70	2361.00	2097.30	5392.90	11505.60	12049.50
M3 1991	58294.90	2115.00	2205.80	4506.30	10967.30	11471.50
M4 1991	60516.00	2667.00	2195.60	4946.30	12351.40	12851.40
M5 1991	62197.30	2378.00	2245.00	5113.90	11192.90	12142.00
M6 1991	64031.60	2433.00	2224.00	4878.80	11876.60	11711.90
M7 1991	68989.50	2538.00	2177.00	4657.50	10178.10	9358.10
M8 1991	67384.10	2414.00	2047.00	4365.00	11245.40	11441.90
M9 1991	68403.20	2441.00	1943.00	5885.10	10506.40	9899.10
M10 1991	71262.60	2544.00	2257.00	5523.40	11075.40	10974.40
M11 1991	72860.10	2409.00	2070.00	5362.00	10088.30	11150.20
M12 1991	73636.20	2689.00	2609.00	5479.90	11076.40	11935.30
M1 1992	73343.60	2358.00	2189.00	5583.90	9691.40	12423.10
M2 1992	73664.10	2487.00	2228.00	5655.80	9537.70	12654.30
M3 1992	74563.20	2627.00	2134.00	5544.50	10029.10	13091.60
M4 1992	77269.40	2390.00	2263.00	5949.50	10397.10	13480.80
M5 1992	79484.80	2703.00	2245.00	5180.90	10430.10	13633.80
M6 1992	81343.30	2694.00	2352.00	5401.60	10902.20	14979.00
M7 1992	81973.10	2844.00	2202.00	5566.30	11568.60	15290.10
M8 1992	84016.80	2017.00	2206.00	6082.80	11076.20	14963.60
M9 1992	87023.60	2851.00	2374.00	6908.40	11689.40	14955.00
M10 1992	89574.40	3453.00	2093.00	6680.90	11582.50	15135.10
M11 1992	91235.70	3313.00	2240.00	6870.60	13526.50	17661.80
M12 1992	91570.00	3351.00	2785.00	7976.00	13009.00	16206.00
M1 1993	91495.00	3002.00	2143.00	8302.00	14094.00	17081.00
M2 1993	93160.00	2893.00	2016.00	7700.00	14622.00	15363.00
M3 1993	93663.00	3009.00	2191.00	5584.00	14347.00	18212.00
M4 1993	92525.00	2958.00	2235.00	6240.00	11833.00	17633.00
M5 1993	92848.00	3118.00	2154.00	5955.00	11731.00	17695.00
M6 1993	94278.00	2981.20	2628.70	6868.00	12225.00	18690.00

Appendix 5 – 03: *Monthly data series used to compute the CRR factors – Indonesia, (Source: IFS)*

DESCRIPTOR	FX rate IDR/USD	CLAIMS ON CENTRAL GOVERNMENT (NET)	CLAIMS ON STATE & LOCAL GOVERNMENT	CLAIMS ON PUBLIC NONFINANCIAL CORPOR	FOREIGN EXCHANGE	MONEY
UNITS	National Currency per U.S	National Currency	National Currency	National Currency	U.S. dollars	National Currency
SCALE	Units	Billions	Billions	Billions	Millions	Billions
SERIESCODE	536..AE.ZF...	53632AN.ZF...	53632B..ZF...	53632C..ZF...	536.1D.DZF...	53634...ZF..
M7 1993	2096.00	-18802.00	354.00	5964.00	10683.20	29599.00
M8 1993	2102.00	-17795.00	369.00	7562.00	10821.40	32304.00
M9 1993	2108.00	-15668.00	369.00	7558.00	10962.60	32401.00
M10 1993	2106.00	-13753.00	362.00	6599.00	10906.20	33189.00
M11 1993	2106.00	-13404.00	268.00	6622.00	10932.00	33152.00
M12 1993	2110.00	-14067.00	256.00	6505.00	10988.00	34661.00
M1 1994	2122.00	-12857.00	120.00	7360.00	11087.90	35069.00
M2 1994	2137.00	-13236.00	125.00	6759.00	11404.20	37414.00
M3 1994	2143.00	-14975.00	127.00	7601.00	11364.90	35814.00
M4 1994	2149.00	-12740.00	133.00	6467.00	10473.80	36078.00
M5 1994	2155.00	-12738.00	124.00	6348.00	10316.60	36332.00
M6 1994	2160.00	-14144.00	134.00	6334.00	10614.10	37455.00
M7 1994	2169.00	-15177.00	135.00	6378.00	10344.40	37659.00
M8 1994	2175.00	-15176.00	135.00	6322.00	11020.70	38873.00
M9 1994	2181.00	-13996.00	134.00	6486.00	11050.20	39716.00
M10 1994	2186.00	-16341.00	142.00	6615.00	11126.60	41077.00
M11 1994	2193.00	-15776.00	111.00	6640.00	12049.20	41401.00
M12 1994	2200.00	-15903.00	113.00	6874.00	11819.90	42887.00
M1 1995	2207.00	-15749.00	116.00	6775.00	11641.80	42184.00
M2 1995	2212.00	-15825.00	133.00	6983.00	11626.10	44499.00
M3 1995	2219.00	-16226.00	115.00	7098.00	11960.70	42093.00
M4 1995	2227.00	-16292.00	120.00	7341.00	11983.80	42100.00
M5 1995	2236.00	-17185.00	122.00	7370.00	12100.10	42203.00
M6 1995	2246.00	-18735.00	141.00	7592.00	12480.80	44244.00
M7 1995	2256.00	-15965.00	132.00	7698.00	12906.70	44270.00
M8 1995	2266.00	-19403.00	134.00	8155.00	12812.20	44775.00
M9 1995	2275.00	-18059.00	183.00	8283.00	12841.30	46241.00
M10 1995	2285.00	-18442.00	222.00	7753.00	12861.00	47405.00
M11 1995	2296.00	-18948.00	218.00	8184.00	13172.40	47329.00
M12 1995	2308.00	-19999.00	276.00	8427.00	13305.60	49572.00
M1 1996	2311.00	-18736.00	268.00	8511.00	13338.20	49241.00
M2 1996	2322.00	-17191.00	267.00	8456.00	14555.80	50770.00
M3 1996	2337.00	-18638.00	269.00	8062.00	14528.30	49979.00
M4 1996	2342.00	-19391.00	278.00	8638.00	14530.00	49222.00
M5 1996	2354.00	-18621.00	289.00	8458.00	14528.20	50458.00
M6 1996	2342.00	-19515.00	287.00	8229.00	15146.20	52911.00
M7 1996	2353.00	-19453.00	322.00	7945.00	15057.70	54062.00
M8 1996	2363.00	-20339.00	316.00	8544.00	15039.90	54134.00
M9 1996	2340.00	-19720.00	322.00	8208.00	15058.30	55516.00
M10 1996	2352.00	-17892.00	338.00	7910.00	15222.30	55775.00
M11 1996	2368.00	-18666.00	339.00	7934.00	16481.20	56467.00
M12 1996	2383.00	-22864.00	290.00	9248.00	17820.40	54534.00
M1 1997	2396.00	-23513.00	287.00	8310.00	18552.90	61844.00
M2 1997	2406.00	-24361.00	815.00	8464.00	18561.50	61074.00
M3 1997	2419.00	-24870.00	840.00	8604.00	18609.90	59918.00
M4 1997	2433.00	-25593.00	864.00	8790.00	19110.00	60960.00
M5 1997	2440.00	-28138.00	854.00	8813.00	19758.70	61335.00
M6 1997	2450.00	-28631.00	877.00	8453.00	19934.50	64920.00
M7 1997	2599.00	-29550.00	889.00	8877.00	19839.90	64841.00
M8 1997	3035.00	-29574.00	747.00	9739.00	18881.80	59502.00
M9 1997	3275.00	-30810.00	377.00	9816.00	19880.40	60649.00
M10 1997	3670.00	-31952.00	378.00	9408.00	17928.40	62137.00
M11 1997	3648.00	-33838.00	372.00	9709.00	17570.80	64848.00
M12 1997	4650.00	-34366.00	292.00	11036.00	16087.70	72431.00

Appendix 5 – 04: *Monthly data series used to compute the CRR factors – Indonesia, (Source: IFS)*

DESCRIPTOR	QUASI-MONEY	EXPORTS,F.O.B.	IMPORTS,C.I.F.	CLAIMS ON CENTRAL GOVERNMENT	FOREIGN ASSETS	FOREIGN LIABILITIES
UNITS	National Currency	U.S. dollars	U.S. dollars	National Currency	National Currency	National Currency
SCALE	Billions	Millions	Millions	Billions	Billions	Billions
SERIESCODE	53635...ZF...	53670..DZF...	53671..DZF...	53612A..ZF...	53621...ZF...	53626C..ZF...
M7 1993	96667.00	3025.70	2430.40	6378.00	11256.00	18638.00
M8 1993	102584.00	3128.40	2221.20	6396.00	11787.00	20272.00
M9 1993	102582.00	3084.10	2682.10	7980.00	11787.00	20272.00
M10 1993	103970.00	3218.40	2431.10	9064.00	11055.00	20680.00
M11 1993	106449.00	3212.10	2374.40	8756.00	10680.00	21033.00
M12 1993	109402.00	3194.70	2821.50	9013.00	11340.00	20448.00
M1 1994	109861.00	2666.50	2112.20	9587.00	11286.00	20953.00
M2 1994	112234.00	2799.60	2245.90	9613.00	13362.00	21234.00
M3 1994	111895.00	3032.30	2619.10	5554.00	12374.00	21109.00
M4 1994	112783.00	3133.90	2326.10	6212.00	13492.00	19469.00
M5 1994	113372.00	3209.80	2642.80	6484.00	13207.00	19434.00
M6 1994	113857.00	3567.80	2806.80	5294.00	12978.00	20966.00
M7 1994	115965.00	3514.90	2643.50	4892.00	13948.00	20994.00
M8 1994	118694.00	3592.20	2756.10	4383.00	12017.00	20382.00
M9 1994	121829.00	3481.20	2857.10	6073.00	13257.00	21387.00
M10 1994	122813.00	3646.30	2857.30	6129.00	13272.00	22742.00
M11 1994	125657.00	3640.90	2757.80	6304.00	12148.00	22768.00
M12 1994	130280.00	3768.00	3364.00	7510.00	12874.00	24885.00
M1 1995	132605.00	3259.00	2740.00	3456.00	11495.00	22276.00
M2 1995	133356.00	3431.00	2942.00	3299.00	11609.00	22473.00
M3 1995	137812.00	3485.00	3010.00	1538.00	12697.00	23445.00
M4 1995	139209.00	3414.00	3059.00	2063.00	14002.00	23520.00
M5 1995	141267.00	3822.00	3559.00	2560.00	13689.00	22708.00
M6 1995	146325.00	3834.00	3964.00	2884.00	14833.00	23431.00
M7 1995	150655.00	3775.00	3460.00	3069.00	14368.00	23194.00
M8 1995	154812.00	3953.00	3807.00	2803.00	13698.00	24134.00
M9 1995	158310.00	3940.00	3847.00	4713.00	15011.00	26119.00
M10 1995	161885.00	3900.00	3391.00	4508.00	14789.00	23590.00
M11 1995	166546.00	4080.00	3371.00	5375.00	15984.00	25786.00
M12 1995	171257.00	4524.00	3505.00	4672.00	17096.00	26952.00
M1 1996	171857.00	3601.00	3184.00	4361.00	16286.00	25772.00
M2 1996	175200.00	3685.00	2870.00	4564.00	14688.00	26903.00
M3 1996	180687.00	3955.00	3563.00	4351.00	15143.00	27063.00
M4 1996	185540.00	4030.00	3690.00	4359.00	15257.00	26543.00
M5 1996	189710.00	4075.00	3942.00	4349.00	16488.00	26675.00
M6 1996	194331.00	4136.00	4012.00	4581.00	16576.00	26713.00
M7 1996	197174.00	4069.00	3589.00	4981.00	16887.00	27556.00
M8 1996	198911.00	4322.00	3434.00	5751.00	15762.00	27597.00
M9 1996	201396.00	4331.00	3645.00	6034.00	17737.00	26495.00
M10 1996	210060.00	4472.00	3521.00	6113.00	18862.00	27534.00
M11 1996	218605.00	4456.00	3652.00	6366.00	22076.00	29442.00
M12 1996	226097.00	4682.00	3827.00	4269.00	20820.00	29744.00
M1 1997	226291.00	4484.00	4781.00	3265.00	20668.00	29819.00
M2 1997	229672.00	4027.00	3310.00	3484.00	18266.00	29595.00
M3 1997	232451.00	4451.00	4699.00	722.00	19263.00	32641.00
M4 1997	235909.00	4946.00	3943.00	612.00	18153.00	33187.00
M5 1997	239819.00	4854.00	5000.00	921.00	17926.00	33186.00
M6 1997	244686.00	4936.00	3550.00	1137.00	17741.00	32722.00
M7 1997	249551.00	5130.00	4340.00	2066.00	20678.00	38976.00
M8 1997	263204.00	4547.00	4732.00	4025.00	25616.00	46247.00
M9 1997	264689.00	4689.00	4459.00	3946.00	27080.00	49011.00
M10 1997	275184.00	4838.00	4786.00	4316.00	31443.00	54028.00
M11 1997	262299.00	4516.00	3966.00	4475.00	34367.00	53066.00
M12 1997	279073.00	4879.00	3741.00	5470.00	46810.00	70434.00

Appendix 5 – 05: *Monthly data series used to compute the CRR factors – Indonesia, (Source: IFS)*

DESCRIPTOR	FX rate IDR/USD	CLAIMS ON CENTRAL GOVERNMENT (NET)	CLAIMS ON STATE & LOCAL GOVERNMENT	CLAIMS ON PUBLIC NONFINANCIAL CORPOR	FOREIGN EXCHANGE	MONEY
UNITS	National Currency per U.S	National Currency	National Currency	National Currency	U.S. dollars	National Currency
SCALE	Units	Billions	Billions	Billions	Millions	Billions
SERIESCODE	536..AE.ZF...	53632AN.ZF...	53632B..ZF...	53632C..ZF...	536.1D.DZF...	53634...ZF..
M1 1998	10375.00	-48317.00	288.00	15061.00	17649.80	87021.00
M2 1998	8750.00	-36358.00	279.00	14395.00	15010.70	85108.00
M3 1998	8325.00	-34072.00	279.00	14301.00	15306.10	91347.00
M4 1998	7500.00	-39409.00	278.00	14113.00	16415.10	86794.00
M5 1998	10525.00	-59162.00	269.00	16063.00	17739.70	93097.00
M6 1998	14900.00	-79601.00	276.00	18103.00	17521.30	100001.00
M7 1998	13000.00	-79953.00	263.00	17351.00	18183.70	96187.00
M8 1998	11075.00	-41472.00	264.00	16169.00	18602.70	93859.00
M9 1998	10700.00	-31119.00	265.00	16286.00	19275.40	92955.00
M10 1998	7550.00	-27601.00	324.00	14807.00	20429.20	88974.00
M11 1998	7300.00	-26549.00	321.00	14745.00	21486.90	90203.00
M12 1998	8025.00	-10625.00	319.00	15128.00	22401.40	90768.00
M1 1999	8950.00	-28681.00	318.00	15723.00	23443.10	91775.00
M2 1999	8730.00	119685.00	309.00	16432.00	23372.90	92737.00
M3 1999	8685.00	115544.00	397.00	13170.00	24944.40	95528.00
M4 1999	8260.00	115554.00	393.00	12325.00	24709.00	91398.00
M5 1999	8105.00	200129.00	303.00	13015.00	25194.10	93956.00
M6 1999	6726.00	205521.00	196.00	11154.00	26118.40	96870.00
M7 1999	6875.00	358205.00	189.00	12059.00	25743.20	97302.00
M8 1999	7565.00	359715.00	209.00	12439.00	25981.60	100234.00
M9 1999	8386.00	361115.00	192.00	12778.00	25830.40	107584.00
M10 1999	6900.00	364678.00	226.00	19283.00	26061.90	107599.00
M11 1999	7425.00	366305.00	192.00	12903.00	26055.00	108743.00
M12 1999	7085.00	413131.00	214.00	11854.00	26245.00	116880.00
M1 2000	7425.00	414895.00	219.00	12415.00	26744.70	114198.00
M2 2000	7505.00	410899.00	224.00	13102.00	27388.30	114458.00
M3 2000	7590.00	467335.00	193.00	12038.00	28263.20	125751.00
M4 2000	7945.00	459063.00	259.00	12267.00	27763.10	128200.00
M5 2000	8620.00	473344.00	186.00	12867.00	27572.60	130493.00
M6 2000	8735.00	504166.00	235.00	13247.00	28354.40	134456.00
M7 2000	9003.00	531985.00	249.00	13445.00	28007.20	136397.00
M8 2000	8290.00	524327.00	239.00	13050.00	30913.30	137771.00
M9 2000	8780.00	512249.00	602.69	14197.50	28487.90	142144.00
M10 2000	9395.00	537202.00	277.57	12550.10	27751.70	145444.00
M11 2000	9530.00	537207.00	290.67	9721.17	27787.70	147287.00
M12 2000	9595.00	523741.00	376.20	10343.20	28280.40	160923.00
M1 2001	9450.00	523473.00	345.11	9893.52	28522.90	147783.00
M2 2001	9835.00	530211.00	355.51	10487.00	28312.80	152027.00
M3 2001	10400.00	525231.00	365.82	10713.40	27899.00	150546.00
M4 2001	11675.00	521222.00	361.38	11350.60	27819.50	155784.00
M5 2001	11058.00	518597.00	365.88	11055.90	27793.70	157559.00
M6 2001	11440.00	510483.00	335.32	11510.90	27764.40	161962.00
M7 2001	9525.00	530836.00	292.68	10067.10	28003.50	163789.00
M8 2001	8865.00	534292.00	268.63	10023.60	27508.60	164195.00
M9 2001	9675.00	517148.00	352.22	10355.70	27961.00	161765.00
M10 2001	10435.00	526292.00	304.79	11130.30	27524.40	167312.00
M11 2001	10430.00	539623.00	268.78	11341.80	27058.20	168867.00
M12 2001	10400.00	546307.00	446.30	10748.40	27047.50	170050.00
M1 2002	10320.00	571797.00	374.44	11276.90	26792.60	161329.00
M2 2002	10189.00	570662.00	315.25	11384.70	26904.00	162488.00
M3 2002	9655.00	575900.00	305.27	11439.80	26966.20	160144.00
M4 2002	9316.00	573343.00	261.52	11938.10	27079.40	163208.00
M5 2002	8785.00	573420.00	275.05	13503.00	27592.60	162889.00
M6 2002	8730.00	572064.00	272.99	13716.00	28127.30	167993.00

Appendix 5 – 06: *Monthly data series used to compute the CRR factors – Indonesia, (Source: IFS)*

DESCRIPTOR	QUASI-MONEY	EXPORTS,F.O.B.	IMPORTS,C.I.F.	CLAIMS ON CENTRAL GOVERNMENT	FOREIGN ASSETS	FOREIGN LIABILITIES
UNITS	National Currency	U.S. dollars	U.S. dollars	National Currency	National Currency	National Currency
SCALE	Billions	Millions	Millions	Billions	Billions	Billions
SERIESCODE	53635...ZF...	53670..DZF...	53671..DZF...	53612A..ZF...	53621...ZF...	53626C..ZF...
M1 1998	359856.00	3892.00	3203.00	4744.00	109884.00	153483.00
M2 1998	340331.00	4027.00	2401.00	6072.00	105740.00	132796.00
M3 1998	354069.00	4908.00	3284.00	4353.00	98080.00	119856.00
M4 1998	360830.00	4385.00	3687.00	6081.00	99953.00	108934.00
M5 1998	393839.00	4239.00	2600.00	4188.00	124394.00	143454.00
M6 1998	460236.00	4668.00	2840.00	6284.00	187526.00	189467.00
M7 1998	454791.00	4333.00	3181.00	6349.00	177579.00	163545.00
M8 1998	439908.00	4252.00	3062.00	7313.00	163224.00	133416.00
M9 1998	451877.00	4781.00	3046.00	14958.00	152017.00	127312.00
M10 1998	437956.00	3785.00	3059.00	14978.00	111253.00	91060.00
M11 1998	455001.00	3542.00	2451.00	16400.00	107335.00	86916.00
M12 1998	481350.00	3557.00	2465.00	35700.00	115657.00	97842.00
M1 1999	495290.00	3041.00	2140.00	35496.00	128713.00	102851.00
M2 1999	504632.00	3357.00	2452.00	178239.00	126849.00	99991.00
M3 1999	502587.00	4413.00	2795.00	179409.00	127265.00	93567.00
M4 1999	516854.00	4127.00	3029.00	179639.00	103860.00	95362.00
M5 1999	529347.00	4169.00	2873.00	179354.00	107705.00	90704.00
M6 1999	514113.00	4106.00	2748.00	230648.00	81140.00	72542.00
M7 1999	525327.00	4534.00	2638.00	231396.00	85799.00	70666.00
M8 1999	530623.00	4903.00	2771.00	233129.00	97500.00	81164.00
M9 1999	539121.00	4832.00	3228.00	232961.00	120596.00	100275.00
M10 1999	516128.00	4549.00	2924.00	233249.00	103569.00	86442.00
M11 1999	525444.00	4394.00	2933.00	233687.00	117900.00	95592.00
M12 1999	525227.00	4819.00	2790.00	248095.00	120209.00	100375.00
M1 2000	531822.00	4471.00	3322.00	249107.00	125903.00	107125.00
M2 2000	534119.00	5013.00	2728.00	248847.00	114087.00	100724.00
M3 2000	534417.00	5630.00	3422.00	246484.00	118636.00	114515.00
M4 2000	541187.00	4720.00	2986.00	243551.00	133100.00	127585.00
M5 2000	556516.00	5258.00	3515.00	244525.00	154938.00	143140.00
M6 2000	553436.00	5759.00	4264.00	234789.00	93951.00	80763.00
M7 2000	557024.00	5758.00	3818.00	235897.00	97375.00	83339.00
M8 2000	551401.00	5844.00	4214.00	232627.00	85180.00	73191.00
M9 2000	556154.00	6224.00	4585.00	231160.00	87388.70	79172.80
M10 2000	574237.00	5907.00	4059.00	232414.00	95765.10	80441.70
M11 2000	582212.00	5753.00	3846.00	233261.00	104209.00	92318.70
M12 2000	587922.00	5068.00	2835.00	233669.00	102179.00	92674.70
M1 2001	596382.00	5054.00	3498.00	234223.00	91955.60	82403.40
M2 2001	608965.00	4797.00	3015.00	248772.00	94963.30	79277.00
M3 2001	621683.00	5548.00	3468.00	249225.00	106971.00	81709.70
M4 2001	641526.00	4963.00	3374.00	250833.00	128098.00	92880.20
M5 2001	635772.00	5115.00	3523.00	251496.00	124200.00	86074.70
M6 2001	639668.00	4924.00	3389.00	252035.00	121485.00	86340.40
M7 2001	612310.00	4894.00	3138.00	265986.00	101432.00	72577.30
M8 2001	610147.00	4802.00	3191.00	266105.00	92803.00	63578.50
M9 2001	622087.00	4534.00	2989.00	265943.00	99060.50	69292.70
M10 2001	642253.00	4647.00	2854.00	267307.00	106581.00	72943.80
M11 2001	653668.00	4230.00	2527.00	267974.00	107347.00	70136.00
M12 2001	667689.00	3852.00	2568.00	270228.00	109774.00	68405.60
M1 2002	672582.00	3827.00	2596.00	288076.00	107292.00	67091.30
M2 2002	670161.00	4181.00	2670.00	288588.00	101811.00	64147.10
M3 2002	667350.00	4716.00	2803.00	289153.00	98600.70	62899.20
M4 2002	661415.00	5010.00	3306.00	289765.00	98664.50	59516.10
M5 2002	667443.00	5137.00	3095.00	290332.00	88707.50	49751.80
M6 2002	667771.00	4967.00	2994.00	290900.00	83277.40	46421.00

Appendix 5 – 07: *Monthly data series used to compute the CRR factors – Indonesia, (Source: IFS)*

DESCRIPTOR	FX rate IDR/USD	CLAIMS ON CENTRAL GOVERNMENT (NET)	CLAIMS ON STATE & LOCAL GOVERNMENT	CLAIMS ON PUBLIC NONFINANCIAL CORPOR	FOREIGN EXCHANGE	MONEY
UNITS	National Currency per U.S	National Currency	National Currency	National Currency	U.S. dollars	National Currency
SCALE	Units	Billions	Billions	Billions	Millions	Billions
SERIESCODE	536..AE.ZF...	53632AN.ZF...	53632B..ZF...	53632C..ZF...	536.1D.DZF...	53634...ZF..
M7 2002	9108.00	575579.00	209.89	13857.60	29128.90	167039.00
M8 2002	8867.00	568215.00	205.04	13624.90	28942.80	169214.00
M9 2002	9015.00	563363.00	230.88	14681.30	28807.80	174391.00
M10 2002	9233.00	553377.00	269.80	14632.90	28741.70	174901.00
M11 2002	8976.00	553069.00	265.37	14983.70	28804.50	189105.00
M12 2002	8940.00	543553.00	309.71	15945.90	30754.30	182647.00
M1 2003	8876.00	556951.00	305.53	15645.30	30829.60	173165.00
M2 2003	8905.00	560599.00	252.73	16525.30	30926.40	174530.00
M3 2003	8908.00	544790.00	278.06	15820.00	31350.80	173334.00
M4 2003	8675.00	540767.00	929.80	14324.20	32348.50	175672.00
M5 2003	8279.00	545598.00	1171.10	13605.00	32843.10	184229.00
M6 2003	8285.00	546059.00	2723.09	11615.10	32717.70	186971.00
M7 2003	8505.00	550165.00	2790.72	11166.10	32307.90	188486.00
M8 2003	8535.00	508026.00	3201.35	10948.60	32131.70	192991.00
M9 2003	8389.00	509394.00	2974.16	10733.50	32615.30	198403.00
M10 2003	8495.00	514387.00	2973.68	10679.80	33334.60	203326.00
M11 2003	8537.00	504234.00	2793.29	11246.70	33632.60	216035.00
M12 2003	8465.00	505939.00	2718.14	11107.20	34742.40	213681.00
M1 2004	8441.00	512118.00	2429.27	11568.40	34393.40	209009.00
M2 2004	8447.00	497389.00	2481.85	11655.30	34513.60	208071.00
M3 2004	8587.00	472110.00	1243.06	13569.30	35850.50	209058.00
M4 2004	8661.00	470471.00	1652.20	14195.90	35564.00	208074.00
M5 2004	9210.00	471410.00	1257.46	14807.60	35007.10	215692.00
M6 2004	9415.00	474480.00	579.99	13702.30	33385.20	225786.00
M7 2004	9168.00	482180.00	569.45	13241.90	33307.00	230680.00
M8 2004	9328.00	479681.00	532.13	13092.60	33333.00	232329.00
M9 2004	9170.00	482114.00	545.51	13033.30	33286.50	234383.00
M10 2004	9090.00	484134.00	612.51	14072.20	33721.80	240202.00
M11 2004	9018.00	484627.00	651.15	13901.20	34285.60	243272.00
M12 2004	9290.00	500318.00	707.77	13907.50	34724.10	245675.00
M1 2005	9165.00	490505.00	618.37	14513.30	34522.30	241907.00
M2 2005	9260.00	478451.00	532.26	15250.40	34970.20	244166.00
M3 2005	9480.00	458074.00	512.75	17136.10	34485.10	243581.00
M4 2005	9570.00	457990.00	503.16	16745.00	34781.00	239976.00
M5 2005	9495.00	463616.00	481.68	18824.90	33091.20	246125.00
M6 2005	9713.00	477713.00	456.43	16945.30	32366.30	261320.00
M7 2005	9819.00	488455.00	427.33	16452.90	30668.20	260657.00
M8 2005	10240.00	487582.00	429.95	17831.20	29627.80	268443.00
M9 2005	10310.00	500376.00	446.27	19130.40	28638.30	267380.00
M10 2005	10090.00	493438.00	473.61	18095.80	30891.00	279921.00
M11 2005	10035.00	486615.00	410.32	17989.70	31494.40	268315.00
M12 2005	9830.00	506204.00	482.97	17219.80	32925.50	270825.00
M1 2006	9395.00	523055.00	427.94	16617.30	33038.10	273776.00
M2 2006	9230.00	524716.00	390.85	16498.30	33603.00	270063.00
M3 2006	9075.00	477786.00	390.93	17184.60	38114.70	270171.00
M4 2006	8775.00	472026.00	328.29	17035.10	40521.60	273349.00
M5 2006	9220.00	485476.00	280.75	17656.60	42021.60	295812.00
M6 2006	9300.00	493553.00	269.00	18388.30	38256.30	303622.00
M7 2006	9070.00	488434.00	290.12	18283.90	39060.30	303041.00
M8 2006	9100.00	488158.00	255.87	19175.00	40195.50	318943.00
M9 2006	9235.00	491923.00	256.65	20378.10	40591.40	323824.00
M10 2006	9110.00	513865.00	281.41	20824.20	38082.40	336211.00
M11 2006	9165.00	491922.00	271.27	23037.80	39844.90	332250.00
M12 2006	9020.00	515666.00	583.12	27647.50	40866.00	346954.00

Appendix 5 – 08: *Monthly data series used to compute the CRR factors – Indonesia, (Source: IFS)*

DESCRIPTOR	QUASI-MONEY	EXPORTS,F.O.B.	IMPORTS,C.I.F.	CLAIMS ON CENTRAL GOVERNMENT	FOREIGN ASSETS	FOREIGN LIABILITIES
UNITS	National Currency	U.S. dollars	U.S. dollars	National Currency	National Currency	National Currency
SCALE	Billions	Millions	Millions	Billions	Billions	Billions
SERIESCODE	53635...ZF...	53670..DZF...	53671..DZF...	53612A..ZF...	53621...ZF...	53626C..ZF...
M7 2002	682404.00	5303.00	3396.00	303917.00	90897.30	46781.10
M8 2002	683986.00	5621.00	3943.00	304481.00	82583.70	45791.70
M9 2002	680965.00	5387.00	3609.00	305065.00	90284.20	49588.10
M10 2002	684218.00	5305.00	3716.00	305626.00	96356.20	50998.10
M11 2002	676437.00	5112.00	3351.00	306174.00	90474.00	51726.00
M12 2002	694951.00	4600.00	2831.00	306822.00	90147.30	51895.00
M1 2003	696313.00	5556.00	3728.00	323186.00	90289.00	50855.10
M2 2003	702190.00	5245.00	4117.00	323697.00	84209.20	47997.40
M3 2003	699364.00	5608.00	3521.00	324332.00	76834.30	46355.20
M4 2003	702291.00	5044.00	3253.00	324902.00	76386.70	47188.40
M5 2003	703757.00	5001.00	3586.00	324483.00	73375.00	47030.30
M6 2003	701429.00	5310.00	3042.00	325281.00	69298.60	38685.40
M7 2003	707123.00	5379.00	3629.00	330499.00	73937.60	39790.60
M8 2003	705491.00	5284.00	3385.00	262504.00	72299.20	39532.40
M9 2003	705148.00	5517.00	3371.00	262751.00	69767.00	39643.80
M10 2003	715454.00	5645.00	3496.00	262958.00	70920.90	27149.60
M11 2003	722397.00	4989.00	3359.00	263158.00	76215.90	27769.50
M12 2003	733579.00	5530.00	3759.00	263394.00	77340.40	31457.60
M1 2004	732743.00	5366.00	4188.00	267856.00	76886.30	29807.40
M2 2004	718233.00	4458.00	3747.00	267977.00	79331.30	30476.60
M3 2004	717628.00	5222.00	4575.00	268199.00	78110.40	43713.30
M4 2004	717637.00	5259.00	4403.00	268398.00	73951.40	45622.00
M5 2004	733780.00	6065.00	4071.00	268605.00	91703.90	47039.30
M6 2004	745335.00	6515.00	4527.00	268656.00	89364.70	54641.70
M7 2004	741364.00	6380.00	4661.00	272215.00	84804.50	42261.40
M8 2004	747910.00	6520.00	4442.00	272348.00	78295.10	52326.30
M9 2004	751331.00	6555.00	5136.00	272547.00	78650.50	54547.70
M10 2004	755453.00	6756.00	5031.00	272752.00	76685.00	53893.80
M11 2004	755686.00	5998.00	4167.00	273405.00	75968.90	54641.00
M12 2004	785532.00	7074.00	5926.00	273670.00	68874.10	60195.10
M1 2005	772989.00	6285.00	5077.00	278134.00	69761.40	57785.00
M2 2005	767518.00	6448.00	4903.00	278541.00	66505.50	58189.30
M3 2005	776523.00	7294.00	6390.00	279033.00	68027.10	63609.60
M4 2005	804297.00	6855.00	6006.00	286644.00	76186.80	65503.90
M5 2005	801188.00	7371.00	6204.00	286993.00	75322.40	74657.60
M6 2005	813078.00	7169.00	5834.00	287078.00	79822.30	70874.90
M7 2005	828866.00	7194.00	6072.00	292444.00	91183.40	69529.70
M8 2005	848195.00	7119.00	6739.00	292936.00	106909.00	74423.00
M9 2005	883550.00	7425.00	5824.00	296695.00	124916.00	75695.30
M10 2005	886601.00	7998.00	5862.00	296800.00	124396.00	75083.70
M11 2005	898574.00	7008.00	4668.00	297154.00	124887.00	71974.20
M12 2005	929658.00	8061.00	5919.00	297275.00	119752.00	68087.80
M1 2006	918825.00	7818.00	5661.00	312774.00	123834.00	68192.30
M2 2006	925333.00	7734.00	5783.00	309902.00	117236.00	63188.30
M3 2006	926152.00	7716.00	6581.00	310140.00	119963.00	60769.70
M4 2006	921328.00	8188.00	6274.00	310581.00	109336.00	59461.30
M5 2006	941524.00	8440.00	6655.00	310802.00	103905.00	63796.80
M6 2006	951479.00	8440.00	6673.00	310526.00	98526.40	64413.50
M7 2006	946875.00	8844.00	7166.00	310849.00	99441.90	63365.40
M8 2006	952134.00	9110.00	7061.00	311098.00	99501.10	61889.70
M9 2006	968053.00	9177.00	6780.00	311601.00	99607.80	65030.80
M10 2006	990788.00	9314.00	6836.00	312044.00	111846.00	60778.30
M11 2006	1007320.00	8465.00	6018.00	292205.00	99923.40	67763.10
M12 2006	1032920.00	8795.00	8151.00	289136.00	95146.80	70779.20

***Appendix 5 – 09:** Monthly data series used to compute the CRR factors – Indonesia, (Source: IFS)*

DESCRIPTOR	FX rate IDR/USD	CLAIMS ON CENTRAL GOVERNMENT (NET)	CLAIMS ON STATE & LOCAL GOVERNMENT	CLAIMS ON PUBLIC NONFINANCIAL CORPOR	FOREIGN EXCHANGE	MONEY
UNITS	National Currency per U.S	National Currency	National Currency	National Currency	U.S. dollars	National Currency
SCALE	Units	Billions	Billions	Billions	Millions	Billions
SERIESCODE	536..AE.ZF...	53632AN.ZF...	53632B..ZF...	53632C..ZF...	536.1D.DZF...	53634...ZF..
M1 2007	9090.00	513797.00	607.18	24387.40	41516.90	335639.00
M2 2007	9160.00	493172.00	596.69	22926.20	43867.90	336333.00
M3 2007	9118.00	461380.00	557.45	25359.50	45433.50	331681.00
M4 2007	9083.00	455688.00	564.99	22275.10	47481.10	342078.00
M5 2007	8815.00	443547.00	531.68	23748.20	48347.40	343245.00
M6 2007	9054.00	453974.00	528.38	29165.10	49171.30	371708.00
M7 2007	9186.00	463677.00	513.65	28288.40	50090.70	386173.00
M8 2007	9410.00	467629.00	571.67	28681.90	49629.30	391897.00
M9 2007	9137.00	463888.00	487.97	28250.90	50920.00	400043.00
M10 2007	9103.00	463122.00	511.30	33325.60	52076.00	
M11 2007	9376.00	470276.00	594.21	34549.70	52791.70	
M12 2007	9419.00	522577.00	685.56	39891.20	54737.30	
M1 2008	9291.00	470645.00	639.56	34714.80	53600.90	
M2 2008	9051.00	456083.00	646.12	31800.50	54632.20	
M3 2008	9217.00	399911.00	606.65	33669.00	56547.80	
M4 2008	9234.00	393037.00	570.45	33119.70	56427.70	
M5 2008	9318.00	388306.00	567.50	35730.50	55117.00	
M6 2008	9225.00	385819.00	694.01	36516.50	57018.50	
M7 2008	9118.00	363435.00	769.72	36948.10	58182.60	
M8 2008	9153.00	333730.00	738.55	38891.10	56124.50	
M9 2008	9378.00	376685.00	691.72	45374.60	54757.60	
M10 2008	10995.00	347864.00	668.45	48812.60	48554.60	
M11 2008	12151.00	353637.00	591.61	47666.70	48021.00	
M12 2008	10950.00	406395.00	983.58	47949.10	49338.90	
M1 2009	11355.00	404075.00	897.03	48014.00	48523.60	
M2 2009	11980.00	n.a.	n.a.	n.a.	n.a.	
M3 2009	n.a.	n.a.	n.a.	n.a.	n.a.	

Appendix 5 – 10: *Monthly data series used to compute the CRR factors – Indonesia, (Source: IFS)*

DESCRIPTOR	QUASI-MONEY	EXPORTS,F.O.B.	IMPORTS,C.I.F.	CLAIMS ON CENTRAL GOVERNMENT	FOREIGN ASSETS	FOREIGN LIABILITIES
UNITS	National Currency	U.S. dollars	U.S. dollars	National Currency	National Currency	National Currency
SCALE	Billions	Millions	Millions	Billions	Billions	Billions
SERIESCODE	53635...ZF...	53670..DZF...	53671..DZF...	53612A..ZF...	53621...ZF...	53626C..ZF...
M1 2007	1030110.00	8676.00	6671.00	289332.00	94566.40	74412.60
M2 2007	1030390.00	8569.00	6358.00	290585.00	93527.20	73193.10
M3 2007	1044960.00	9500.00	7444.00	292571.00	91677.20	71994.80
M4 2007	1041000.00	9351.00	7052.00	294656.00	100106.00	70988.60
M5 2007	1050120.00	10061.00	8101.00	282039.00	117509.00	76240.50
M6 2007	1079860.00	9989.00	7682.00	282429.00	101682.00	74552.90
M7 2007	1085840.00	9788.00	7788.00	280488.00	88221.20	77104.20
M8 2007	1097520.00	9686.00	8022.00	282163.00	84421.80	81392.90
M9 2007	1112840.00	10447.00	8142.00	282764.00	108817.00	81726.90
M10 2007	1533850.00	10774.00	8003.00	282915.00	97757.50	82392.50
M11 2007	1559570.00	10679.00	8709.00	280305.00	82194.30	87517.00
M12 2007	1649660.00	11643.00	7910.00	279931.00	72755.80	92902.10
M1 2008	1596560.00	11484.00	9467.00	280036.00	90638.40	88993.00
M2 2008	1603750.00	10882.00	9674.00	279410.00	106139.00	88289.80
M3 2008	1594390.00	12047.00	10099.00	278807.00	88723.10	92600.80
M4 2008	1611690.00	11319.00	11660.00	278097.00	85357.90	93962.80
M5 2008	1641730.00	13054.00	11235.00	278941.00	85806.30	95180.70
M6 2008	1703380.00	12972.00	11812.00	278465.00	102324.00	94187.80
M7 2008	1686050.00	12704.00	12615.00	279292.00	104452.00	100710.00
M8 2008	1682810.00	12453.00	11672.00	281052.00	88113.20	96303.80
M9 2008	1778000.00	12924.00	10860.00	280711.00	85606.30	105057.00
M10 2008	1812490.00	11262.00	10945.00	278841.00	128584.00	134765.00
M11 2008	1851020.00	9528.00	8518.00	282038.00	142725.00	139836.00
M12 2008	1895840.00	8665.00	7625.00	283381.00	148301.00	113317.00
M1 2009	1874150.00	n.a.	n.a.	283788.00	146844.00	112125.00
M2 2009	n.a.	n.a.	n.a.	284036.00	n.a.	n.a.
M3 2009	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Appendix V: Monthly CRR factors - Indonesia

Appendix 5 – 11: *Monthly factors and the computed CRR index - Indonesia*

Years	Rte of change in M2	Rate of change in reserves	Rate of change in export	Rate of change in M2/ foreign reserves	Rate of change in foreign assets / foreign liabilities	Rate of change in debt	CRR index
UNITS	Factor	Factor	Factor	Factor	Factor	Factor	Factor
M1 1990	1.46	0.26	0.56	0.84	-0.69	-0.05	2.47
M2 1990	0.82	0.05	0.01	0.54	-1.13	0.23	0.06
M3 1990	1.25	0.01	0.38	0.97	-1.03	-0.07	1.65
M4 1990	1.36	-0.16	0.16	1.27	-0.59	-0.05	2.10
M5 1990	1.20	-0.24	-0.08	1.21	-0.83	-0.07	1.34
M6 1990	1.57	0.00	-0.29	1.26	-1.18	-0.01	1.37
M7 1990	1.30	0.47	-0.13	0.35	-1.31	0.00	0.68
M8 1990	0.95	0.58	0.28	-0.31	-1.31	-0.02	0.21
M9 1990	1.30	0.39	0.68	0.46	-1.35	0.01	1.46
M10 1990	1.27	0.53	0.83	0.15	-1.33	0.06	1.40
M11 1990	1.10	0.25	0.56	0.46	-1.19	0.00	1.20
M12 1990	0.91	0.79	0.80	-0.92	-1.32	0.03	0.22
M1 1991	1.14	0.82	0.80	-0.71	-1.27	-0.06	0.84
M2 1991	0.90	0.97	0.37	-1.53	-1.08	0.13	-0.50
M3 1991	0.56	1.08	0.42	-2.54	-1.17	0.10	-1.75
M4 1991	0.67	1.27	0.93	-3.36	-1.07	0.12	-1.67
M5 1991	0.11	1.12	0.76	-3.46	-0.77	0.10	-2.35
M6 1991	0.63	0.96	0.73	-1.94	-0.37	0.00	0.02
M7 1991	0.77	0.85	0.47	-1.31	-0.04	0.00	0.73
M8 1991	0.50	0.91	-0.22	-1.91	-0.08	0.00	-0.80
M9 1991	0.52	0.83	-0.23	-1.57	-0.05	-0.05	-0.45
M10 1991	0.52	0.74	-0.15	-1.28	0.07	0.01	-0.12
M11 1991	0.44	0.50	-0.29	-0.71	-0.03	-0.01	-0.08
M12 1991	0.53	0.53	0.14	-0.68	-0.08	0.02	0.43
M1 1992	0.49	0.27	0.00	-0.17	-0.31	-0.05	0.33
M2 1992	0.68	0.32	0.43	-0.07	-0.35	0.01	1.00
M3 1992	0.66	0.40	-0.04	-0.25	-0.34	-0.01	0.44
M4 1992	0.61	0.42	0.01	-0.32	-0.27	-0.02	0.46
M5 1992	0.60	0.46	0.29	-0.43	-0.41	0.01	0.49
M6 1992	0.49	0.51	0.17	-0.67	-0.55	0.04	-0.10
M7 1992	0.57	0.58	0.43	-0.74	-0.38	0.06	0.41
M8 1992	0.58	0.61	-0.60	-0.79	-0.50	0.02	-0.72
M9 1992	0.61	0.51	0.31	-0.49	-0.38	0.02	0.55
M10 1992	0.61	0.27	0.87	-0.02	-0.26	0.04	1.43
M11 1992	0.61	0.32	0.54	-0.10	-0.29	0.02	1.05
M12 1992	0.67	0.20	0.85	0.19	0.05	0.07	1.89
M1 1993	0.67	0.34	0.49	-0.07	0.16	0.03	1.56
M2 1993	0.64	0.27	0.26	0.05	0.40	0.04	1.59
M3 1993	0.63	0.18	0.59	0.19	0.04	-0.03	1.66
M4 1993	0.45	0.09	0.25	0.17	-0.20	0.02	0.74
M5 1993	0.38	0.03	0.39	0.20	-0.15	-0.01	0.87
M6 1993	0.42	-0.03	0.13	0.31	-0.23	-0.01	0.61
M7 1993	0.42	-0.10	0.96	0.39	-0.31	0.00	1.36
M8 1993	0.57	0.05	0.25	0.31	-0.43	-0.04	0.80
M9 1993	0.49	0.15	-0.34	0.09	-0.40	-0.01	-0.02
M10 1993	0.50	0.10	-0.08	0.20	-0.50	0.01	0.20
M11 1993	0.56	0.17	-0.12	0.15	-0.61	-0.04	0.19
M12 1993	2.29	1.01	0.88	-0.25	-0.55	0.00	3.38
M1 1994	2.18	1.00	0.23	-0.31	-0.72	0.02	2.36
M2 1994	2.24	1.04	0.36	-0.34	-0.34	0.10	2.88
M3 1994	2.04	0.98	0.60	-0.39	-0.21	-0.03	3.06
M4 1994	1.97	0.67	0.69	-0.07	0.08	-0.01	3.35
M5 1994	1.89	0.59	0.74	-0.01	0.06	-0.03	3.31
M6 1994	1.85	0.64	1.11	-0.09	0.04	-0.04	3.60

Appendix 5 – 12: *Monthly factors and the computed CRR index - Indonesia*

Years	Rte of change in M2	Rate of change in reserves	Rate of change in export	Rate of change in M2/ foreign reserves	Rate of change in foreign assets / foreign liabilities	Rate of change in debt	CRR index
UNITS	Factor	Factor	Factor	Factor	Factor	Factor	Factor
M7 1994	1.83	0.52	1.01	0.05	0.24	-0.05	3.71
M8 1994	1.89	0.68	1.05	-0.11	0.02	-0.09	3.62
M9 1994	1.94	0.65	0.89	-0.02	0.27	-0.07	3.79
M10 1994	1.93	0.63	1.03	0.01	0.25	-0.06	3.91
M11 1994	1.94	0.85	0.98	-0.24	-0.06	-0.06	3.53
M12 1994	2.07	0.74	1.08	-0.04	-0.07	-0.05	3.83
M1 1995	2.02	0.66	0.51	0.06	-0.30	-0.11	3.05
M2 1995	2.03	0.61	0.66	0.13	-0.20	-0.08	3.30
M3 1995	1.99	0.66	0.68	0.05	-0.36	-0.13	3.16
M4 1995	1.93	0.63	0.57	0.08	-0.21	-0.12	3.13
M5 1995	1.90	0.61	0.95	0.10	-0.04	-0.09	3.61
M6 1995	2.04	0.67	0.91	0.14	-0.08	-0.07	3.77
M7 1995	2.08	0.74	0.81	0.09	0.08	-0.05	3.85
M8 1995	2.12	0.68	0.95	0.20	-0.14	-0.09	3.89
M9 1995	2.17	0.64	0.91	0.29	-0.03	-0.04	4.02
M10 1995	2.20	0.61	0.84	0.37	0.29	-0.05	4.37
M11 1995	2.23	0.65	0.99	0.34	0.33	-0.05	4.58
M12 1995	2.32	0.65	1.37	0.39	0.38	0.06	5.05
M1 1996	2.23	0.63	0.47	0.38	0.37	0.06	4.02
M2 1996	2.25	0.89	0.53	0.05	0.01	0.34	3.39
M3 1996	2.25	0.85	0.74	0.09	-0.10	0.18	3.65
M4 1996	2.26	0.81	0.79	0.14	-0.08	0.11	3.81
M5 1996	2.29	0.78	0.79	0.19	-0.04	0.08	3.93
M6 1996	2.42	0.89	0.82	0.17	0.00	0.07	4.23
M7 1996	2.40	0.83	0.73	0.22	0.13	0.12	4.20
M8 1996	2.33	0.80	0.92	0.22	-0.01	0.02	4.22
M9 1996	2.40	0.77	0.89	0.36	0.11	0.04	4.49
M10 1996	2.50	0.77	0.98	0.41	0.18	0.01	4.83
M11 1996	2.59	1.01	0.92	0.15	0.30	0.04	4.93
M12 1996	2.58	1.25	1.08	-0.14	0.18	-0.02	4.97
M1 1997	2.62	1.36	0.87	-0.24	0.45	-0.06	5.12
M2 1997	2.55	1.31	0.46	-0.24	0.17	-0.04	4.29
M3 1997	2.44	1.27	0.78	-0.27	0.04	-0.15	4.42
M4 1997	2.41	1.33	1.14	-0.36	-0.19	-0.15	4.48
M5 1997	2.38	1.41	1.03	-0.45	-0.22	-0.14	4.30
M6 1997	2.44	1.40	1.05	-0.41	-0.19	-0.13	4.42
M7 1997	2.05	1.34	1.17	-0.75	-0.12	-0.11	3.79
M8 1997	1.18	1.11	0.66	-1.44	-0.29	-0.06	1.28
M9 1997	0.75	1.26	0.74	-1.89	-0.32	-0.06	0.59
M10 1997	0.31	0.85	0.84	-2.06	-0.37	-0.05	-0.38
M11 1997	0.16	0.76	0.57	-2.04	-0.12	0.01	-0.70
M12 1997	-0.62	0.46	0.82	-2.59	-0.07	0.13	-2.12
M1 1998	-2.35	0.72	0.05	-3.72	0.27	0.07	-5.10
M2 1998	-2.05	0.22	0.14	-3.51	0.58	1.33	-5.95
M3 1998	-1.78	0.26	0.78	-3.43	0.83	0.95	-4.30
M4 1998	-1.45	0.44	0.37	-3.32	1.16	0.78	-3.58
M5 1998	-2.17	0.65	0.24	-3.68	1.00	0.32	-4.28
M6 1998	-2.63	0.59	0.54	-3.84	1.44	0.22	-4.12
M7 1998	-2.36	0.68	0.27	-3.78	1.60	0.03	-3.62
M8 1998	-2.04	0.72	0.20	-3.68	2.02	0.06	-2.84
M9 1998	-1.88	0.81	0.56	-3.65	1.75	0.26	-2.67
M10 1998	-0.85	0.97	-0.17	-3.30	1.48	0.23	-2.10
M11 1998	-0.59	1.11	-0.35	-3.24	1.43	0.18	-1.82
M12 1998	-0.78	1.22	-0.34	-3.37	1.09	0.70	-2.88

Appendix 5 – 13: *Monthly factors and the computed CRR index - Indonesia*

Years	Rte of change in M2	Rate of change in reserves	Rate of change in export	Rate of change in M2/ foreign reserves	Rate of change in foreign assets / foreign liabilities	Rate of change in debt	CRR index
UNITS	Factor	Factor	Factor	Factor	Factor	Factor	Factor
M1 1999	-1.09	1.34	-0.72	-3.50	0.95	0.46	-3.48
M2 1999	-0.93	1.28	-0.50	-3.45	0.92	4.07	-6.75
M3 1999	-0.91	1.48	0.25	-3.47	0.80	2.00	-3.85
M4 1999	-0.65	1.38	0.03	-3.38	0.43	2.45	-4.64
M5 1999	-0.48	1.40	0.05	-3.33	0.33	1.22	-3.25
M6 1999	0.26	1.48	0.00	-3.04	0.05	1.39	-2.64
M7 1999	0.23	1.36	0.29	-3.02	-0.01	1.01	-2.17
M8 1999	-0.17	1.34	0.53	-3.18	0.01	0.35	-1.83
M9 1999	-0.51	1.26	0.46	-3.31	-0.03	0.33	-2.45
M10 1999	0.19	1.24	0.25	-2.97	-0.05	0.26	-1.60
M11 1999	-0.08	1.19	0.13	-3.08	0.07	0.02	-1.79
M12 1999	0.19	1.17	0.42	-2.95	-0.07	0.03	-1.29
M1 2000	-0.01	1.18	0.16	-3.04	-0.12	-0.13	-1.70
M2 2000	-0.05	1.22	0.51	-3.06	-0.28	-0.13	-1.52
M3 2000	-0.03	1.28	0.90	-3.07	-0.08	-0.13	-0.85
M4 2000	-0.18	1.16	0.27	-3.10	-0.20	-0.13	-1.91
M5 2000	-0.42	1.09	0.61	-3.19	-0.05	-0.14	-1.82
M6 2000	-0.46	1.14	0.92	-3.21	-0.07	-0.14	-1.54
M7 2000	-0.55	1.05	0.89	-3.22	-0.05	-0.14	-1.73
M8 2000	-0.22	1.36	0.92	-3.14	-0.05	-0.14	-0.98
M9 2000	-0.40	1.01	1.14	-3.13	-0.13	-0.14	-1.37
M10 2000	-0.55	0.88	0.90	-3.17	-0.06	-0.14	-1.85
M11 2000	-0.54	0.84	0.78	-3.15	-0.10	-0.15	-2.02
M12 2000	-0.44	0.86	0.33	-3.12	-0.10	-0.15	-2.33
M1 2001	-0.39	0.85	0.30	-3.07	-0.02	-0.15	-2.18
M2 2001	-0.45	0.79	0.13	-3.08	0.26	-0.14	-2.20
M3 2001	-0.60	0.71	0.59	-3.12	0.42	-0.14	-1.86
M4 2001	-0.90	0.67	0.21	-3.26	0.46	-0.14	-2.69
M5 2001	-0.69	0.63	0.29	-3.13	0.40	-0.14	-2.35
M6 2001	-0.75	0.60	0.16	-3.14	0.34	-0.14	-2.65
M7 2001	-0.09	0.60	0.13	-2.72	0.33	-0.14	-1.60
M8 2001	0.26	0.51	0.07	-2.40	0.54	-0.14	-0.89
M9 2001	-0.07	0.53	-0.10	-2.60	0.33	-0.14	-1.76
M10 2001	-0.23	0.46	-0.03	-2.66	0.49	-0.14	-1.84
M11 2001	-0.13	0.39	-0.29	-2.52	0.65	-0.14	-1.76
M12 2001	0.01	0.37	-0.52	-2.39	0.73	-0.14	-1.66
M1 2002	0.06	0.32	-0.53	-2.25	0.56	-0.14	-1.70
M2 2002	0.15	0.32	-0.31	-2.09	0.35	-0.14	-1.43
M3 2002	0.43	0.31	0.03	-1.74	0.23	-0.14	-0.61
M4 2002	0.63	0.30	0.21	-1.41	0.25	-0.14	0.12
M5 2002	1.03	0.34	0.29	-0.90	0.45	-0.14	1.34
M6 2002	1.14	0.38	0.18	-0.65	0.47	-0.14	1.66
M7 2002	1.02	0.47	0.39	-0.75	0.55	-0.14	1.82
M8 2002	1.21	0.43	0.57	-0.31	0.44	-0.14	2.48
M9 2002	1.14	0.39	0.42	-0.22	0.41	-0.14	2.28
M10 2002	1.02	0.37	0.36	-0.20	0.39	-0.14	2.08
M11 2002	1.22	0.35	0.24	0.24	0.15	-0.14	2.34
M12 2002	1.30	0.52	-0.08	0.19	0.14	-0.14	2.22
M1 2003	1.22	0.50	0.49	0.18	0.20	-0.14	2.73
M2 2003	1.18	0.48	0.29	0.17	0.20	-0.14	2.46
M3 2003	1.10	0.49	0.50	0.11	0.00	-0.14	2.34
M4 2003	1.24	0.55	0.15	0.25	-0.15	-0.14	2.18
M5 2003	1.52	0.57	0.12	0.62	-0.22	-0.14	2.75
M6 2003	1.43	0.53	0.30	0.58	-0.13	-0.14	2.84

Appendix 5 – 14: *Monthly factors and the computed CRR index - Indonesia*

Years	Rte of change in M2	Rate of change in reserves	Rate of change in export	Rate of change in M2/ foreign reserves	Rate of change in foreign assets / foreign liabilities	Rate of change in debt	CRR index
UNITS	Factor	Factor	Factor	Factor	Factor	Factor	Factor
M7 2003	1.24	0.47	0.33	0.39	0.05	-0.14	2.62
M8 2003	1.17	0.42	0.26	0.37	0.01	-0.15	2.38
M9 2003	1.24	0.45	0.39	0.45	-0.11	-0.15	2.56
M10 2003	1.22	0.49	0.45	0.33	0.82	-0.15	3.45
M11 2003	1.28	0.49	0.04	0.36	0.97	-0.15	3.28
M12 2003	1.34	0.57	0.34	0.33	0.64	-0.15	3.37
M1 2004	1.27	0.52	0.22	0.36	0.78	-0.15	3.30
M2 2004	1.12	0.51	-0.32	0.26	0.95	-0.14	2.66
M3 2004	0.99	0.61	0.11	-0.04	0.17	-0.14	1.98
M4 2004	0.90	0.56	0.12	-0.08	0.06	-0.13	1.70
M5 2004	0.67	0.50	0.57	-0.38	0.15	-0.13	1.63
M6 2004	0.66	0.35	0.80	-0.25	-0.20	-0.12	1.47
M7 2004	0.80	0.33	0.70	0.00	0.16	-0.08	2.07
M8 2004	0.73	0.32	0.76	-0.09	-0.25	-0.07	1.53
M9 2004	0.82	0.30	0.76	0.08	-0.75	-0.05	1.26
M10 2004	0.91	0.33	0.85	0.17	-0.80	-0.03	1.47
M11 2004	0.94	0.36	0.41	0.20	-0.72	-0.02	1.20
M12 2004	0.93	0.38	0.97	0.06	-0.93	-0.01	1.43
M1 2005	0.90	0.35	0.52	0.15	-0.89	0.00	1.03
M2 2005	0.80	0.38	0.59	0.01	-0.60	0.00	1.19
M3 2005	0.70	0.33	1.04	-0.07	-0.57	0.00	1.42
M4 2005	0.75	0.34	0.77	-0.08	-0.67	0.01	1.11
M5 2005	0.78	0.19	1.02	0.20	-0.64	0.01	1.55
M6 2005	0.76	0.13	0.90	0.20	-0.73	0.00	1.26
M7 2005	0.75	-0.02	0.90	0.39	-0.21	0.01	1.81
M8 2005	0.63	-0.10	0.84	0.27	-0.01	0.01	1.64
M9 2005	0.73	-0.18	0.99	0.49	0.27	0.01	2.28
M10 2005	0.88	0.00	1.27	0.38	0.32	0.01	2.84
M11 2005	0.88	0.04	0.73	0.33	0.86	0.01	2.84
M12 2005	1.11	0.16	1.25	0.42	0.76	0.00	3.69
M1 2006	1.29	0.16	1.09	0.77	0.98	0.01	4.28
M2 2006	1.36	0.20	1.01	0.84	1.22	0.01	4.62
M3 2006	1.41	0.55	0.98	0.39	1.16	0.01	4.48
M4 2006	1.54	0.72	1.18	0.37	1.37	0.01	5.17
M5 2006	1.39	0.82	1.26	-0.08	0.74	0.01	4.13
M6 2006	1.36	0.50	1.22	0.27	0.28	0.00	3.63
M7 2006	1.43	0.54	1.37	0.37	0.15	0.00	3.87
M8 2006	1.46	0.61	1.45	0.28	-0.04	0.00	3.76
M9 2006	1.42	0.62	1.43	0.17	-0.13	0.00	3.51
M10 2006	1.60	0.41	1.44	0.66	0.10	0.00	4.21
M11 2006	1.56	0.53	1.00	0.42	-0.27	-0.01	3.24
M12 2006	1.78	0.59	1.10	0.55	-0.43	-0.02	3.60
M1 2007	1.60	0.61	0.99	0.35	-0.53	-0.02	3.04
M2 2007	1.49	0.76	0.90	0.03	-0.59	-0.02	2.62
M3 2007	1.51	0.85	1.26	-0.05	-0.51	-0.01	3.08
M4 2007	1.50	0.97	1.15	-0.17	-0.22	-0.01	3.24
M5 2007	1.68	1.00	1.41	0.03	0.01	-0.02	4.14
M6 2007	1.71	1.02	1.33	-0.09	-0.22	-0.02	3.77
M7 2007	1.65	1.05	1.20	-0.22	-0.48	-0.02	3.22
M8 2007	1.52	0.98	1.12	-0.31	-0.54	-0.02	2.78
M9 2007	1.74	1.04	1.38	-0.13	-0.46	-0.02	3.59
M10 2007	1.78	1.08	1.46	-0.13	-0.33	-0.01	3.87
M11 2007	1.64	1.09	1.36	-0.34	-0.50	-0.01	3.26
M12 2007	1.91	1.19	1.68	-0.30	-0.64	-0.01	3.84

Appendix 5 – 15: *Monthly factors and the computed CRR index - Indonesia*

Years	Rte of change in M2	Rate of change in reserves	Rate of change in export	Rate of change in M2/ foreign reserves	Rate of change in foreign assets / foreign liabilities	Rate of change in debt	CRR index
UNITS	Factor	Factor	Factor	Factor	Factor	Factor	Factor
M1 2008	1.72	1.07	1.55	-0.23	-0.34	-0.01	3.78
M2 2008	1.85	1.10	1.27	-0.09	-0.09	-0.01	4.05
M3 2008	1.63	1.19	1.65	-0.38	-0.53	-0.01	3.57
M4 2008	1.63	1.14	1.32	-0.34	-0.68	0.00	3.07
M5 2008	1.63	1.02	1.88	-0.24	-0.57	0.00	3.73
M6 2008	1.87	1.11	1.78	-0.14	-0.08	0.00	4.53
M7 2008	1.81	1.14	1.61	-0.16	0.00	0.00	4.40
M8 2008	1.71	0.98	1.46	-0.06	-0.52	0.00	3.57
M9 2008	1.85	0.86	1.56	0.08	-0.52	0.00	3.82
M10 2008	0.96	0.46	0.94	-0.59	0.03	0.00	1.79
M11 2008	0.50	0.41	0.32	-1.11	0.51	0.00	0.62
M12 2008	1.17	0.47	0.01	-0.43	0.47	0.00	1.69
M1 2009	0.86	0.40	0.00	-0.65	0.15	0.00	0.76
M2 2009	0.00	0.00	0.00	0.00	0.00	0.00	0.00
M3 2009	0.00	0.00	0.00	0.00	0.00	-0.17	0.17

Appendix V: Monthly data series CRR index Philippines

Appendix 5 – 16: *Monthly data series used to compute the CRR factors – Philippines, (Source: IFS)*

DESCRIPTOR	MARKET RATE, END OF PERIOD	CLAIMS ON CENTRAL GOVT.(NET)	CLAIMS ON NONFIN.PUB.ENTERPS.	FOREIGN EXCHANGE	MONEY
UNITS	National Currency per U.S	National Currency	National Currency	U.S. dollars	National Currency
SCALE	Units	Billions	Billions	Millions	Billions
COUNTRYNAME	PHILIPPINES	PHILIPPINES	PHILIPPINES	PHILIPPINES	PHILIPPINES
SERIESCODE	566..AE.ZF...	56632AN.ZF...	56632C..ZF...	566.1D.DZF...	56634...ZF...
M1 1989	21.35	-6.88	17.33	814.00	56.26
M2 1989	21.35	-2.27	18.14	728.00	56.84
M3 1989	21.33	0.29	18.15	624.00	59.75
M4 1989	21.56	-6.96	18.48	433.00	62.96
M5 1989	21.61	-6.54	18.75	506.00	63.09
M6 1989	21.81	-4.09	19.85	461.00	61.90
M7 1989	21.88	-4.31	20.17	377.00	61.53
M8 1989	21.88	-8.86	20.46	507.00	61.06
M9 1989	21.95	-16.95	20.68	551.00	61.20
M10 1989	22.10	-17.78	20.19	823.00	63.37
M11 1989	22.23	-8.83	20.77	766.00	69.48
M12 1989	22.44	-1.45	20.80	1365.00	81.28
M1 1990	22.54	-8.23	25.76	734.00	72.99
M2 1990	22.76	-10.49	21.34	626.00	73.54
M3 1990	22.75	-15.58	20.87	737.00	73.03
M4 1990	22.81	-21.10	20.24	582.00	74.85
M5 1990	22.98	-15.85	20.02	969.00	75.20
M6 1990	23.27	-5.55	20.55	895.00	73.34
M7 1990	23.86	-9.69	21.20	882.00	72.65
M8 1990	25.00	-11.25	21.39	1020.00	75.07
M9 1990	25.75	1.16	22.67	946.00	75.06
M10 1990	25.75	4.65	22.02	840.00	78.75
M11 1990	28.00	3.87	24.41	749.00	83.84
M12 1990	28.00	3.94	25.56	868.00	92.94
M1 1991	28.00	11.27	25.39	701.00	89.47
M2 1991	28.00	2.37	26.91	1272.00	85.02
M3 1991	28.00	4.32	26.98	1244.00	85.97
M4 1991	27.84	-7.20	26.94	1788.00	87.75
M5 1991	27.81	-10.55	24.96	2108.00	89.54
M6 1991	27.75	-9.27	24.22	2362.00	88.10
M7 1991	27.75	-16.78	24.79	2124.00	89.17
M8 1991	27.00	-19.55	24.53	2208.00	90.95
M9 1991	27.00	-30.11	23.37	2370.00	89.19
M10 1991	27.00	-24.50	25.34	2569.00	90.15
M11 1991	26.70	-29.52	25.51	2882.00	95.33
M12 1991	26.65	-19.50	25.86	3186.00	107.69
M1 1992	26.53	-30.65	25.75	3536.00	99.78
M2 1992	26.05	-47.99	25.38	3891.00	97.84
M3 1992	25.38	-71.11	23.48	4324.00	100.36
M4 1992	25.80	-77.69	24.03	3708.00	108.82
M5 1992	26.25	-64.45	24.14	3008.00	106.27
M6 1992	25.58	-59.87	23.68	3115.00	109.97
M7 1992	24.91	-76.02	23.04	3154.00	101.88
M8 1992	23.29	-83.76	21.63	2983.00	99.23
M9 1992	25.12	-81.89	24.91	3742.00	100.43
M10 1992	24.64	-74.33	23.23	4108.00	105.13
M11 1992	25.49	-64.28	24.10	4283.00	109.31
M12 1992	25.10	-34.20	24.96	4283.00	117.54
M1 1993	25.35	-45.60	23.98	4646.00	112.72
M2 1993	25.28	-56.08	24.12	5018.00	113.50
M3 1993	25.51	-79.80	24.74	5662.00	113.15
M4 1993	26.39	-84.14	23.20	5731.00	119.65
M5 1993	27.09	-79.17	23.86	4895.70	118.65
M6 1993	27.27	-82.84	25.08	4766.60	118.28

Appendix 5 – 17: *Monthly data series used to compute the CRR factors – Philippines, (Source: IFS)*

DESCRIPTOR	QUASI-MONEY	EXPORTS	IMPORTS, CIF	CLAIMS ON CENTRAL GOVERNMENT	FOREIGN ASSETS	FOREIGN LIABILITIES
UNITS	National Currency	National Currency	National Currency	National Currency	National Currency	National Currency
SCALE	Billions	Millions	Millions	Billions	Billions	Billions
COUNTRY-NAME	PHILIPPINES	PHILIPPINES	PHILIPPINES	PHILIPPINES	PHILIPPINES	PHILIPPINES
SERIESCODE	56635...ZF...	56670...ZF...	56671...ZF...	56612A..ZF...	56621...ZF...	56626C..ZF...
M1 1989	173.91	12165.00	16175.00	41.32	66.03	42.90
M2 1989	178.83	11933.00	15006.00	40.40	67.91	44.18
M3 1989	185.57	13413.00	19485.00	40.29	69.38	43.88
M4 1989	181.56	13808.00	21427.00	39.97	69.91	44.67
M5 1989	185.48	14498.00	20437.00	40.00	70.34	44.57
M6 1989	192.91	14186.00	20241.00	40.05	69.83	44.36
M7 1989	195.21	15363.00	21780.00	39.93	71.92	44.97
M8 1989	198.31	14449.00	23353.00	39.43	72.20	45.82
M9 1989	198.87	14756.00	20470.00	39.17	72.57	46.58
M10 1989	200.79	14738.00	22838.00	38.78	72.10	46.92
M11 1989	211.71	14246.00	21235.00	38.60	76.08	47.60
M12 1989	220.13	15123.00	20561.00	40.03	79.42	45.42
M1 1990	220.03	13059.00	20559.00	39.28	80.72	44.91
M2 1990	224.09	13806.00	22450.00	38.72	82.60	45.46
M3 1990	225.48	15733.00	25374.00	38.72	82.66	47.31
M4 1990	227.46	14093.00	25203.00	38.40	83.54	47.77
M5 1990	233.07	15845.00	24294.00	38.38	86.44	46.90
M6 1990	245.22	14724.00	23024.00	37.60	87.40	48.98
M7 1990	252.24	17070.00	27987.00	37.87	89.42	50.00
M8 1990	252.20	16503.00	25934.00	38.65	90.78	54.37
M9 1990	262.92	18744.00	28198.00	39.63	93.87	59.40
M10 1990	266.82	17719.00	32852.00	40.22	95.32	60.11
M11 1990	271.97	19073.00	31256.00	42.91	105.58	65.34
M12 1990	275.98	20401.00	30830.00	39.80	109.49	66.59
M1 1991	277.80	17397.00	28284.00	50.29	107.25	63.22
M2 1991	281.67	18371.00	30507.00	51.91	109.44	62.28
M3 1991	289.26	20567.00	32001.00	52.01	119.17	61.60
M4 1991	294.99	19293.00	26827.00	37.98	113.29	59.32
M5 1991	301.32	18823.00	29165.00	37.78	117.26	60.48
M6 1991	314.64	21178.00	27802.00	34.17	123.91	60.25
M7 1991	309.05	21753.00	30309.00	34.10	116.04	55.39
M8 1991	299.77	20750.00	28271.00	33.50	110.71	51.70
M9 1991	303.60	20473.00	28641.00	33.44	105.25	52.34
M10 1991	298.24	20278.00	29520.00	32.71	105.25	52.71
M11 1991	297.01	19931.00	31583.00	32.35	99.50	52.88
M12 1991	326.58	21866.00	28291.00	32.14	105.18	54.87
M1 1992	310.81	17372.00	29443.00	32.04	100.46	56.52
M2 1992	312.23	18463.00	28832.00	33.55	94.17	53.79
M3 1992	323.91	23202.00	32116.00	34.83	92.99	55.77
M4 1992	315.46	16420.00	32787.00	34.73	105.61	58.85
M5 1992	330.86	20736.00	32845.00	50.80	110.93	57.45
M6 1992	339.41	21517.00	30091.00	53.80	115.48	59.09
M7 1992	326.38	20916.00	31452.00	54.44	109.14	58.84
M8 1992	331.34	21971.00	36881.00	55.99	105.78	59.30
M9 1992	345.66	21294.00	35057.00	55.97	117.31	67.01
M10 1992	346.70	20903.00	34872.00	58.98	116.83	71.14
M11 1992	363.13	20091.00	33337.00	62.86	115.49	64.52
M12 1992	373.67	25499.00	35608.00	76.24	117.73	75.17
M1 1993	356.50	19645.00	32269.00	76.33	110.10	74.16
M2 1993	357.24	20515.00	31929.00	76.58	111.95	78.96
M3 1993	371.92	21070.00	37412.00	78.26	114.79	80.17
M4 1993	368.16	22277.00	41309.00	79.59	105.08	81.08
M5 1993	380.86	24988.00	41774.00	79.39	111.72	81.12
M6 1993	391.39	25118.00	38807.00	76.83	114.32	73.75

Appendix 5 – 18: *Monthly data series used to compute the CRR factors – Philippines, (Source: IFS)*

DESCRIPTOR	MARKET RATE, END OF PERIOD	CLAIMS ON CENTRAL GOVT.(NET)	CLAIMS ON NONFIN.PUB.ENTERPS.	FOREIGN EXCHANGE	MONEY
UNITS	National Currency per U.S	National Currency	National Currency	U.S. dollars	National Currency
SCALE	Units	Billions	Billions	Millions	Billions
COUNTRYNAME	PHILIPPINES	PHILIPPINES	PHILIPPINES	PHILIPPINES	PHILIPPINES
SERIESCODE	566..AE.ZF...	56632AN.ZF...	56632C..ZF...	566.1D.DZF...	56634...ZF...
M7 1993	27.70	140.43	24.15	4523.60	119.73
M8 1993	28.04	176.62	24.58	4138.00	118.04
M9 1993	29.81	213.19	25.65	4010.80	121.17
M10 1993	28.83	216.31	25.36	4251.60	126.96
M11 1993	27.96	225.64	25.91	4322.00	126.05
M12 1993	27.70	236.81	25.14	4546.00	143.71
M1 1994	27.68	226.17	23.75	4550.45	130.41
M2 1994	27.70	216.00	22.64	4680.78	130.31
M3 1994	27.57	217.34	21.92	5528.18	132.31
M4 1994	27.28	191.34	21.66	5906.20	133.76
M5 1994	26.87	203.85	21.10	5815.75	132.21
M6 1994	26.91	228.07	22.15	6411.54	137.44
M7 1994	26.23	209.91	22.59	6683.86	136.86
M8 1994	26.48	200.43	23.39	6536.70	136.39
M9 1994	26.00	225.75	19.81	6476.98	138.15
M10 1994	24.93	216.75	19.05	6032.11	141.97
M11 1994	23.88	226.26	19.51	5922.85	143.91
M12 1994	24.42	270.27	19.04	5886.54	159.90
M1 1995	24.57	264.06	18.89	5919.76	158.57
M2 1995	25.73	276.72	19.68	5575.02	155.37
M3 1995	25.99	295.01	22.33	5401.53	159.17
M4 1995	26.02	296.87	21.72	5601.61	168.33
M5 1995	25.80	279.23	22.02	5747.44	161.07
M6 1995	25.58	263.35	21.66	6035.87	159.78
M7 1995	25.59	253.65	22.63	6876.48	161.84
M8 1995	25.91	257.98	22.46	6816.44	162.61
M9 1995	26.07	266.81	21.76	6569.15	164.36
M10 1995	25.99	251.66	21.22	6121.02	176.91
M11 1995	26.18	264.64	21.52	6010.74	176.92
M12 1995	26.21	292.21	16.80	6258.87	194.63
M1 1996	26.19	309.05	14.21	6528.67	182.99
M2 1996	26.18	333.15	15.02	6846.44	185.82
M3 1996	26.20	336.43	16.47	6903.62	191.15
M4 1996	26.17	297.85	18.88	7438.48	196.83
M5 1996	26.22	300.83	21.45	7940.62	196.41
M6 1996	26.20	308.44	22.01	8342.46	191.62
M7 1996	26.23	303.72	21.84	8893.54	193.36
M8 1996	26.20	286.43	17.14	9870.94	196.90
M9 1996	26.26	278.46	20.27	9677.96	200.16
M10 1996	26.29	295.61	19.67	9524.04	205.03
M11 1996	26.29	294.96	18.41	9577.07	206.26
M12 1996	26.29	319.53	18.19	9930.57	233.12
M1 1997	26.34	294.16	18.08	9561.98	220.76
M2 1997	26.33	275.19	16.99	10209.00	220.46
M3 1997	26.37	273.28	18.34	10313.60	227.68
M4 1997	26.37	270.31	19.37	10073.20	233.69
M5 1997	26.37	283.53	21.01	9895.61	239.30
M6 1997	26.38	299.21	20.30	9687.57	236.08
M7 1997	28.97	338.05	23.35	8253.10	236.87
M8 1997	30.17	331.89	20.66	8792.05	230.76
M9 1997	33.87	342.53	27.39	9313.01	231.23
M10 1997	34.94	360.49	27.83	8469.85	236.00
M11 1997	34.66	391.49	27.87	8342.98	243.47
M12 1997	39.98	413.64	28.63	7178.22	266.33

Appendix 5 – 19: *Monthly data series used to compute the CRR factors – Philippines, (Source: IFS)*

DESCRIPTOR	QUASI-MONEY	EXPORTS	IMPORTS, CIF	CLAIMS ON CENTRAL GOVERNMENT	FOREIGN ASSETS	FOREIGN LIABILITIES
UNITS	National Currency	National Currency	National Currency	National Currency	National Currency	National Currency
SCALE	Billions	Millions	Millions	Billions	Billions	Billions
COUNTRY-NAME	PHILIPPINES	PHILIPPINES	PHILIPPINES	PHILIPPINES	PHILIPPINES	PHILIPPINES
SERIESCODE	56635...ZF...	56670...ZF...	56671...ZF...	56612A..ZF...	56621...ZF...	56626C..ZF...
M7 1993	383.82	27315.00	45508.00	117.56	105.26	77.82
M8 1993	405.23	27584.00	45045.00	161.93	116.01	77.86
M9 1993	423.36	28534.00	47561.00	195.38	126.00	81.66
M10 1993	435.42	29280.00	51450.00	214.98	123.80	83.29
M11 1993	457.59	27878.00	51188.00	218.23	124.20	79.36
M12 1993	485.75	27697.00	46580.00	293.48	132.35	80.70
M1 1994	481.81	26080.00	48294.00	267.41	130.35	75.89
M2 1994	478.13	25188.00	39899.00	266.46	133.86	80.89
M3 1994	475.18	28758.00	46612.00	272.36	129.17	91.75
M4 1994	466.09	26162.00	51849.00	269.78	119.06	90.15
M5 1994	489.32	29064.00	50963.00	264.04	109.20	85.88
M6 1994	498.48	29925.00	57812.00	266.91	115.92	102.28
M7 1994	499.67	29910.00	49450.00	252.48	115.98	105.11
M8 1994	525.24	32642.00	48331.00	241.41	121.90	85.45
M9 1994	546.99	31874.00	53925.00	253.67	122.06	96.91
M10 1994	538.01	32748.00	50638.00	235.74	124.60	98.75
M11 1994	572.21	27057.00	47803.00	220.76	125.18	96.74
M12 1994	637.85	30669.00	48523.00	233.87	147.38	113.29
M1 1995	646.11	28310.00	48823.00	224.59	130.57	104.59
M2 1995	686.11	34560.00	43103.00	224.81	143.67	104.49
M3 1995	703.08	33243.00	58776.00	241.77	148.16	107.66
M4 1995	700.93	35408.00	61443.00	234.92	139.97	111.24
M5 1995	699.29	35896.00	59256.00	220.85	140.03	113.98
M6 1995	689.36	38223.00	63688.00	200.51	151.65	138.84
M7 1995	702.61	41742.00	59354.00	212.98	126.27	131.28
M8 1995	721.22	40421.00	63147.00	200.61	144.73	134.03
M9 1995	719.14	40690.00	67851.00	213.98	146.09	143.61
M10 1995	736.75	41030.00	67128.00	221.11	144.75	140.37
M11 1995	756.44	36494.00	68675.00	227.85	146.83	138.26
M12 1995	793.58	44470.00	68618.00	227.85	167.83	168.29
M1 1996	817.03	36953.00	63818.00	245.63	140.67	150.10
M2 1996	835.43	41354.00	68720.00	239.61	144.63	193.78
M3 1996	855.26	43277.00	76588.00	256.93	166.02	219.19
M4 1996	828.05	38975.00	79167.00	253.40	146.60	215.32
M5 1996	834.76	41879.00	75612.00	242.89	175.53	265.36
M6 1996	862.47	46575.00	76501.00	239.98	181.86	291.53
M7 1996	872.29	44036.00	74096.00	227.20	176.46	306.78
M8 1996	878.30	46121.00	78391.00	225.32	177.59	328.45
M9 1996	889.89	49591.00	72370.00	228.19	180.71	332.53
M10 1996	917.68	49165.00	79318.00	239.41	192.01	348.09
M11 1996	929.37	48226.00	74214.00	241.06	194.79	362.20
M12 1996	989.60	49144.00	75758.00	240.26	215.16	377.59
M1 1997	988.08	43518.00	78806.00	217.57	216.13	373.82
M2 1997	986.16	48128.00	73197.00	189.38	229.89	410.40
M3 1997	1017.06	52572.00	82041.00	175.85	243.89	418.63
M4 1997	1011.75	54130.00	82322.00	191.09	231.48	440.96
M5 1997	1020.04	52816.00	82624.00	198.97	230.50	457.13
M6 1997	1040.55	59540.00	86213.00	206.74	255.50	483.73
M7 1997	1085.93	57778.00	95496.00	229.67	252.62	454.65
M8 1997	1093.65	65904.00	104713.00	185.82	268.44	513.01
M9 1997	1123.95	74204.00	103680.00	181.52	287.68	585.91
M10 1997	1148.14	79928.00	123774.00	185.70	292.78	566.57
M11 1997	1148.06	75165.00	105680.00	201.20	284.39	556.60
M12 1997	1238.93	80844.00	111084.00	226.57	354.90	615.86

Appendix 5 – 20: *Monthly data series used to compute the CRR factors – Philippines, (Source: IFS)*

DESCRIPTOR	MARKET RATE, END OF PERIOD	CLAIMS ON CENTRAL GOVT.(NET)	CLAIMS ON NONFIN.PUB.ENTERPS.	FOREIGN EXCHANGE	MONEY
UNITS	National Currency per U.S	National Currency	National Currency	U.S. dollars	National Currency
SCALE	Units	Billions	Billions	Millions	Billions
COUNTRYNAME	PHILIPPINES	PHILIPPINES	PHILIPPINES	PHILIPPINES	PHILIPPINES
SERIESCODE	566..AE.ZF...	56632AN.ZF...	56632C..ZF...	566.1D.DZF...	56634...ZF...
M1 1998	42.41	412.64	31.27	7009.74	255.66
M2 1998	40.36	401.31	32.58	7687.23	249.92
M3 1998	37.08	398.40	32.12	7737.90	245.22
M4 1998	39.98	365.25	44.63	9167.55	251.58
M5 1998	38.90	389.21	46.45	9228.11	255.96
M6 1998	42.09	399.27	48.16	8940.14	251.04
M7 1998	42.02	379.11	47.34	8732.69	240.43
M8 1998	43.87	391.40	48.20	8364.39	237.23
M9 1998	43.81	381.84	43.35	8916.77	239.10
M10 1998	40.83	373.59	45.30	8832.40	244.61
M11 1998	39.46	401.11	40.97	8816.18	258.57
M12 1998	39.06	402.61	44.82	9149.59	285.95
M1 1999	38.72	380.79	46.61	10027.80	266.55
M2 1999	39.10	369.07	48.39	10577.90	268.45
M3 1999	38.77	350.78	47.56	11301.30	289.06
M4 1999	38.02	336.05	46.63	12117.30	294.07
M5 1999	38.10	380.04	49.85	12105.00	305.87
M6 1999	38.02	389.33	43.58	12221.80	297.90
M7 1999	38.25	399.53	45.97	12310.20	303.72
M8 1999	39.67	440.25	45.17	12566.30	300.51
M9 1999	41.11	439.78	47.17	12657.20	311.73
M10 1999	40.16	421.20	50.66	12738.10	318.33
M11 1999	40.79	440.19	56.17	12852.70	338.31
M12 1999	40.31	439.74	65.44	13143.20	395.56
M1 2000	40.39	414.17	58.68	12797.40	346.61
M2 2000	40.85	416.21	64.28	12608.70	330.76
M3 2000	41.06	412.72	65.18	14125.40	341.50
M4 2000	41.28	419.24	77.48	13889.80	350.25
M5 2000	42.83	445.84	90.40	13498.30	345.58
M6 2000	43.15	463.84	91.63	13328.60	346.02
M7 2000	44.94	478.77	86.81	12814.90	344.49
M8 2000	45.08	446.84	84.44	13481.80	346.50
M9 2000	46.28	475.01	83.44	12894.40	347.89
M10 2000	51.43	464.10	96.63	12427.30	344.20
M11 2000	49.39	460.60	93.67	12485.50	363.80
M12 2000	50.00	468.97	97.51	12974.80	390.55
M1 2001	49.41	486.75	90.19	12324.50	385.08
M2 2001	48.26	486.94	91.67	12114.60	365.87
M3 2001	49.38	516.44	93.88	12686.10	375.27
M4 2001	51.22	518.75	97.22	12413.30	393.58
M5 2001	50.58	517.39	92.27	12387.50	386.49
M6 2001	52.37	528.19	93.75	12503.70	382.28
M7 2001	53.56	536.96	92.72	12248.60	375.21
M8 2001	51.21	524.17	93.88	12071.80	365.74
M9 2001	51.36	540.71	93.27	12217.90	358.56
M10 2001	51.94	544.43	92.39	12067.30	356.18
M11 2001	52.02	558.19	105.04	12527.40	357.63
M12 2001	51.40	538.61	112.90	13352.70	392.25
M1 2002	51.20	519.28	122.12	13963.00	369.74
M2 2002	51.35	532.17	116.39	13774.60	376.36
M3 2002	51.15	496.52	118.06	14850.80	395.19
M4 2002	50.74	501.63	112.38	14510.30	408.98
M5 2002	49.97	533.03	112.59	14375.00	411.03
M6 2002	50.42	519.42	115.81	14207.80	412.30

Appendix 5 – 21: *Monthly data series used to compute the CRR factors – Philippines, (Source: IFS)*

DESCRIPTOR	QUASI-MONEY	EXPORTS	IMPORTS, CIF	CLAIMS ON CENTRAL GOVERNMENT	FOREIGN ASSETS	FOREIGN LIABILITIES
UNITS	National Currency	National Currency	National Currency	National Currency	National Currency	National Currency
SCALE	Billions	Millions	Millions	Billions	Billions	Billions
COUNTRY-NAME	PHILIPPINES	PHILIPPINES	PHILIPPINES	PHILIPPINES	PHILIPPINES	PHILIPPINES
SERIESCODE	56635...ZF...	56670...ZF...	56671...ZF...	56612A..ZF...	56621...ZF...	56626C..ZF...
M1 1998	1250.14	89560.00	128236.00	227.48	325.95	599.94
M2 1998	1202.90	89381.00	109580.00	231.09	289.94	583.83
M3 1998	1208.26	95779.00	110140.00	199.72	301.60	551.14
M4 1998	1207.48	87165.00	101408.00	208.58	302.10	582.62
M5 1998	1214.06	92177.00	76201.00	201.75	320.69	571.53
M6 1998	1272.52	95696.00	97320.00	194.03	361.72	620.81
M7 1998	1286.23	90159.00	108872.00	192.83	367.33	581.96
M8 1998	1331.19	122501.00	114389.00	192.60	367.23	564.02
M9 1998	1331.57	186766.00	115708.00	188.14	374.98	586.81
M10 1998	1289.31	54911.00	109271.00	190.39	369.70	553.61
M11 1998	1302.35	103450.00	100276.00	190.06	362.01	532.90
M12 1998	1348.25	98715.00	86471.00	194.18	357.52	498.05
M1 1999	1320.59	109277.00	98131.00	182.21	324.61	485.52
M2 1999	1331.74	97312.00	93188.00	177.41	343.78	471.33
M3 1999	1328.72	97394.00	110281.00	183.12	366.09	472.60
M4 1999	1319.84	85130.00	104660.00	184.57	333.36	459.90
M5 1999	1344.71	115789.00	101002.00	189.94	353.32	477.01
M6 1999	1376.14	127953.00	105796.00	189.94	366.00	508.97
M7 1999	1387.87	140654.00	112535.00	198.82	327.52	464.45
M8 1999	1435.54	78497.00	109950.00	205.43	326.41	472.49
M9 1999	1424.03	58962.00	108189.00	220.53	347.26	508.38
M10 1999	1419.32	258834.00	112423.00	238.33	338.58	474.61
M11 1999	1471.58	147730.00	101677.00	237.67	337.52	454.87
M12 1999	1514.53	115062.00	114616.00	237.91	407.73	482.86
M1 2000	1465.32	103556.00	114965.00	213.08	353.82	436.76
M2 2000	1466.40	112709.00	105803.00	210.47	359.13	444.86
M3 2000	1512.58	116144.00	119620.00	211.95	345.40	447.87
M4 2000	1515.73	95532.00	115634.00	217.75	320.34	426.65
M5 2000	1521.30	105554.00	111684.00	221.39	316.08	456.71
M6 2000	1554.00	129242.00	114195.00	214.69	319.24	470.63
M7 2000	1567.29	254509.00	127771.00	217.51	336.50	459.28
M8 2000	1567.61	168486.00	128669.00	213.19	331.65	466.48
M9 2000	1595.71	179258.00	145921.00	220.79	360.88	490.57
M10 2000	1682.30	168710.00	147323.00	179.04	403.12	534.14
M11 2000	1640.05	165072.00	141757.00	177.11	387.17	509.87
M12 2000	1674.66	174369.00	121159.00	165.80	409.03	515.10
M1 2001	1664.61	146095.00	135290.00	169.12	391.25	473.13
M2 2001	1672.46	135475.00	114217.00	166.67	390.67	456.39
M3 2001	1681.95	139084.00	133426.00	165.09	391.19	474.03
M4 2001	1710.55	112701.00	142823.00	165.82	400.40	477.95
M5 2001	1705.25	131400.00	143835.00	164.28	413.45	492.30
M6 2001	1741.56	132745.00	141596.00	151.57	434.88	498.48
M7 2001	1742.98	138087.00	149332.00	133.52	410.00	487.38
M8 2001	1709.46	136248.00	141302.00	108.46	402.63	474.57
M9 2001	1719.85	139964.00	135825.00	105.60	390.28	474.74
M10 2001	1700.74	152136.00	129937.00	108.89	361.48	468.02
M11 2001	1701.75	136723.00	112866.00	111.61	369.72	470.08
M12 2001	1746.80	137006.00	117356.00	132.96	383.90	448.75
M1 2002	1740.95	135282.00	109589.00	142.43	374.23	421.33
M2 2002	1748.07	134762.00	118909.00	149.51	381.27	412.47
M3 2002	1746.37	145490.00	152641.00	149.22	397.56	453.79
M4 2002	1755.92	140154.00	171761.00	153.51	428.49	458.77
M5 2002	1759.22	145382.00	144617.00	153.66	412.07	463.02
M6 2002	1747.26	145884.00	151966.00	153.38	391.89	439.82

Appendix 5 – 22: *Monthly data series used to compute the CRR factors – Philippines, (Source: IFS)*

DESCRIPTOR	MARKET RATE, END OF PERIOD	CLAIMS ON CENTRAL GOVT.(NET)	CLAIMS ON NONFIN.PUB.ENTERPS.	FOREIGN EXCHANGE	MONEY
UNITS	National Currency per U.S	National Currency	National Currency	U.S. dollars	National Currency
SCALE	Units	Billions	Billions	Millions	Billions
COUNTRYNAME	PHILIPPINES	PHILIPPINES	PHILIPPINES	PHILIPPINES	PHILIPPINES
SERIESCODE	566..AE.ZF...	56632AN.ZF...	56632C..ZF...	566.1D.DZF...	56634...ZF...
M7 2002	51.29	544.54	117.27	13480.10	410.33
M8 2002	51.81	534.95	118.63	13426.20	411.41
M9 2002	52.45	543.30	137.41	13216.90	418.15
M10 2002	53.02	553.77	142.69	13126.90	426.82
M11 2002	53.59	566.77	145.08	12940.00	444.18
M12 2002	53.10	593.77	155.23	13200.50	478.48
M1 2003	53.80	582.84	149.67	13403.50	454.37
M2 2003	54.35	569.21	150.11	13244.00	450.97
M3 2003	53.53	586.21	166.94	13074.60	454.97
M4 2003	52.82	555.49	176.31	13247.80	459.72
M5 2003	52.28	571.66	180.17	12909.30	459.68
M6 2003	53.71	570.56	191.82	12881.30	454.32
M7 2003	54.69	549.60	203.36	13044.00	450.17
M8 2003	55.11	583.66	212.53	12951.50	452.82
M9 2003	54.94	619.50	229.69	12980.20	453.93
M10 2003	55.25	593.24	231.51	13625.60	463.13
M11 2003	55.77	612.67	237.84	13468.70	480.23
M12 2003	55.57	622.37	252.22	13523.30	519.84
M1 2004	56.09	633.14	250.32	12906.70	502.51
M2 2004	56.28	635.00	252.93	12699.60	495.02
M3 2004	56.36	649.60	264.08	13085.60	507.89
M4 2004	55.86	648.57	281.43	13419.90	522.52
M5 2004	55.84	674.36	280.50	13478.10	518.50
M6 2004	56.18	674.12	279.21	13077.90	509.48
M7 2004	56.01	661.00	271.09	12800.70	499.98
M8 2004	56.22	650.83	272.22	12759.00	494.82
M9 2004	56.34	634.10	275.17	12609.60	498.41
M10 2004	56.35	678.02	264.39	12715.40	510.47
M11 2004	56.23	710.45	250.87	12696.60	529.59
M12 2004	56.27	762.57	251.14	12979.50	567.74
M1 2005	55.11	791.56	257.85	12737.80	546.45
M2 2005	54.72	701.80	252.18	13511.30	551.92
M3 2005	54.79	722.45	252.78	13691.90	559.09
M4 2005	54.35	717.42	248.10	13936.90	568.95
M5 2005	54.37	681.08	253.47	14656.00	568.57
M6 2005	55.92	640.30	271.99	15013.20	565.80
M7 2005	56.11	670.30	273.77	14943.30	567.05
M8 2005	56.16	708.83	272.56	15281.80	565.37
M9 2005	56.06	636.26	275.15	15846.20	569.00
M10 2005	55.06	644.83	269.37	15504.60	583.63
M11 2005	54.00	648.04	278.74	15379.10	588.45
M12 2005	53.07	649.65	275.45	15800.10	620.22
M1 2006	52.34	544.32	274.65	17611.50	596.72
M2 2006	52.09	544.84	272.70	17743.70	595.44
M3 2006	51.28	535.11	278.83	17721.60	616.36
M4 2006	51.83	550.59	268.29	17674.80	631.59
M5 2006	52.65	644.48	264.49	17968.90	636.67
M6 2006	53.59	661.85	265.39	18089.60	642.37
M7 2006	51.62	675.41	260.43	18198.20	640.08
M8 2006	50.94	618.22	254.78	18541.50	635.26
M9 2006	50.39	646.38	253.91	18717.10	645.57
M10 2006	49.81	651.20	261.14	19303.90	655.44
M11 2006	49.76	677.35	255.35	19523.00	697.60
M12 2006	49.13	679.26	268.43	19891.40	772.30

Appendix 5 – 23: *Monthly data series used to compute the CRR factors – Philippines, (Source: IFS)*

DESCRIPTOR	QUASI-MONEY	EXPORTS	IMPORTS, CIF	CLAIMS ON CENTRAL GOVERNMENT	FOREIGN ASSETS	FOREIGN LIABILITIES
UNITS	National Currency	National Currency	National Currency	National Currency	National Currency	National Currency
SCALE	Billions	Millions	Millions	Billions	Billions	Billions
COUNTRY-NAME	PHILIPPINES	PHILIPPINES	PHILIPPINES	PHILIPPINES	PHILIPPINES	PHILIPPINES
SERIESCODE	56635...ZF...	56670...ZF...	56671...ZF...	56612A..ZF...	56621...ZF...	56626C..ZF...
M7 2002	1764.59	161430.00	169770.00	157.28	384.24	415.84
M8 2002	1783.18	157046.00	184974.00	158.52	419.72	417.52
M9 2002	1784.31	166364.00	174962.00	156.63	414.67	435.74
M10 2002	1816.77	160476.00	163958.00	156.19	409.32	407.70
M11 2002	1814.52	165430.00	175195.00	155.12	395.55	394.33
M12 2002	1883.10	155942.00	150778.00	149.43	428.72	425.22
M1 2003	1901.89	144148.00	164790.00	149.08	431.06	400.98
M2 2003	1901.27	147263.00	160577.00	150.66	423.65	388.73
M3 2003	1882.01	168861.00	196064.00	142.16	414.43	404.36
M4 2003	1834.02	142458.00	176908.00	141.34	414.92	401.27
M5 2003	1873.40	147160.00	182514.00	140.41	442.19	380.00
M6 2003	1882.72	163429.00	164446.00	130.51	473.59	402.02
M7 2003	1866.73	161651.00	184783.00	129.82	445.78	382.18
M8 2003	1867.92	165151.00	179314.00	127.80	437.57	386.01
M9 2003	1911.92	184546.00	177056.00	125.64	454.45	397.95
M10 2003	1893.92	183535.00	182444.00	124.96	422.37	397.86
M11 2003	1917.79	170849.00	191312.00	127.48	425.70	407.63
M12 2003	1926.86	176046.00	181018.00	125.10	457.81	421.30
M1 2004	1938.10	157909.00	188743.00	123.42	451.57	387.60
M2 2004	1944.98	168148.00	175770.00	96.65	524.26	448.37
M3 2004	1970.24	188639.00	211001.00	97.94	548.08	497.09
M4 2004	1964.69	165954.00	202005.00	87.97	532.03	518.12
M5 2004	1978.67	182018.00	191768.00	84.96	527.29	534.24
M6 2004	1973.29	185470.00	202979.00	78.88	533.78	554.16
M7 2004	1970.67	173763.00	200847.00	77.48	527.18	519.59
M8 2004	2004.22	190694.00	195445.00	71.63	564.33	517.62
M9 2004	1998.62	204451.00	205788.00	76.23	576.85	544.72
M10 2004	2011.10	211332.00	217316.00	76.97	579.22	563.45
M11 2004	2067.35	207709.00	201099.00	74.38	603.33	557.55
M12 2004	2121.63	183579.00	180425.00	76.71	542.22	505.66
M1 2005	2162.77	183009.00	194788.00	72.02	587.27	500.18
M2 2005	2164.24	163473.00	174496.00	69.69	648.91	510.06
M3 2005	2181.25	177245.00	208708.00	69.22	668.93	553.36
M4 2005	2154.37	175953.00	222344.00	67.14	653.89	549.30
M5 2005	2150.16	179106.00	203958.00	65.59	640.08	565.59
M6 2005	2219.07	183476.00	231274.00	63.11	708.21	582.56
M7 2005	2212.67	193920.00	213743.00	56.55	657.96	572.01
M8 2005	2258.76	193459.00	238015.00	56.67	617.42	548.30
M9 2005	2230.74	200754.00	240451.00	55.29	633.08	549.84
M10 2005	2182.84	202465.00	225350.00	57.60	603.56	537.54
M11 2005	2202.27	198073.00	211655.00	57.02	619.62	543.23
M12 2005	2241.98	205179.00	222600.00	48.00	687.91	572.67
M1 2006	2233.04	174871.00	202694.00	49.51	669.23	536.74
M2 2006	2253.25	178620.00	175192.00	49.92	657.13	493.77
M3 2006	2237.74	211393.00	221732.00	52.26	673.93	509.61
M4 2006	2229.72	200895.00	238605.00	79.77	665.27	490.45
M5 2006	2372.67	202123.00	243287.00	46.28	687.81	479.94
M6 2006	2453.71	215291.00	250714.00	24.02	725.08	498.65
M7 2006	2424.51	210445.00	240912.00	29.31	680.21	465.68
M8 2006	2454.95	219512.00	259965.00	47.13	714.87	444.07
M9 2006	2494.13	210596.00	228278.00	77.39	748.35	453.67
M10 2006	2512.22	210384.00	244056.00	124.61	740.94	464.91
M11 2006	2596.93	200919.00	234675.00	149.92	773.32	481.96
M12 2006	2649.96	182556.00	216667.00	179.65	792.81	481.69

Appendix 5 – 24: *Monthly data series used to compute the CRR factors – Philippines, (Source: IFS)*

DESCRIPTOR	MARKET RATE, END OF PERIOD	CLAIMS ON CENTRAL GOVT.(NET)	CLAIMS ON NONFIN.PUB.ENTERPS.	FOREIGN EXCHANGE	MONEY
UNITS	National Currency per U.S	National Currency	National Currency	U.S. dollars	National Currency
SCALE	Units	Billions	Billions	Millions	Billions
COUNTRYNAME	PHILIPPINES	PHILIPPINES	PHILIPPINES	PHILIPPINES	PHILIPPINES
SERIESCODE	566..AE.ZF...	56632AN.ZF...	56632C..ZF...	566.1D.DZF...	56634...ZF...
M1 2007	49.03	671.82	261.97	20583.50	756.34
M2 2007	48.29	632.56	260.03	21421.10	760.84
M3 2007	48.26	668.50	236.31	21542.10	809.96
M4 2007	47.51	675.25	224.54	21914.10	854.17
M5 2007	46.27	697.85	222.35	22473.80	829.42
M6 2007	46.33	752.04	211.45	23321.40	833.21
M7 2007	45.61	767.69	214.06	24859.40	828.55
M8 2007	46.70	747.59	204.42	27228.10	804.25
M9 2007	45.06	751.50	212.48	27731.10	786.43
M10 2007	43.95	725.83	212.86	28993.10	805.21
M11 2007	42.80	719.09	213.83	29248.50	808.81
M12 2007	41.40	679.30	214.75	30071.40	880.51
M1 2008	40.65	741.80	213.32	30811.20	820.67
M2 2008	40.36	755.23	204.35	32087.10	836.71
M3 2008	41.87	n.a.	n.a.	32645.50	n.a.
M4 2008	42.19	n.a.	n.a.	32615.10	n.a.
M5 2008	43.88	n.a.	n.a.	32282.90	n.a.
M6 2008	44.76	n.a.	n.a.	32593.40	n.a.
M7 2008	44.14	n.a.	n.a.	32842.20	n.a.
M8 2008	45.69	n.a.	n.a.	33024.80	n.a.
M9 2008	46.92	n.a.	n.a.	32702.10	n.a.
M10 2008	48.75	n.a.	n.a.	32293.70	n.a.
M11 2008	48.88	n.a.	n.a.	32878.90	n.a.
M12 2008	47.49	n.a.	n.a.	33047.20	n.a.
M1 2009	47.08	n.a.	n.a.	34539.50	n.a.
M2 2009	48.24	n.a.	n.a.	34098.70	n.a.
M3 2009	n.a.	n.a.	n.a.	n.a.	n.a.

***Appendix 5 – 25:** Monthly factors and the computed CRR index - Philippines*

DESCRIPTOR	QUASI-MONEY	EXPORTS	IMPORTS, CIF	CLAIMS ON CENTRAL GOVERNMENT	FOREIGN ASSETS	FOREIGN LIABILITIES
UNITS	National Currency	National Currency	National Currency	National Currency	National Currency	National Currency
SCALE	Billions	Millions	Millions	Billions	Billions	Billions
COUNTRY-NAME	PHILIPPINES	PHILIPPINES	PHILIPPINES	PHILIPPINES	PHILIPPINES	PHILIPPINES
SERIESCODE	56635...ZF...	56670...ZF...	56671...ZF...	56612A..ZF...	56621...ZF...	56626C..ZF...
M1 2007	2673.49	195017.00	189700.00	184.48	790.87	475.39
M2 2007	2689.31	179847.00	186260.00	208.78	810.15	445.72
M3 2007	2727.31	217237.00	229745.00	215.24	858.28	452.83
M4 2007	2714.72	196898.00	216330.00	214.60	815.74	431.35
M5 2007	2669.65	192950.00	209875.00	218.53	853.37	456.82
M6 2007	2770.70	190026.00	227202.00	214.20	884.64	462.16
M7 2007	2748.78	191077.00	239587.00	224.11	875.87	450.82
M8 2007	2689.88	189091.00	239137.00	224.14	816.35	475.32
M9 2007	2668.66	201710.00	228658.00	226.18	807.27	463.01
M10 2007	2667.69	206294.00	238960.00	223.38	748.62	442.50
M11 2007	2682.37	170603.00	229654.00	278.43	750.36	439.28
M12 2007	2726.09	186693.00	217862.00	285.91	736.37	444.22
M1 2008	2696.23	173191.00	215929.00	309.94	776.64	451.40
M2 2008	2712.95	167240.00	194109.00	297.24	738.94	439.38
M3 2008	n.a.	172975.00	223793.00	296.71	n.a.	n.a.
M4 2008	n.a.	180860.00	204413.00	292.57	n.a.	n.a.
M5 2008	n.a.	181223.00	217705.00	291.01	n.a.	n.a.
M6 2008	n.a.	199858.00	250512.00	284.05	n.a.	n.a.
M7 2008	n.a.	199480.00	279737.00	284.08	n.a.	n.a.
M8 2008	n.a.	197143.00	241658.00	286.73	n.a.	n.a.
M9 2008	n.a.	207249.00	241752.00	286.53	n.a.	n.a.
M10 2008	n.a.	190709.00	234633.00	n.a.	n.a.	n.a.
M11 2008	n.a.	172789.00	182723.00	n.a.	n.a.	n.a.
M12 2008	n.a.	128631.00	n.a.	n.a.	n.a.	n.a.
M1 2009	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
M2 2009	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
M3 2009	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Appendix V: Monthly CRR factors - Philippines

Appendix 5 – 26: *Monthly factors and the computed CRR index - Philippines*

Years	Rate of change of M2	Rate of change of reserves	Rate of change of export	Rate of change of M2/ foreign reserves	Rate of change of foreign assets / foreign liabilities	Rate of change of growth of debt	CRR index
Units	Factor	Factor	Factor	Factor	Factor	Factor	Factor
M1 1990	0.49	0.01	0.10	0.48	0.42	-0.19	1.31
M2 1990	0.44	0.00	0.03	0.39	0.37	-0.03	1.21
M3 1990	0.45	0.37	0.14	-1.57	0.29	-0.04	-0.36
M4 1990	0.44	0.12	-0.03	0.01	0.27	0.01	0.82
M5 1990	0.43	0.48	0.12	-2.77	0.43	0.07	-1.24
M6 1990	0.49	0.53	-0.05	-3.45	0.29	0.06	-2.14
M7 1990	0.50	0.39	0.17	-1.72	0.34	0.02	-0.30
M8 1990	0.51	0.42	0.12	-2.25	0.18	-0.01	-1.03
M9 1990	0.55	0.12	0.24	-0.16	0.07	-0.15	0.66
M10 1990	0.47	0.08	0.22	-0.11	-0.02	-0.20	0.43
M11 1990	0.38	-0.75	0.23	1.40	-0.19	-0.21	0.86
M12 1990	0.51	0.14	0.40	-0.56	-0.21	0.07	0.35
M1 1991	0.47	0.10	0.23	-0.39	-0.17	-0.69	-0.45
M2 1991	0.46	0.38	0.16	-2.43	0.01	-0.56	-1.97
M3 1991	0.49	0.48	0.35	-3.71	0.27	-0.71	-2.84
M4 1991	0.49	0.42	0.20	-2.67	0.09	-0.23	-1.71
M5 1991	0.46	0.52	0.24	-4.31	0.22	-0.19	-3.06
M6 1991	0.48	0.57	0.22	-5.04	0.37	0.00	-3.40
M7 1991	0.45	0.47	0.27	-3.00	0.64	0.04	-1.14
M8 1991	0.34	0.52	0.11	-3.72	0.89	0.25	-1.62
M9 1991	0.30	0.59	0.15	-5.34	0.67	0.41	-3.23
M10 1991	0.21	0.64	0.07	-6.77	0.59	0.51	-4.75
M11 1991	0.15	0.64	-0.03	-6.59	0.36	0.36	-5.11
M12 1991	0.39	0.71	0.23	-8.86	0.32	0.90	-6.32
M1 1992	0.27	0.58	-0.06	-4.51	0.03	0.80	-2.90
M2 1992	0.21	0.62	-0.13	-5.54	-0.24	0.84	-4.24
M3 1992	0.24	0.53	0.19	-3.30	-0.32	0.32	-2.33
M4 1992	0.20	0.39	-0.16	-1.68	-0.19	0.22	-1.22
M5 1992	0.20	0.20	-0.02	-0.37	-0.15	-0.50	-0.65
M6 1992	0.28	0.29	-0.01	-0.66	-0.17	-0.57	-0.84
M7 1992	0.22	0.27	0.01	-0.67	-0.33	-0.77	-1.27
M8 1992	0.22	0.19	0.08	0.03	-0.28	-1.01	-0.78
M9 1992	0.32	0.28	0.05	-0.60	-0.31	-1.18	-1.43
M10 1992	0.33	0.27	0.05	-0.47	-0.32	-1.17	-1.31
M11 1992	0.20	0.23	-0.10	-0.61	-0.17	-2.08	-2.51
M12 1992	0.41	0.16	0.35	0.14	-0.30	-2.43	-1.67
M1 1993	0.32	0.15	0.07	-0.05	-0.38	-2.34	-2.25
M2 1993	0.25	0.13	-0.15	-0.14	-0.37	-1.54	-1.82
M3 1993	0.31	0.31	0.25	-1.07	-0.51	-1.45	-2.15
M4 1993	0.26	0.43	0.08	-2.39	-0.82	-0.11	-2.55
M5 1993	0.25	0.33	0.15	-1.66	-0.74	-0.02	-1.68
M6 1993	0.40	0.31	0.19	-1.30	-0.41	0.02	-0.79
M7 1993	0.36	0.31	0.22	-1.81	-0.60	-2.77	-4.29
M8 1993	0.37	0.09	0.25	-0.17	-0.37	-3.70	-3.54
M9 1993	0.43	-0.02	0.30	0.07	-0.15	-4.53	-3.91
M10 1993	0.40	-0.01	0.35	0.19	-0.42	-4.17	-3.66
M11 1993	0.40	0.01	0.09	0.18	0.00	-2.75	-2.08
M12 1993	1.60	0.84	0.49	-1.80	0.26	-4.77	-3.38
M1 1994	1.42	0.79	0.38	-1.82	0.53	-4.03	-2.73
M2 1994	1.33	0.80	0.31	-1.85	0.39	-3.53	-2.55
M3 1994	1.27	1.04	0.50	-2.05	0.22	-3.39	-2.42
M4 1994	1.17	1.11	0.33	-2.09	-0.10	-2.90	-2.48
M5 1994	1.24	1.01	0.48	-1.96	-0.45	-2.85	-2.53
M6 1994	1.27	1.14	0.50	-2.01	-0.41	0.00	0.50

Appendix 5 – 27: Monthly factors and the computed CRR index - Philippines

Years	Rate of change of M2	Rate of change of reserves	Rate of change of export	Rate of change of M2/ foreign reserves	Rate of change of foreign assets / foreign liabilities	Rate of change of growth of debt	CRR index
M7 1994	1.22	1.15	0.48	-1.96	-0.65	0.46	0.71
M8 1994	1.31	1.04	0.61	-1.82	-0.19	0.70	1.65
M9 1994	1.38	0.96	0.54	-1.66	-0.38	0.68	1.53
M10 1994	1.29	0.78	0.57	-1.43	-0.48	0.77	1.50
M11 1994	1.43	0.71	0.26	-1.14	-0.53	0.91	1.65
M12 1994	1.81	0.66	0.42	-0.90	-0.61	0.76	2.15
M1 1995	1.77	0.63	0.29	-0.84	-0.61	0.76	2.00
M2 1995	1.88	0.51	0.58	-0.59	-0.06	0.75	3.07
M3 1995	1.90	0.43	0.49	-0.37	0.10	0.62	3.18
M4 1995	1.85	0.45	0.57	-0.34	-0.03	0.65	3.16
M5 1995	1.73	0.46	0.57	-0.36	0.21	0.76	3.37
M6 1995	1.60	0.50	0.65	-0.44	-0.03	0.77	3.05
M7 1995	1.61	0.66	0.78	-0.68	-0.81	0.72	2.27
M8 1995	1.63	0.60	0.69	-0.57	-0.36	0.80	2.80
M9 1995	1.56	0.52	0.68	-0.41	-0.48	0.71	2.56
M10 1995	1.62	0.39	0.66	0.03	-0.51	0.72	2.91
M11 1995	1.64	0.34	0.45	0.25	-0.46	0.78	3.01
M12 1995	1.81	0.37	0.76	0.42	-0.50	0.71	3.57
M1 1996	1.78	0.39	0.43	0.46	-0.80	0.68	2.95
M2 1996	1.79	0.43	0.59	0.42	-1.14	0.71	2.80
M3 1996	1.82	0.41	0.64	0.54	-1.00	0.67	3.09
M4 1996	1.66	0.49	0.45	0.22	-1.11	0.67	2.37
M5 1996	1.61	0.56	0.54	0.02	-0.99	0.61	2.35
M6 1996	1.63	0.60	0.70	-0.05	-0.88	0.61	2.61
M7 1996	1.60	0.67	0.58	-0.20	-1.17	0.63	2.10
M8 1996	1.57	0.80	0.63	-0.47	-1.17	0.72	2.08
M9 1996	1.55	0.73	0.74	-0.36	-1.18	0.70	2.18
M10 1996	1.60	0.67	0.69	-0.20	-1.20	0.70	2.25
M11 1996	1.58	0.64	0.63	-0.18	-1.15	0.74	2.26
M12 1996	1.81	0.67	0.64	-0.05	-0.98	0.76	2.84
M1 1997	1.68	0.58	0.41	0.03	-0.56	0.86	3.00
M2 1997	1.60	0.66	0.55	-0.20	-0.65	0.96	2.92
M3 1997	1.65	0.65	0.68	-0.15	-0.36	0.94	3.41
M4 1997	1.58	0.58	0.70	-0.07	-0.52	0.91	3.18
M5 1997	1.55	0.53	0.62	0.04	-0.48	0.88	3.14
M6 1997	1.54	0.48	0.81	0.16	-0.20	0.81	3.59
M7 1997	1.61	0.25	0.72	0.55	0.07	0.66	3.85
M8 1997	1.54	0.31	0.94	0.18	-0.09	0.74	3.61
M9 1997	1.56	0.37	1.14	-0.32	-0.27	0.76	3.24
M10 1997	1.57	0.24	1.26	-0.05	-0.10	0.72	3.64
M11 1997	1.52	0.21	1.06	0.05	-0.26	0.68	3.26
M12 1997	1.77	0.04	1.17	0.35	-0.01	0.50	3.82
M1 1998	1.68	0.02	1.35	0.20	-0.08	0.38	3.55
M2 1998	1.46	0.10	1.27	-0.08	-0.37	0.35	2.73
M3 1998	1.40	0.10	1.37	0.17	0.11	0.45	3.59
M4 1998	1.34	0.28	1.09	-0.60	0.07	0.52	2.71
M5 1998	1.31	0.28	1.16	-0.52	0.16	0.54	2.92
M6 1998	1.38	0.23	1.19	-0.56	0.12	0.65	3.02
M7 1998	1.32	0.19	1.01	-0.48	0.52	0.57	3.12
M8 1998	1.36	0.13	1.68	-0.40	0.82	0.53	4.12
M9 1998	1.30	0.19	2.94	-0.57	0.59	0.56	5.01
M10 1998	1.15	0.17	0.06	-0.40	0.77	0.61	2.35
M11 1998	1.16	0.16	1.05	-0.24	0.45	0.60	3.18
M12 1998	1.28	0.18	0.91	-0.17	0.80	0.53	3.53

Appendix 5 – 28: *Monthly factors and the computed CRR index - Philippines*

Years	Rate of change of M2	Rate of change of reserves	Rate of change of export	Rate of change of M2/ foreign reserves	Rate of change of foreign assets / foreign liabilities	Rate of change of growth of debt	CRR index
M1 1999	1.11	0.28	1.07	-0.50	0.87	0.52	3.34
M2 1999	1.09	0.33	0.79	-0.65	0.83	0.42	2.81
M3 1999	1.07	0.40	0.75	-0.77	1.23	0.36	3.04
M4 1999	1.01	0.47	0.49	-0.91	0.73	0.36	2.16
M5 1999	1.04	0.45	1.02	-0.85	0.68	0.16	2.50
M6 1999	1.04	0.45	1.18	-0.83	0.35	0.08	2.26
M7 1999	1.02	0.45	1.34	-0.84	0.21	0.05	2.22
M8 1999	1.06	0.46	0.23	-0.91	0.20	-0.13	0.91
M9 1999	1.01	0.45	-0.11	-1.01	0.06	-0.18	0.21
M10 1999	0.96	0.44	3.08	-0.96	0.13	-0.12	3.54
M11 1999	1.06	0.43	1.21	-0.90	0.08	-0.14	1.74
M12 1999	1.20	0.45	0.66	-0.78	0.66	-0.25	1.93
M1 2000	0.97	0.39	0.45	-0.83	0.28	-0.14	1.11
M2 2000	0.89	0.36	0.56	-0.82	0.11	-0.20	0.90
M3 2000	0.96	0.49	0.58	-1.01	0.16	-0.24	0.94
M4 2000	0.94	0.44	0.26	-0.94	0.03	-0.14	0.60
M5 2000	0.90	0.39	0.38	-0.94	-0.09	-0.23	0.41
M6 2000	0.92	0.36	0.69	-0.86	-0.10	-0.19	0.81
M7 2000	0.89	0.29	2.29	-0.83	0.15	-0.09	2.71
M8 2000	0.86	0.34	1.08	-0.95	0.10	0.04	1.47
M9 2000	0.87	0.27	1.16	-0.85	0.08	-0.03	1.50
M10 2000	0.97	0.22	0.98	-0.89	0.04	0.11	1.43
M11 2000	0.89	0.21	0.88	-0.80	-0.25	0.14	1.08
M12 2000	0.95	0.24	0.95	-0.82	-0.05	0.01	1.28
M1 2001	0.88	0.17	0.58	-0.65	0.06	-0.01	1.04
M2 2001	0.83	0.15	0.43	-0.53	0.27	-0.01	1.15
M3 2001	0.82	0.19	0.44	-0.66	0.25	-0.01	1.02
M4 2001	0.86	0.15	0.13	-0.62	0.53	0.07	1.12
M5 2001	0.80	0.15	0.32	-0.58	0.60	0.11	1.39
M6 2001	0.82	0.15	0.31	-0.64	0.48	0.13	1.24
M7 2001	0.77	0.12	0.35	-0.64	0.46	0.07	1.13
M8 2001	0.67	0.10	0.31	-0.52	0.38	0.21	1.16
M9 2001	0.64	0.11	0.33	-0.54	0.22	0.10	0.86
M10 2001	0.58	0.09	0.43	-0.56	0.04	0.07	0.66
M11 2001	0.56	0.13	0.25	-0.65	-0.02	0.01	0.28
M12 2001	0.65	0.19	0.24	-0.67	0.09	0.02	0.52
M1 2002	0.58	0.24	0.20	-0.79	0.09	0.02	0.35
M2 2002	0.57	0.21	0.18	-0.73	0.30	0.07	0.60
M3 2002	0.57	0.29	0.27	-0.87	0.11	0.15	0.53
M4 2002	0.57	0.26	0.20	-0.74	0.28	0.13	0.70
M5 2002	0.56	0.24	0.23	-0.65	0.05	0.07	0.50
M6 2002	0.52	0.22	0.22	-0.63	0.15	0.07	0.55
M7 2002	0.51	0.15	0.34	-0.48	0.22	-0.07	0.68
M8 2002	0.52	0.14	0.28	-0.44	0.56	-0.03	1.03
M9 2002	0.50	0.12	0.35	-0.41	0.58	-0.06	1.08
M10 2002	0.54	0.10	0.28	-0.34	0.69	-0.02	1.25
M11 2002	0.53	0.08	0.31	-0.29	0.43	-0.03	1.04
M12 2002	0.65	0.09	0.21	-0.15	0.34	-0.10	1.04
M1 2003	0.62	0.10	0.10	-0.22	0.41	-0.04	0.96
M2 2003	0.59	0.08	0.12	-0.20	0.61	-0.10	1.09
M3 2003	0.54	0.06	0.29	-0.11	0.24	-0.15	0.88
M4 2003	0.46	0.07	0.06	-0.16	0.40	-0.04	0.81
M5 2003	0.49	0.04	0.09	0.03	0.76	-0.10	1.32
M6 2003	0.48	0.03	0.22	-0.04	0.69	-0.04	1.34

***Appendix 5 – 29:** Monthly factors and the computed CRR index - Philippines*

Years	Rate of change of M2	Rate of change of reserves	Rate of change of export	Rate of change of M2/ foreign reserves	Rate of change of foreign assets / foreign liabilities	Rate of change of growth of debt	CRR index
M7 2003	0.43	0.04	0.19	-0.15	0.40	-0.03	0.88
M8 2003	0.42	0.03	0.21	-0.13	0.48	-0.06	0.94
M9 2003	0.46	0.02	0.37	-0.05	0.34	-0.12	1.02
M10 2003	0.42	0.06	0.34	-0.22	0.15	-0.04	0.71
M11 2003	0.46	0.05	0.23	-0.14	0.09	-0.03	0.65
M12 2003	0.50	0.04	0.26	-0.05	0.03	-0.09	0.68
M1 2004	0.47	0.00	0.11	0.08	0.17	-0.12	0.70
M2 2004	0.45	-0.02	0.18	0.13	0.35	-0.03	1.05
M3 2004	0.47	0.00	0.32	0.08	0.17	-0.12	0.93
M4 2004	0.46	0.03	0.13	0.04	-0.29	-0.08	0.29
M5 2004	0.45	0.03	0.25	0.04	-0.41	-0.11	0.26
M6 2004	0.42	0.00	0.26	0.11	-0.44	-0.12	0.24
M7 2004	0.39	-0.02	0.17	0.18	-0.26	0.01	0.46
M8 2004	0.40	-0.02	0.28	0.22	-0.11	0.11	0.88
M9 2004	0.38	-0.03	0.36	0.25	-0.01	0.08	1.04
M10 2004	0.39	-0.03	0.42	0.25	-0.04	0.08	1.07
M11 2004	0.46	-0.03	0.38	0.37	-0.01	0.08	1.26
M12 2004	0.55	-0.01	0.19	0.42	-0.20	0.01	0.96
M1 2005	0.55	-0.02	0.18	0.59	0.01	-0.08	1.23
M2 2005	0.54	0.03	0.03	0.40	0.38	0.11	1.50
M3 2005	0.55	0.04	0.12	0.37	0.44	0.09	1.61
M4 2005	0.51	0.06	0.10	0.30	0.52	0.13	1.62
M5 2005	0.49	0.11	0.12	0.11	0.44	0.17	1.42
M6 2005	0.54	0.13	0.14	0.01	0.50	0.16	1.48
M7 2005	0.51	0.12	0.22	0.01	0.14	0.10	1.11
M8 2005	0.54	0.15	0.21	-0.02	0.16	0.02	1.07
M9 2005	0.50	0.18	0.26	-0.16	0.30	0.19	1.27
M10 2005	0.45	0.15	0.27	-0.07	0.09	0.20	1.09
M11 2005	0.45	0.14	0.23	0.05	0.16	0.26	1.30
M12 2005	0.51	0.17	0.28	0.10	0.06	0.31	1.43
M1 2006	0.46	0.28	0.07	-0.24	-0.05	0.33	0.85
M2 2006	0.47	0.28	0.09	-0.22	0.25	0.35	1.22
M3 2006	0.46	0.27	0.30	-0.16	0.28	0.34	1.48
M4 2006	0.45	0.26	0.22	-0.18	0.50	0.24	1.49
M5 2006	0.58	0.28	0.22	-0.11	0.45	0.11	1.51
M6 2006	0.65	0.28	0.29	-0.10	0.66	0.15	1.93
M7 2006	0.60	0.27	0.25	-0.03	0.74	0.18	2.02
M8 2006	0.60	0.29	0.30	-0.02	1.00	0.15	2.31
M9 2006	0.63	0.29	0.23	0.04	1.17	0.06	2.42
M10 2006	0.64	0.32	0.22	0.00	0.99	-0.02	2.16
M11 2006	0.74	0.32	0.15	0.10	0.84	-0.11	2.04
M12 2006	0.84	0.34	0.03	0.21	0.80	-0.40	1.80
M1 2007	0.81	0.37	0.10	0.09	0.63	-0.38	1.62
M2 2007	0.81	0.41	0.00	0.02	0.94	-0.35	1.83
M3 2007	0.86	0.41	0.23	0.08	0.99	-0.30	2.27
M4 2007	0.86	0.42	0.10	0.10	0.80	-0.16	2.11
M5 2007	0.77	0.44	0.07	0.03	0.71	-0.21	1.81
M6 2007	0.84	0.48	0.04	-0.01	0.78	-0.24	1.89
M7 2007	0.78	0.55	0.05	-0.19	0.52	-0.38	1.33
M8 2007	0.68	0.67	0.03	-0.60	0.10	-0.20	0.68
M9 2007	0.62	0.68	0.10	-0.57	0.23	-0.11	0.94
M10 2007	0.61	0.72	0.13	-0.61	0.14	0.00	0.99
M11 2007	0.61	0.71	-0.09	-0.54	0.09	0.00	0.78
M12 2007	0.69	0.73	0.00	-0.42	-0.01	0.03	1.02

Appendix 5 – 30: *Monthly factors and the computed CRR index - Philippines*

Years	Rate of change of M2	Rate of change of reserves	Rate of change of export	Rate of change of M2/ foreign reserves	Rate of change of foreign assets / foreign liabilities	Rate of change of growth of debt	CRR index
M1 2008	0.58	0.74	-0.08	-0.50	-0.13	-0.12	0.49
M2 2008	0.59	0.78	-0.12	-0.56	-0.28	-0.08	0.33
M3 2008	0.00	0.77	-0.08	-3.39	0.00	0.00	-2.70
M4 2008	0.00	0.74	-0.04	0.00	0.00	0.00	0.70
M5 2008	0.00	0.70	-0.04	0.00	0.00	0.00	0.65
M6 2008	0.00	0.68	0.07	0.00	0.00	0.00	0.75
M7 2008	0.00	0.67	0.06	0.00	0.00	0.00	0.73
M8 2008	0.00	0.65	0.04	0.00	0.00	0.00	0.69
M9 2008	0.00	0.61	0.10	0.00	0.00	0.00	0.71
M10 2008	0.00	0.56	0.00	0.00	0.00	0.00	0.57
M11 2008	0.00	0.57	-0.11	0.00	0.00	0.00	0.46
M12 2008	0.00	0.55	-0.36	0.00	0.00	0.00	0.19
M1 2009	0.00	0.59	0.00	0.00	0.00	0.00	0.59
M2 2009	0.00	0.55	0.00	0.00	0.00	0.00	0.55
M2 2010	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Appendix V: Monthly data series CRR index Malaysia

Appendix 5 – 31: *Monthly data series used to compute the CRR factors – Malaysia, (Source: IFS)*

DESCRIPTOR	OFFICIAL RATE, END OF PERIOD	CLAIMS ON CENTRAL GOVERNMENT (NET)	CLAIMS ON PUBLIC NONFINANCIAL CORPOR	FOREIGN EXCHANGE	MONEY
UNITS	National Currency per U.S	National Currency	National Currency	U.S. dollars	National Currency
SCALE	Units	Millions	Millions	Millions	Millions
COUNTRYNAME	MALAYSIA	MALAYSIA	MALAYSIA	MALAYSIA	MALAYSIA
SERIESCODE	548..AE.ZF...	54832AN.ZF...	54832C..ZF...	548.1D.DZF...	54834...ZF...
M1 1989	2.73	42321.10	0.00	5695.00	20448.90
M2 1989	2.73	42886.80	0.00	5638.00	19907.30
M3 1989	2.76	41855.60	0.00	5619.00	19150.50
M4 1989	2.70	43089.20	0.00	5793.00	19398.20
M5 1989	2.71	42710.70	0.00	6076.00	19508.30
M6 1989	2.71	41775.20	0.00	5850.00	19677.80
M7 1989	2.66	41796.10	0.00	6204.00	19884.70
M8 1989	2.70	42071.40	0.00	6068.00	19902.90
M9 1989	2.69	42434.00	0.00	6444.00	20342.90
M10 1989	2.70	41941.70	0.00	6652.00	20852.50
M11 1989	2.70	42360.10	0.00	6689.00	21287.80
M12 1989	2.70	42680.80	0.00	7393.00	21978.30
M1 1990	2.70	5219.70	0.00	7663.00	24497.40
M2 1990	2.70	5239.20	0.00	7679.00	23657.10
M3 1990	2.73	5395.80	0.00	7481.00	23060.30
M4 1990	2.72	5917.50	0.00	7343.00	23528.50
M5 1990	2.70	4170.40	0.00	7585.00	23251.10
M6 1990	2.71	4865.20	0.00	7718.00	23176.60
M7 1990	2.71	5540.40	0.00	7942.00	24149.00
M8 1990	2.69	6007.10	0.00	8330.00	23688.20
M9 1990	2.70	4144.50	0.00	8682.00	23811.30
M10 1990	2.70	4129.60	0.00	10110.00	24797.10
M11 1990	2.70	2803.90	0.00	9013.00	24645.10
M12 1990	2.70	3883.40	0.00	9327.00	25405.20
M1 1991	2.70	6002.70	0.00	9386.00	26435.10
M2 1991	2.72	5298.90	0.00	9620.00	27442.50
M3 1991	2.77	4417.80	0.00	9186.00	25917.30
M4 1991	2.76	4367.20	0.00	9443.00	25856.90
M5 1991	2.76	2358.30	0.00	9481.00	25839.70
M6 1991	2.78	2305.10	0.00	9190.00	26093.90
M7 1991	2.79	1124.00	0.00	9337.00	26039.70
M8 1991	2.79	2049.70	0.00	9480.00	26301.20
M9 1991	2.74	2318.80	0.00	9299.00	26815.60
M10 1991	2.75	2669.10	0.00	9448.00	26589.90
M11 1991	2.75	1504.30	0.00	9766.00	26902.50
M12 1991	2.72	1822.50	0.00	10421.00	27928.30
M1 1992	2.70	11557.80	0.00	10631.00	33104.80
M2 1992	2.59	10906.00	0.00	10875.00	31335.50
M3 1992	2.59	11943.90	0.00	11469.00	31479.20
M4 1992	2.53	9696.10	0.00	12352.00	31121.40
M5 1992	2.53	6503.00	0.00	12574.00	31262.20
M6 1992	2.51	6815.90	0.00	12073.00	31721.00
M7 1992	2.50	6609.20	0.00	14211.00	31654.80
M8 1992	2.49	6774.20	0.00	15456.00	32028.90
M9 1992	2.50	6822.40	0.00	18174.00	33015.40
M10 1992	2.51	5485.30	0.00	18842.00	32953.30
M11 1992	2.53	5237.20	0.00	18991.00	34104.90
M12 1992	2.61	8466.40	0.00	16784.00	35544.20
M1 1993	2.62	8179.50	0.00	16896.00	37139.30
M2 1993	2.63	8593.40	0.00	16372.00	35863.50
M3 1993	2.60	8363.30	0.00	14907.00	36803.70
M4 1993	2.57	8123.70	0.00	15620.00	37315.40
M5 1993	2.56	7152.50	0.00	14993.00	38472.90
M6 1993	2.58	6983.50	0.00	15824.00	39499.00

Appendix 5 – 32: *Monthly data series used to compute the CRR factors – Malaysia, (Source: IFS)*

DESCRIPTOR	QUASI-MONEY	EXPORTS	IMPORTS, CIF	CLAIMS ON CENTRAL GOVERNMENT	FOREIGN ASSETS	FOREIGN LIABILITIES
UNITS	National Currency	National Currency	National Currency	National Currency	National Currency	National Currency
SCALE	Millions	Millions	Millions	Millions	Millions	Millions
COUNTRY-NAME	MALAYSIA	MALAYSIA	MALAYSIA	MALAYSIA	MALAYSIA	MALAYSIA
SERIESCODE	54835...ZF...	54870...ZF...	54871...ZF...	54812A..ZF...	54821...ZF...	54826C..ZF...
M1 1989	94255.50	5035.41	4111.76	3054.30	7950.50	5031.60
M2 1989	94861.50	4322.04	3860.04	3506.50	8155.40	4900.10
M3 1989	95886.50	5708.35	4670.70	4486.90	8154.90	5284.80
M4 1989	95858.10	5569.99	4894.26	3820.30	7711.10	5819.90
M5 1989	95599.10	5326.46	4726.78	3700.30	7832.20	5841.70
M6 1989	95979.10	5637.05	5180.48	3846.50	8599.10	5831.00
M7 1989	97002.30	5676.72	5393.60	2444.30	7286.70	4977.10
M8 1989	102897.00	6116.94	5340.43	2345.30	7832.30	5340.20
M9 1989	104535.00	5967.22	5439.77	1798.80	7575.90	5683.60
M10 1989	106041.00	5766.77	5885.66	1767.70	7513.60	5873.00
M11 1989	108631.00	6257.06	5844.61	1477.70	6249.40	6089.30
M12 1989	114279.00	6124.26	5506.45	1529.10	6843.20	6387.50
M1 1990	47771.10	6045.81	5365.25	1680.20	7620.10	6361.00
M2 1990	48728.40	5436.99	5374.65	1771.70	7753.80	6330.10
M3 1990	48653.10	6448.83	6474.56	1899.80	7576.30	6269.60
M4 1990	48663.50	5644.44	5560.26	2198.80	7695.20	6410.60
M5 1990	48023.90	6118.30	6563.11	2756.00	7735.80	6325.20
M6 1990	48750.00	6447.57	6185.61	2674.90	7636.70	6011.50
M7 1990	49491.30	6257.13	6400.59	2597.20	7946.90	6355.50
M8 1990	50307.40	6910.76	7218.53	2754.40	8163.00	7296.70
M9 1990	49619.50	6817.37	7009.28	2792.50	7845.70	7402.00
M10 1990	50112.60	7976.63	8270.73	3007.20	7766.20	7807.40
M11 1990	51190.90	7840.52	7152.57	2860.80	7004.20	7201.00
M12 1990	51255.70	7791.37	7617.71	2681.20	6672.00	8129.40
M1 1991	53884.60	7558.96	7573.37	2310.70	6633.30	7951.20
M2 1991	54470.60	6390.31	7017.30	1968.20	6811.30	8770.20
M3 1991	54197.90	7667.95	8811.56	1569.10	6610.40	9210.40
M4 1991	53807.00	6390.12	8189.62	1555.90	5899.30	9006.30
M5 1991	54180.90	7763.98	8384.15	1591.70	5850.50	8691.70
M6 1991	54652.60	7486.17	8312.43	1551.10	5837.20	8747.80
M7 1991	55440.30	8477.14	9417.73	1545.20	5439.10	8770.40
M8 1991	55880.00	8647.94	8987.88	2107.20	5300.40	8953.60
M9 1991	56287.40	8294.54	8332.68	1956.60	5485.70	9092.70
M10 1991	58104.80	8629.28	9043.93	2001.20	5803.10	10566.70
M11 1991	59800.50	8479.84	8258.40	1910.20	5789.80	10938.00
M12 1991	61670.80	8712.69	8504.21	1611.00	5500.30	11755.40
M1 1992	96083.70	7548.10	8292.02	1686.70	7105.90	11379.30
M2 1992	100651.00	6147.93	7401.34	1595.90	6660.60	10903.30
M3 1992	100084.00	8819.92	8974.82	1648.80	6435.20	12436.10
M4 1992	104320.00	7608.34	8197.25	1722.70	6244.00	13568.60
M5 1992	103865.00	8529.78	8175.35	1816.10	5853.90	13814.70
M6 1992	108197.00	8739.21	8092.69	1610.20	5644.10	13111.70
M7 1992	111703.00	9597.17	9315.33	1298.70	5391.50	15088.60
M8 1992	113788.00	8807.48	8335.07	1165.20	5404.60	16976.90
M9 1992	117080.00	9331.12	8730.53	741.50	5582.20	18207.00
M10 1992	114313.00	9715.80	8832.61	737.30	5580.40	18591.80
M11 1992	116894.00	9089.87	8307.23	562.80	5327.60	18259.20
M12 1992	118487.00	9679.28	8893.89	560.80	5375.70	18684.00
M1 1993	119971.00	8360.41	7970.60	684.10	5397.10	18617.20
M2 1993	125083.00	8654.46	8136.42	648.10	6257.50	18806.10
M3 1993	123563.00	9732.29	8942.43	507.50	6007.20	19218.10
M4 1993	125411.00	10609.10	10495.50	476.80	6077.80	19882.80
M5 1993	126619.00	9974.18	9513.37	541.30	5616.70	19834.10
M6 1993	130777.00	9865.77	9591.42	373.00	6103.70	19471.30

Appendix 5 – 33: *Monthly data series used to compute the CRR factors – Malaysia, (Source: IFS)*

DESCRIPTOR	OFFICIAL RATE, END OF PERIOD	CLAIMS ON CENTRAL GOVERNMENT (NET)	CLAIMS ON PUBLIC NONFINANCIAL CORPOR	FOREIGN EXCHANGE	MONEY
UNITS	National Currency per U.S	National Currency	National Currency	U.S. dollars	National Currency
SCALE	Units	Millions	Millions	Millions	Millions
COUNTRYNAME	MALAYSIA	MALAYSIA	MALAYSIA	MALAYSIA	MALAYSIA
SERIESCODE	548..AE.ZF...	54832AN.ZF...	54832C..ZF...	548.1D.DZF...	54834...ZF...
M7 1993	2.57	6937.00	0.00	17500.00	38039.50
M8 1993	2.55	6619.90	0.00	20019.00	39158.60
M9 1993	2.55	6957.90	0.00	21988.00	40957.50
M10 1993	2.56	6664.70	0.00	20456.00	42643.50
M11 1993	2.56	5887.20	0.00	23287.00	43239.10
M12 1993	2.70	9303.60	0.00	26814.00	48077.10
M1 1994	2.76	10183.60	0.00	36760.00	52204.40
M2 1994	2.73	10523.00	0.00	33790.00	52304.20
M3 1994	2.67	9194.80	0.00	33193.00	49492.70
M4 1994	2.69	8157.10	0.00	31618.00	50296.40
M5 1994	2.58	7372.60	0.00	32074.00	48865.20
M6 1994	2.60	5760.90	0.00	32084.00	51423.90
M7 1994	2.59	4617.80	0.00	29689.00	50375.90
M8 1994	2.55	4156.90	0.00	30218.00	53067.60
M9 1994	2.57	4076.00	0.00	29824.00	55039.90
M10 1994	2.55	4128.50	0.00	28758.00	54726.50
M11 1994	2.56	3135.60	0.00	28844.00	54184.20
M12 1994	2.56	3146.40	0.00	24888.00	56174.80
M1 1995	2.56	5927.80	0.00	24610.00	59657.70
M2 1995	2.56	6729.10	0.00	24334.00	60142.10
M3 1995	2.54	6623.90	0.00	24385.00	55697.50
M4 1995	2.47	5952.90	0.00	24737.00	56436.70
M5 1995	2.47	4961.30	0.00	24738.00	57277.90
M6 1995	2.44	3631.30	0.00	25720.00	58034.70
M7 1995	2.46	1891.30	0.00	25794.00	58098.00
M8 1995	2.50	2388.80	0.00	24077.00	59800.10
M9 1995	2.51	1930.60	0.00	24255.00	59137.60
M10 1995	2.55	1359.20	0.00	23513.00	60382.50
M11 1995	2.54	395.70	0.00	22929.00	61591.70
M12 1995	2.54	1594.20	0.00	22945.00	63593.90
M1 1996	2.56	4111.30	0.00	21531.00	68216.60
M2 1996	2.55	4673.20	0.00	22234.00	70691.90
M3 1996	2.54	3380.90	0.00	22661.00	66800.80
M4 1996	2.49	2610.40	0.00	23378.00	68072.40
M5 1996	2.50	958.20	0.00	24583.00	68383.10
M6 1996	2.50	1794.90	0.00	24702.00	68683.40
M7 1996	2.50	1972.00	0.00	25270.00	71632.70
M8 1996	2.50	3798.60	0.00	25296.00	71170.50
M9 1996	2.51	1870.60	0.00	25214.00	73717.70
M10 1996	2.53	1985.70	0.00	25546.00	73911.40
M11 1996	2.53	652.70	0.00	25917.00	75314.10
M12 1996	2.53	-11962.30	0.00	26156.00	73055.20
M1 1997	2.49	-9780.50	0.00	26096.00	80871.30
M2 1997	2.48	-10025.50	0.00	26322.00	78156.90
M3 1997	2.48	-11542.70	0.00	26913.00	76707.10
M4 1997	2.51	-5277.90	0.00	26202.00	75302.30
M5 1997	2.51	-11552.10	0.00	25466.00	74452.70
M6 1997	2.53	-11358.20	0.00	25799.00	77578.20
M7 1997	2.63	-12823.70	0.00	20933.00	76307.70
M8 1997	2.96	-14487.20	0.00	21224.00	77304.70
M9 1997	3.19	-15317.20	0.00	21380.00	80084.90
M10 1997	3.43	-13145.20	0.00	21433.00	79816.10
M11 1997	3.51	-13149.10	0.00	20984.00	77971.80
M12 1997	3.89	-10156.20	3103.90	20013.00	81654.50

Appendix 5 – 34: *Monthly data series used to compute the CRR factors – Malaysia, (Source: IFS)*

DESCRIPTOR	QUASI-MONEY	EXPORTS	IMPORTS, CIF	CLAIMS ON CENTRAL GOVERNMENT	FOREIGN ASSETS	FOREIGN LIABILITIES
UNITS	National Currency	National Currency	National Currency	National Currency	National Currency	National Currency
SCALE	Millions	Millions	Millions	Millions	Millions	Millions
COUNTRY-NAME	MALAYSIA	MALAYSIA	MALAYSIA	MALAYSIA	MALAYSIA	MALAYSIA
SERIESCODE	54835...ZF...	54870...ZF...	54871...ZF...	54812A..ZF...	54821...ZF...	54826C..ZF...
M7 1993	132275.00	11129.60	10253.60	426.20	6874.70	19715.90
M8 1993	134483.00	10086.20	9532.78	888.90	6104.60	20622.60
M9 1993	139425.00	11144.30	10394.60	691.80	6181.80	21743.50
M10 1993	142431.00	10655.50	11496.10	712.80	7689.70	23545.90
M11 1993	143307.00	10042.10	10518.10	515.80	7759.20	23292.10
M12 1993	146561.00	10987.00	10570.40	454.40	10619.30	31488.30
M1 1994	147625.00	10859.50	10621.40	1009.60	8541.80	32931.90
M2 1994	152615.00	9984.60	10834.00	922.00	9195.10	31357.40
M3 1994	156448.00	12113.00	12151.50	576.70	7841.00	31853.30
M4 1994	156773.00	12600.60	13133.00	268.00	7211.30	31472.40
M5 1994	155160.00	12118.00	11919.50	168.80	7001.10	34901.90
M6 1994	156341.00	12806.10	12585.60	1531.90	7853.20	32483.90
M7 1994	155585.00	13313.30	13065.70	856.00	7021.70	26405.30
M8 1994	160252.00	13591.90	14200.00	621.20	9792.10	22046.20
M9 1994	160435.00	13762.20	14227.00	658.20	9338.70	20173.90
M10 1994	159258.00	14334.50	14087.40	853.10	10016.90	17369.40
M11 1994	159750.00	13847.20	13815.80	1014.40	10960.70	17109.00
M12 1994	160863.00	14555.10	15286.70	980.40	10708.80	17030.40
M1 1995	163176.00	13654.30	13501.80	1134.00	10435.70	15862.70
M2 1995	165386.00	13037.40	13515.20	1420.30	10899.20	16722.60
M3 1995	166607.00	13952.70	15342.60	1472.00	11244.70	19272.70
M4 1995	165997.00	14936.80	15231.60	1863.60	10568.70	19765.70
M5 1995	171770.00	14693.80	16026.70	1692.20	11009.30	18260.90
M6 1995	176614.00	15636.00	17740.20	988.30	10628.00	17327.20
M7 1995	177277.00	15531.10	16826.00	244.30	9018.40	16592.40
M8 1995	181280.00	16372.40	17549.50	1663.30	8762.90	16837.20
M9 1995	185176.00	16911.50	17196.20	1784.80	9694.20	15954.00
M10 1995	186570.00	15903.70	17524.90	2002.70	11441.10	16779.70
M11 1995	189347.00	17020.50	17059.90	2467.90	10628.30	16645.30
M12 1995	193651.00	17504.50	16867.20	2155.40	10528.40	15934.90
M1 1996	200536.00	16121.90	17266.90	2166.50	13541.20	13664.20
M2 1996	205404.00	13008.10	13744.20	2479.60	12667.00	12456.80
M3 1996	209188.00	18179.70	17655.70	2840.50	10777.50	14439.70
M4 1996	210252.00	15971.60	16225.50	2975.10	10580.80	16812.10
M5 1996	212977.00	16976.30	16737.90	3085.00	10028.70	19499.10
M6 1996	215745.00	16225.30	15638.50	3399.50	9980.90	20479.40
M7 1996	216913.00	15890.50	16507.30	2696.00	9260.40	19993.20
M8 1996	221854.00	17241.70	16612.90	3253.90	8819.70	20764.40
M9 1996	224929.00	16572.20	15919.20	3057.80	9612.00	23105.20
M10 1996	232286.00	16951.70	17718.60	3089.00	10139.40	22155.80
M11 1996	235263.00	16522.00	17026.20	3236.00	11130.20	22946.20
M12 1996	231741.00	17290.80	16250.40	7112.60	11391.30	29303.30
M1 1997	229966.00	16754.10	16857.00	5870.40	13580.50	35656.30
M2 1997	233619.00	13521.80	13153.30	5643.10	14257.80	35830.40
M3 1997	238885.00	18677.60	16924.70	5746.90	14554.00	37609.10
M4 1997	243209.00	15633.10	17759.20	5614.20	14282.00	40436.50
M5 1997	243355.00	17252.20	17096.00	5801.80	17048.30	42463.80
M6 1997	250776.00	16543.50	19343.20	5740.00	14934.10	41054.70
M7 1997	253581.00	17153.30	18007.20	5819.00	17651.80	36300.90
M8 1997	259687.00	19450.90	18297.20	5584.00	17540.00	36974.00
M9 1997	258286.00	20086.70	18956.00	5676.20	19224.10	44935.10
M10 1997	262578.00	21547.20	21698.50	5656.60	18490.80	47410.50
M11 1997	263839.00	21568.70	20890.90	5757.00	20215.10	50170.10
M12 1997	272018.00	22938.60	21977.60	7153.00	24432.80	49758.40

Appendix 5 – 35: *Monthly data series used to compute the CRR factors – Malaysia, (Source: IFS)*

DESCRIPTOR	OFFICIAL RATE, END OF PERIOD	CLAIMS ON CENTRAL GOVERNMENT (NET)	CLAIMS ON PUBLIC NONFINANCIAL CORPOR	FOREIGN EXCHANGE	MONEY
UNITS	National Currency per U.S	National Currency	National Currency	U.S. dollars	National Currency
SCALE	Units	Millions	Millions	Millions	Millions
COUNTRYNAME	MALAYSIA	MALAYSIA	MALAYSIA	MALAYSIA	MALAYSIA
SERIESCODE	548..AE.ZF...	54832AN.ZF...	54832C..ZF...	548.1D.DZF...	54834...ZF...
M1 1998	4.57	-7906.59	3219.20	18933.00	82935.10
M2 1998	3.67	-10779.20	3021.30	19025.00	71344.40
M3 1998	3.65	-11286.10	3672.10	19031.00	67585.50
M4 1998	3.73	-10226.50	3506.50	18968.00	65752.20
M5 1998	3.89	-11875.90	3683.41	18937.00	63609.30
M6 1998	4.17	-13877.90	3597.65	18926.00	64406.90
M7 1998	4.14	-16191.30	3665.47	18764.00	59923.50
M8 1998	4.21	-16923.70	3708.49	18788.00	59557.80
M9 1998	3.80	-16284.20	3572.66	19898.00	55396.40
M10 1998	3.80	-22696.70	3785.96	21917.00	53972.00
M11 1998	3.80	-21869.10	3938.25	22164.00	55583.00
M12 1998	3.80	-23320.90	3927.80	24728.00	57425.20
M1 1999	3.80	-21517.60	3623.89	26334.00	58597.40
M2 1999	3.80	-22363.10	3588.08	26641.00	58250.00
M3 1999	3.80	-22846.90	3786.27	26247.00	55928.50
M4 1999	3.80	-23431.30	3871.57	27149.00	57261.10
M5 1999	3.80	-25679.80	4036.68	28151.00	59373.60
M6 1999	3.80	-28747.70	4011.77	29688.00	61363.80
M7 1999	3.80	-27015.70	4185.10	30658.00	62376.00
M8 1999	3.80	-28015.30	4285.78	31618.00	62386.30
M9 1999	3.80	-26456.90	4514.68	30211.00	64239.70
M10 1999	3.80	-28999.40	4530.25	29044.00	63187.20
M11 1999	3.80	-27502.40	4375.92	28859.00	66972.10
M12 1999	3.80	-27971.80	4735.74	29670.00	73720.30
M1 2000	3.80	-26385.40	4139.80	31274.00	74716.90
M2 2000	3.80	-27448.00	3895.54	32321.00	73103.00
M3 2000	3.80	-28552.60	4328.75	32719.00	69065.60
M4 2000	3.80	-29046.30	4407.03	31382.70	67866.50
M5 2000	3.80	-29495.80	3884.29	31245.30	68060.60
M6 2000	3.80	-31201.60	4061.01	31191.60	68291.50
M7 2000	3.80	-27284.60	4142.06	30714.10	68331.90
M8 2000	3.80	-24644.80	3464.63	30554.30	69137.30
M9 2000	3.80	-29257.00	3882.05	29738.70	68333.30
M10 2000	3.80	-21775.50	4256.04	28291.90	71450.00
M11 2000	3.80	-21829.50	3680.92	27775.00	71658.20
M12 2000	3.80	-19523.50	4570.49	27432.20	79380.80
M1 2001	3.80	-13906.00	3617.88	27082.30	79382.20
M2 2001	3.80	-10059.50	3620.42	26573.50	76614.80
M3 2001	3.80	-18061.20	3403.11	24798.40	73729.80
M4 2001	3.80	-16073.40	3468.98	24136.30	73636.30
M5 2001	3.80	-17604.00	3385.65	23635.10	73901.00
M6 2001	3.80	-22170.00	3601.80	23745.40	74846.70
M7 2001	3.80	-25528.00	3628.09	24971.90	74550.80
M8 2001	3.80	-24638.80	2981.10	25455.10	76939.40
M9 2001	3.80	-25671.30	2702.85	27447.30	78186.10
M10 2001	3.80	-22441.30	2691.29	27975.60	77401.20
M11 2001	3.80	-20607.70	3652.61	28432.40	79186.70
M12 2001	3.80	-10426.80	23825.80	28632.90	78374.30
M1 2002	3.80	-6672.64	23701.80	28719.10	80868.10
M2 2002	3.80	-4114.81	23711.00	29283.50	81405.10
M3 2002	3.80	-8799.88	23320.80	30564.80	79255.00
M4 2002	3.80	-3866.54	23423.80	30534.70	79977.70
M5 2002	3.80	-5832.23	24110.70	30361.40	78292.90
M6 2002	3.80	-4690.55	23812.70	31362.70	80261.40

Appendix 5 – 36: *Monthly data series used to compute the CRR factors – Malaysia, (Source: IFS)*

DESCRIPTOR	QUASI-MONEY	EXPORTS	IMPORTS, CIF	CLAIMS ON CENTRAL GOVERNMENT	FOREIGN ASSETS	FOREIGN LIABILITIES
UNITS	National Currency	National Currency	National Currency	National Currency	National Currency	National Currency
SCALE	Millions	Millions	Millions	Millions	Millions	Millions
COUNTRY-NAME	MALAYSIA	MALAYSIA	MALAYSIA	MALAYSIA	MALAYSIA	MALAYSIA
SERIESCODE	54835...ZF...	54870...ZF...	54871...ZF...	54812A..ZF...	54821...ZF...	54826C..ZF...
M1 1998	270847.00	22601.90	20057.10	5825.50	27618.80	49357.70
M2 1998	276932.00	22403.40	19823.20	5778.40	24162.00	40198.30
M3 1998	279828.00	24253.80	20275.40	5560.10	26663.40	42428.10
M4 1998	281653.00	22313.50	18902.00	5604.40	26020.80	40494.20
M5 1998	281695.00	22365.80	18608.00	5602.30	25826.30	38095.20
M6 1998	283692.00	23503.80	17405.40	5633.90	27469.20	38281.50
M7 1998	283552.00	23936.40	20002.10	5568.70	29009.90	36891.40
M8 1998	288249.00	24319.30	18122.00	4938.00	28579.20	36706.20
M9 1998	292586.00	25054.60	18909.80	4630.70	24681.50	32266.10
M10 1998	291675.00	25488.80	18852.00	4603.50	24712.00	34275.20
M11 1998	294174.00	24648.80	18190.10	4499.20	23703.30	33460.00
M12 1998	297059.00	25874.00	19152.00	3926.00	21980.10	36134.50
M1 1999	299355.00	21829.30	17543.00	3701.50	21399.00	36681.50
M2 1999	305526.00	21848.40	16984.10	3678.50	20554.60	36329.30
M3 1999	304024.00	25583.00	19168.50	3704.60	20162.70	36000.90
M4 1999	314304.00	25889.60	19718.90	3504.60	21247.00	33879.70
M5 1999	317920.00	25624.70	19112.20	3489.80	23161.30	38312.30
M6 1999	323437.00	26349.20	20870.70	2985.00	22895.30	38442.00
M7 1999	325128.00	28274.20	22368.30	2961.70	22576.50	37799.80
M8 1999	324653.00	27102.10	20441.50	2961.70	25020.30	40578.70
M9 1999	325212.00	28179.90	22063.60	2960.40	23373.10	34099.20
M10 1999	321626.00	28566.30	22919.40	2959.90	24234.00	30984.50
M11 1999	322510.00	28079.90	22400.50	2948.90	26844.80	33248.80
M12 1999	323652.00	34033.20	25132.60	2377.30	25704.90	28655.30
M1 2000	330367.00	25471.70	20857.90	2403.00	24338.90	29201.00
M2 2000	332130.00	27287.80	22381.10	2402.10	25583.80	30898.40
M3 2000	335755.00	31998.10	24991.80	2411.60	24790.50	30382.30
M4 2000	342455.00	28917.60	25512.30	2409.20	25121.40	32203.80
M5 2000	343631.00	30277.90	26129.60	2512.70	24974.90	31852.90
M6 2000	347961.00	31772.40	27039.40	2447.60	24726.30	31530.80
M7 2000	350332.00	32729.20	28729.10	2436.60	27959.20	31067.70
M8 2000	351041.00	34026.30	29242.80	2444.40	27524.90	29572.20
M9 2000	352021.00	34951.20	28784.00	2427.30	29038.70	28782.20
M10 2000	355762.00	32971.80	27281.30	2427.80	27143.50	28135.90
M11 2000	355788.00	32778.60	26765.50	2414.60	31341.10	28800.90
M12 2000	357919.00	30228.30	24522.10	1837.70	29841.20	26498.10
M1 2001	367468.00	28092.70	25059.10	1838.20	32171.00	25914.60
M2 2001	370467.00	28449.80	22216.10	1903.50	35588.40	26289.50
M3 2001	367029.00	29609.90	25530.30	1956.20	36596.20	25414.80
M4 2001	371159.00	27340.40	22874.70	1957.10	40816.40	24373.80
M5 2001	372102.00	28042.10	23353.70	1940.70	40883.10	23375.80
M6 2001	367076.00	27443.20	24203.40	1787.50	40093.30	23761.70
M7 2001	367295.00	26935.20	22698.90	1787.50	39544.80	24489.60
M8 2001	365972.00	27663.70	21969.70	1781.50	39033.90	24055.50
M9 2001	368338.00	27563.60	22317.90	1778.50	36962.50	24652.80
M10 2001	373260.00	28708.90	24373.20	1892.40	32954.00	23759.00
M11 2001	374420.00	28329.90	24352.80	2007.90	29673.50	22851.20
M12 2001	398687.00	26267.70	21580.50	1422.10	28575.40	23893.70
M1 2002	396502.00	27316.90	23032.90	1378.10	27464.40	24092.60
M2 2002	404970.00	24012.90	20364.20	1377.40	29863.70	24392.80
M3 2002	406991.00	30576.20	25581.20	1379.30	28887.60	26858.80
M4 2002	407105.00	28983.00	26948.80	1378.30	26393.70	25165.30
M5 2002	410991.00	28995.50	25368.20	1378.30	30961.40	28212.10
M6 2002	407879.00	29105.80	24841.80	1378.30	28790.00	26175.80

Appendix 5 – 37: *Monthly data series used to compute the CRR factors – Malaysia, (Source: IFS)*

DESCRIPTOR	OFFICIAL RATE, END OF PERIOD	CLAIMS ON CENTRAL GOVERNMENT (NET)	CLAIMS ON PUBLIC NONFINANCIAL CORPOR	FOREIGN EXCHANGE	MONEY
UNITS	National Currency per U.S	National Currency	National Currency	U.S. dollars	National Currency
SCALE	Units	Millions	Millions	Millions	Millions
COUNTRYNAME	MALAYSIA	MALAYSIA	MALAYSIA	MALAYSIA	MALAYSIA
SERIESCODE	548..AE.ZF...	54832AN.ZF...	54832C..ZF...	548.1D.DZF...	54834...ZF...
M7 2002	3.80	-4610.41	23463.00	31789.90	79673.50
M8 2002	3.80	-1310.42	22929.20	32002.60	80514.70
M9 2002	3.80	-219.62	23168.60	31737.40	80930.40
M10 2002	3.80	2806.98	23107.70	31727.50	81853.40
M11 2002	3.80	4803.65	23289.50	32253.70	84936.70
M12 2002	3.80	-3242.77	9610.71	32419.10	87588.10
M1 2003	3.80	3137.00	9085.58	32445.20	91520.20
M2 2003	3.80	296.33	8866.90	32659.50	88353.10
M3 2003	3.80	326.77	8624.04	32707.00	87129.00
M4 2003	3.80	4610.36	8804.19	33330.10	86478.90
M5 2003	3.80	7402.33	9160.75	34287.30	88633.60
M6 2003	3.80	6432.25	9758.21	34868.60	90336.40
M7 2003	3.80	4591.16	9861.28	36038.40	90568.30
M8 2003	3.80	2996.92	10121.80	36504.80	93784.90
M9 2003	3.80	1213.10	10511.30	38564.40	93059.20
M10 2003	3.80	245.16	10515.70	41508.50	95570.00
M11 2003	3.80	3385.77	10712.30	41838.40	98752.80
M12 2003	3.80	2018.27	10341.20	42772.40	101627.00
M1 2004	3.80	3378.37	10573.40	45597.60	102731.00
M2 2004	3.80	-909.70	10717.80	47105.30	103248.00
M3 2004	3.80	-1464.04	11127.60	49328.20	105216.00
M4 2004	3.80	1189.69	10778.10	51428.00	102066.00
M5 2004	3.80	-1079.89	11609.20	51957.20	102803.00
M6 2004	3.80	-374.52	12284.30	51955.00	104419.00
M7 2004	3.80	1737.50	10507.80	52422.20	103839.00
M8 2004	3.80	1911.33	10897.30	52637.00	105984.00
M9 2004	3.80	-2711.74	11634.50	55030.50	106619.00
M10 2004	3.80	-3821.23	11509.80	57644.60	108455.00
M11 2004	3.80	-3260.37	10920.70	61196.20	110010.00
M12 2004	3.80	-6922.20	11516.00	64905.90	112980.00
M1 2005	3.80	-8376.21	10626.20	67839.20	118415.00
M2 2005	3.80	-11233.90	10430.60	70047.00	117170.00
M3 2005	3.80	-12581.60	11339.60	70718.40	114067.00
M4 2005	3.80	-11353.80	10327.90	72040.20	113126.00
M5 2005	3.80	-17360.00	10350.40	73256.20	112928.00
M6 2005	3.80	-20512.20	11475.50	73616.90	114554.00
M7 2005	3.75	-21637.90	9000.49	77162.70	115530.00
M8 2005	3.77	-22602.70	9091.20	78674.50	117350.00
M9 2005	3.77	-24190.30	9926.35	78964.60	116990.00
M10 2005	3.78	-21488.10	8806.63	75697.40	122536.00
M11 2005	3.78	-19870.10	8349.98	71726.50	118500.00
M12 2005	3.78	-12590.70	8257.05	69369.00	122861.00
M1 2006	3.75	-8449.09	9380.05	70196.80	129059.00
M2 2006	3.71	-4961.74	9992.80	71105.80	125892.00
M3 2006	3.69	-12880.80	9994.17	72643.60	120335.00
M4 2006	3.63	-14105.30	7286.61	74669.80	122878.00
M5 2006	3.63	-21849.80	7979.10	77887.00	123777.00
M6 2006	3.68	-26089.80	9385.23	77974.90	124991.00
M7 2006	3.65	-24655.60	9460.26	78291.10	126250.00
M8 2006	3.68	-19939.60	9142.88	78515.10	129495.00
M9 2006	3.69	-25463.70	9076.77	78752.80	128169.00
M10 2006	3.65	-23321.60	8394.89	78876.00	131924.00
M11 2006	3.62	-15851.50	8210.20	79310.00	134540.00
M12 2006	3.53	-2837.35	7800.49	82781.10	137834.00

Appendix 5 – 38: *Monthly data series used to compute the CRR factors – Malaysia, (Source: IFS)*

DESCRIPTOR	QUASI-MONEY	EXPORTS	IMPORTS, CIF	CLAIMS ON CENTRAL GOVERNMENT	FOREIGN ASSETS	FOREIGN LIABILITIES
UNITS	National Currency	National Currency	National Currency	National Currency	National Currency	National Currency
SCALE	Millions	Millions	Millions	Millions	Millions	Millions
COUNTRY-NAME	MALAYSIA	MALAYSIA	MALAYSIA	MALAYSIA	MALAYSIA	MALAYSIA
SERIESCODE	54835...ZF...	54870...ZF...	54871...ZF...	54812A..ZF...	54821...ZF...	54826C..ZF...
M7 2002	407329.00	30946.90	26869.80	1438.30	28959.50	26877.70
M8 2002	411050.00	31509.60	26830.90	1438.26	28168.90	27799.50
M9 2002	411824.00	31196.60	26416.10	1438.20	25910.80	27315.10
M10 2002	414619.00	32941.60	27084.40	1438.20	25894.90	26807.20
M11 2002	416514.00	32384.90	25768.80	1438.20	28198.90	30382.10
M12 2002	408171.00	29742.90	24288.20	601.15	26751.70	35325.10
M1 2003	412265.00	31644.30	24583.20	601.14	25415.20	34499.40
M2 2003	413786.00	27132.60	21299.60	600.78	23865.20	33282.20
M3 2003	416583.00	33168.60	25860.50	600.50	24984.70	35996.40
M4 2003	422508.00	32223.30	25476.80	600.45	22271.80	34095.50
M5 2003	426880.00	31983.40	25056.10	600.44	21844.70	36647.60
M6 2003	430243.00	32526.40	25045.40	600.42	22118.80	39461.10
M7 2003	433805.00	33094.10	27846.40	598.30	21558.50	39364.50
M8 2003	432659.00	33496.30	25855.70	598.29	21889.40	39983.20
M9 2003	436833.00	34462.80	27479.00	598.10	22517.60	41642.70
M10 2003	439015.00	37200.60	30447.00	598.06	21226.40	42845.80
M11 2003	441232.00	33236.30	26611.00	670.02	22892.80	43739.60
M12 2003	434374.00	38713.00	32186.00	98.52	21666.80	41509.00
M1 2004	438648.00	35244.00	28756.00	98.30	23663.50	42689.80
M2 2004	443427.00	32345.00	26488.00	98.17	31035.20	46097.10
M3 2004	453824.00	40247.00	33385.00	98.00	31012.40	45668.00
M4 2004	461714.00	39656.00	33542.00	97.93	30705.50	50631.60
M5 2004	459835.00	38465.00	31636.00	224.09	28348.80	53002.00
M6 2004	465365.00	39875.00	34698.00	223.61	32282.90	57156.60
M7 2004	466844.00	42385.00	35028.00	223.59	33038.50	58157.10
M8 2004	466285.00	41441.00	33380.00	223.57	33336.30	59286.60
M9 2004	471083.00	44379.00	37061.00	222.61	36381.10	60744.30
M10 2004	476930.00	44169.00	36190.00	221.13	34905.80	59105.20
M11 2004	483151.00	38845.00	32868.00	221.12	34441.00	61149.80
M12 2004	485917.00	43690.00	37044.00	221.13	40609.10	64005.70
M1 2005	486759.00	39039.00	31431.00	221.12	39481.30	66353.30
M2 2005	498103.00	36722.00	29556.00	321.09	41326.30	66664.10
M3 2005	508067.00	46814.00	36578.00	520.97	40756.50	63867.30
M4 2005	505349.00	43542.00	35090.00	615.00	41133.80	63764.30
M5 2005	509610.00	42662.00	35993.00	614.80	50289.40	66678.30
M6 2005	505309.00	44529.00	36791.00	614.55	38716.60	66602.90
M7 2005	506847.00	43593.00	37636.00	614.30	36837.60	72421.70
M8 2005	509739.00	46591.00	36841.00	614.04	33078.00	72339.00
M9 2005	505029.00	47680.00	40061.00	613.79	25767.30	74549.90
M10 2005	506860.00	49723.00	39203.00	613.53	24402.20	72225.60
M11 2005	510392.00	43424.00	34792.00	963.28	26630.80	67395.40
M12 2005	514002.00	49468.00	40037.00	961.04	32710.50	69441.60
M1 2006	514970.00	43160.80	34344.10	960.76	28584.30	65606.70
M2 2006	523960.00	42269.40	34884.30	960.53	34110.30	65998.30
M3 2006	530597.00	51275.40	41695.30	1085.27	34596.70	67634.90
M4 2006	533783.00	45711.40	39083.70	1084.42	37968.70	69461.00
M5 2006	528219.00	48239.40	40250.10	1084.16	33313.00	74868.20
M6 2006	524368.00	49218.60	40979.50	1223.91	34566.30	72775.60
M7 2006	530254.00	50525.90	41489.80	1223.74	36485.70	77928.80
M8 2006	534311.00	53444.10	43345.30	1223.57	37770.50	74779.10
M9 2006	533504.00	53119.80	42881.30	1272.91	42714.60	71769.90
M10 2006	541303.00	48052.40	38625.20	1422.74	48106.20	68164.30
M11 2006	556536.00	51423.20	42249.40	1355.58	50027.80	65911.50
M12 2006	572263.00	52525.00	40945.00	1504.20	50573.40	61692.40

Appendix 5 – 39: *Monthly data series used to compute the CRR factors – Malaysia, (Source: IFS)*

DESCRIPTOR	OFFICIAL RATE, END OF PERIOD	CLAIMS ON CENTRAL GOVERNMENT (NET)	CLAIMS ON PUBLIC NONFINANCIAL CORPOR	FOREIGN EXCHANGE	MONEY
UNITS	National Currency per U.S	National Currency	National Currency	U.S. dollars	National Currency
SCALE	Units	Millions	Millions	Millions	Millions
COUNTRYNAME	MALAYSIA	MALAYSIA	MALAYSIA	MALAYSIA	MALAYSIA
SERIESCODE	548..AE.ZF...	54832AN.ZF...	54832C..ZF...	548.1D.DZF...	54834...ZF...
M1 2007	3.50	2871.82	8226.35	86164.80	125222.00
M2 2007	3.51	2297.20	7898.50	87827.40	128008.00
M3 2007	3.46	-776.29	7873.26	90848.60	122563.00
M4 2007	3.42	-7243.87	7573.04	97657.70	126224.00
M5 2007	3.41	-17325.10	6412.62	97680.30	126378.00
M6 2007	3.46	-22105.80	7304.97	97776.70	130369.00
M7 2007	3.45	-17420.00	7172.32	96089.60	129221.00
M8 2007	3.50	-14411.80	6700.78	97524.90	126689.00
M9 2007	3.42	-17847.70	6902.69	98931.90	126338.00
M10 2007	3.34	-21211.40	6915.62	100400.00	133120.00
M11 2007	3.36	-23881.00	6455.72	100635.00	131284.00
M12 2007	3.31	-12808.80	6817.53	108564.00	138059.00
M1 2008	3.24	-8865.16	6881.20	115570.00	143883.00
M2 2008	3.19	-11117.90	6943.31	119562.00	142631.00
M3 2008	3.19	-11171.50	6920.38	123366.00	139872.00
M4 2008	3.16	-13318.60	6914.38	124446.00	136328.00
M5 2008	3.24	-20947.20	6972.25	125063.00	138200.00
M6 2008	3.27	-18701.70	4346.36	124347.00	142373.00
M7 2008	3.26	-9500.65	4337.71	121861.00	142416.00
M8 2008	3.39	-11900.60	4508.42	109052.00	142939.00
M9 2008	3.46	-1990.12	4213.05	99523.20	144313.00
M10 2008	3.56	-4378.62	4342.60	96847.90	140990.00
M11 2008	3.59	-1730.11	4305.63	90605.10	141663.00
M12 2008	3.46	19281.30	7357.29	90422.60	150997.00
M1 2009	3.61	26388.40	7782.99	90199.70	148622.00
M2 2009	3.69	n.a.	n.a.	n.a.	n.a.
M3 2009	n.a.	n.a.	n.a.		n.a.

Appendix 5 – 40: *Monthly data series used to compute the CRR factors – Malaysia, (Source: IFS)*

DESCRIPTOR	QUASI-MONEY	EXPORTS	IMPORTS, CIF	CLAIMS ON CENTRAL GOVERNMENT	FOREIGN ASSETS	FOREIGN LIABILITIES
UNITS	National Currency	National Currency	National Currency	National Currency	National Currency	National Currency
SCALE	Millions	Millions	Millions	Millions	Millions	Millions
COUNTRY-NAME	MALAYSIA	MALAYSIA	MALAYSIA	MALAYSIA	MALAYSIA	MALAYSIA
SERIESCODE	54835...ZF...	54870...ZF...	54871...ZF...	54812A..ZF...	54821...ZF...	54826C..ZF...
M1 2007	557035.00	48036.80	40431.70	1682.68	56596.20	61598.00
M2 2007	569791.00	41101.40	34169.40	1807.60	68410.90	64787.50
M3 2007	579951.00	48986.80	42464.40	1807.36	70864.80	67437.60
M4 2007	583081.00	46155.80	40293.90	1807.28	80617.50	65721.20
M5 2007	581856.00	49677.20	41699.00	1833.23	92390.00	77258.60
M6 2007	587000.00	49171.60	40390.00	1833.14	85545.70	75064.80
M7 2007	594911.00	50508.90	42530.70	2008.21	86400.30	77612.40
M8 2007	596892.00	53866.30	45055.30	2008.10	74546.10	82437.20
M9 2007	602542.00	54156.70	42686.70	2143.25	84531.10	86507.70
M10 2007	598972.00	54872.70	46279.40	2319.35	94206.10	90182.70
M11 2007	600370.00	54457.70	44063.30	2469.28	88663.90	87973.40
M12 2007	610161.00	54161.40	44750.10	2468.27	93539.80	84036.70
M1 2008	637128.00	53038.80	43316.90	2468.20	91175.60	86631.70
M2 2008	646193.00	47076.70	37972.20	2468.06	94834.40	96064.40
M3 2008	656362.00	51682.30	43682.90	2466.72	92193.30	90856.20
M4 2008	665225.00	55791.40	43477.40	2466.65	97219.90	99106.70
M5 2008	664949.00	61073.90	45598.00	2638.69	90587.50	95842.80
M6 2008	657004.00	58303.90	45450.00	2638.67	85766.30	105257.00
M7 2008	670776.00	63309.40	48895.40	2536.25	73379.50	98339.80
M8 2008	663882.00	59623.80	47015.50	2536.47	62810.50	106139.00
M9 2008	665396.00	62300.50	47563.30	2536.68	63170.90	112648.00
M10 2008	664908.00	53438.30	43829.10	2536.90	62713.90	97113.10
M11 2008	665211.00	51786.10	40279.00	2525.02	56367.60	93450.60
M12 2008	681879.00	46069.00	34531.00	2525.54	57150.20	89305.80
M1 2009	693674.00	38299.00	29471.00	2525.45	55289.30	82717.40
M2 2009	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
M3 2009	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Appendix V: Monthly CRR factors - Malaysia

***Appendix 5 – 41:** Monthly factors and the computed CRR index - Malaysia*

Years	Rate of change of growth of M2	Rate of change of growth of reserves	Rate of change of growth of export	Rate of change of M2/ foreign reserves	Rate of change of foreign assets / foreign liabilities	Rate of change of growth of debt	CRR index
	Factor	Factor	Factor	Factor	Factor	Factor	Factor
M1 1990	-1.03	0.47	0.19	-3.59	-0.14	0.28	-3.82
M2 1990	-0.98	0.43	-0.10	-3.44	-0.10	0.28	-3.91
M3 1990	-0.95	0.34	0.35	-3.27	-0.04	0.27	-3.30
M4 1990	-0.89	0.27	-0.02	-3.03	-0.05	0.26	-3.47
M5 1990	-0.88	0.32	0.19	-3.07	-0.09	0.27	-3.26
M6 1990	-0.82	0.34	0.32	-3.01	-0.07	0.26	-2.98
M7 1990	-0.75	0.39	0.22	-2.92	-0.07	0.25	-2.89
M8 1990	-0.71	0.48	0.48	-2.97	-0.08	0.23	-2.57
M9 1990	-0.70	0.55	0.41	-3.09	-0.09	0.25	-2.66
M10 1990	-0.64	0.92	0.87	-3.48	-0.02	0.25	-2.10
M11 1990	-0.59	0.56	0.77	-2.92	-0.05	0.26	-1.97
M12 1990	-0.55	0.61	0.70	-2.94	-0.16	-0.21	-2.55
M1 1991	-0.43	0.60	0.57	-2.70	-0.16	-0.33	-2.45
M2 1991	-0.38	0.63	0.08	-2.68	-0.18	-0.20	-2.73
M3 1991	-0.41	0.48	0.59	-2.60	-0.20	-0.05	-2.20
M4 1991	-0.41	0.53	0.05	-2.66	-0.23	-0.11	-2.83
M5 1991	-0.39	0.52	0.60	-2.60	-0.24	0.06	-2.05
M6 1991	-0.36	0.42	0.46	-2.40	-0.23	0.09	-2.02
M7 1991	-0.33	0.44	0.83	-2.39	-0.22	0.17	-1.50
M8 1991	-0.30	0.46	0.86	-2.36	-0.22	0.01	-1.55
M9 1991	-0.27	0.40	0.69	-2.10	-0.20	0.01	-1.46
M10 1991	-0.22	0.42	0.79	-2.04	-0.22	-0.11	-1.38
M11 1991	-0.16	0.49	0.70	-2.06	-0.18	0.06	-1.14
M12 1991	-0.07	0.63	0.76	-2.12	-0.22	0.11	-0.90
M1 1992	0.99	0.66	0.31	-0.09	-0.10	-0.65	1.13
M2 1992	1.03	0.70	-0.22	0.18	-0.07	-0.73	0.88
M3 1992	0.98	0.82	0.77	-0.19	-0.11	-0.77	1.50
M4 1992	1.05	1.00	0.31	-0.33	-0.16	-0.98	0.88
M5 1992	1.00	1.01	0.63	-0.46	-0.18	-0.58	1.43
M6 1992	1.09	0.86	0.69	0.10	-0.15	-0.94	1.65
M7 1992	1.14	1.32	0.98	-0.77	-0.20	-0.39	2.08
M8 1992	1.16	1.55	0.67	-1.12	-0.24	-0.35	1.68
M9 1992	1.23	2.09	0.83	-1.81	-0.22	-0.25	1.87
M10 1992	1.12	2.14	0.94	-2.06	-0.22	-0.31	1.61
M11 1992	1.18	2.08	0.70	-2.00	-0.19	-0.25	1.51
M12 1992	1.21	1.54	0.88	-1.40	-0.27	0.10	2.07
M1 1993	1.25	1.51	0.40	-1.33	-0.26	0.09	1.66
M2 1993	1.30	1.35	0.50	-1.02	-0.18	0.10	2.05
M3 1993	1.25	1.02	0.85	-0.37	-0.16	0.06	2.65
M4 1993	1.27	1.13	1.13	-0.51	-0.14	-0.03	2.84
M5 1993	1.28	0.97	0.88	-0.11	-0.17	0.02	2.87
M6 1993	1.36	1.10	0.82	-0.32	-0.06	0.01	2.92
M7 1993	1.33	1.39	1.22	-0.89	0.05	0.01	3.11
M8 1993	1.36	1.82	0.85	-1.47	-0.02	-0.01	2.53
M9 1993	1.47	2.12	1.17	-1.74	-0.03	-0.09	2.90
M10 1993	1.53	1.77	0.98	-1.22	0.06	-0.11	3.02
M11 1993	1.52	2.22	0.76	-1.84	0.08	0.09	2.84
M12 1993	1.65	2.75	1.05	-2.51	0.08	-0.05	2.97
M1 1994	1.71	4.24	0.96	-3.58	-0.11	-0.08	3.14
M2 1994	1.77	3.51	0.64	-3.09	-0.03	-0.11	2.69
M3 1994	1.73	3.22	1.27	-2.85	-0.10	-0.06	3.22
M4 1994	1.70	2.81	1.37	-2.57	-0.10	-0.04	3.18
M5 1994	1.59	2.72	1.17	-2.43	-0.18	-0.02	2.86
M6 1994	1.62	2.58	1.32	-2.30	-0.15	0.00	3.06

Appendix 5 – 42: *Monthly factors and the computed CRR index - Malaysia*

Years	Rate of change of growth of M2	Rate of change of growth of reserves	Rate of change of growth of export	Rate of change of M2/ foreign reserves	Rate of change of foreign assets / foreign liabilities	Rate of change of growth of debt	CRR index
	Factor	Factor	Factor	Factor	Factor	Factor	Factor
M7 1994	1.53	2.12	1.42	-1.87	-0.05	0.09	3.23
M8 1994	1.63	2.08	1.44	-1.59	0.28	0.12	3.96
M9 1994	1.62	1.92	1.43	-1.39	0.21	0.11	3.91
M10 1994	1.55	1.69	1.53	-1.09	0.37	0.06	4.11
M11 1994	1.51	1.62	1.34	-1.00	0.45	0.19	4.10
M12 1994	1.52	1.06	1.47	0.13	0.71	0.20	5.10
M1 1995	1.56	0.97	1.17	0.40	0.62	0.12	4.85
M2 1995	1.53	0.89	0.96	0.57	0.82	0.04	4.82
M3 1995	1.40	0.85	1.15	0.50	0.77	0.00	4.68
M4 1995	1.34	0.84	1.35	0.59	0.83	-0.02	4.94
M5 1995	1.38	0.80	1.23	0.82	0.75	0.03	5.00
M6 1995	1.41	0.86	1.41	0.77	0.65	0.06	5.16
M7 1995	1.35	0.82	1.33	0.71	0.11	0.19	4.51
M8 1995	1.37	0.59	1.48	1.28	0.06	0.06	4.83
M9 1995	1.35	0.58	1.54	1.26	0.03	0.09	4.86
M10 1995	1.33	0.47	1.25	1.42	0.03	0.08	4.58
M11 1995	1.32	0.38	1.46	1.73	0.01	0.12	5.00
M12 1995	1.35	0.35	1.51	1.88	0.00	0.17	5.26
M1 1996	1.44	0.18	1.14	2.71	0.26	0.09	5.82
M2 1996	1.48	0.23	0.40	2.62	0.37	0.05	5.15
M3 1996	1.40	0.25	1.51	2.42	0.20	0.08	5.86
M4 1996	1.36	0.29	0.97	2.30	0.02	0.07	5.01
M5 1996	1.33	0.38	1.14	1.86	-0.08	0.06	4.69
M6 1996	1.31	0.36	0.94	1.87	-0.05	-0.43	3.99
M7 1996	1.29	0.39	0.83	1.74	-0.06	-0.02	4.17
M8 1996	1.28	0.36	1.07	1.81	-0.15	-0.24	4.13
M9 1996	1.28	0.32	0.89	1.89	-0.19	-0.10	4.10
M10 1996	1.31	0.33	0.93	1.85	-0.14	-0.19	4.09
M11 1996	1.29	0.33	0.81	1.82	-0.13	0.03	4.15
M12 1996	1.16	0.32	0.92	1.52	-0.30	0.01	3.63
M1 1997	1.18	0.29	0.78	1.84	-0.31	0.10	3.87
M2 1997	1.14	0.29	0.11	1.80	-0.23	0.07	3.17
M3 1997	1.13	0.31	1.08	1.72	-0.19	0.02	4.07
M4 1997	1.11	0.23	0.46	1.89	-0.16	-0.10	3.43
M5 1997	1.05	0.14	0.73	2.09	-0.09	-0.02	3.92
M6 1997	1.12	0.15	0.57	2.21	-0.11	-0.06	3.88
M7 1997	1.09	-0.27	0.65	3.81	0.07	0.06	5.42
M8 1997	1.12	-0.25	1.03	2.65	0.07	-0.04	4.57
M9 1997	1.08	-0.24	1.10	1.86	-0.03	-0.04	3.73
M10 1997	1.08	-0.24	1.31	1.29	-0.10	-0.16	3.18
M11 1997	1.02	-0.28	1.26	1.22	0.02	0.06	3.30
M12 1997	1.10	-0.37	1.44	1.00	0.14	-0.26	3.06
M1 1998	1.05	-0.46	1.32	0.22	0.20	-0.20	2.13
M2 1998	0.95	-0.45	1.23	1.69	0.28	-0.17	3.53
M3 1998	0.90	-0.46	1.48	1.70	0.39	-0.20	3.81
M4 1998	0.86	-0.47	1.11	1.51	0.30	-0.17	3.14
M5 1998	0.80	-0.47	1.07	1.12	0.43	-0.18	2.77
M6 1998	0.79	-0.48	1.20	0.65	0.24	-0.17	2.23
M7 1998	0.71	-0.49	1.22	0.65	0.33	-0.18	2.24
M8 1998	0.72	-0.49	1.22	0.58	0.41	-0.14	2.30
M9 1998	0.68	-0.39	1.28	0.88	0.48	-0.11	2.82
M10 1998	0.63	-0.23	1.29	0.10	0.39	-0.11	2.08
M11 1998	0.64	-0.21	1.11	0.09	0.22	0.08	1.94
M12 1998	0.65	0.01	1.24	-0.57	0.04	0.07	1.44

Appendix 5 – 43: *Monthly factors and the computed CRR index - Malaysia*

Years	Rate of change of growth of M2	Rate of change of growth of reserves	Rate of change of growth of export	Rate of change of M2/ foreign reserves	Rate of change of foreign assets / foreign liabilities	Rate of change of growth of debt	CRR index
	Factor	Factor	Factor	Factor	Factor	Factor	Factor
M1 1999	0.65	0.15	0.61	-0.93	-0.01	0.08	0.55
M2 1999	0.67	0.19	0.58	-0.94	-0.05	0.09	0.55
M3 1999	0.61	0.17	1.07	-0.94	-0.06	0.08	0.92
M4 1999	0.68	0.25	1.07	-0.98	-0.04	0.09	1.07
M5 1999	0.70	0.34	0.99	-1.13	-0.08	0.08	0.91
M6 1999	0.73	0.48	1.04	-1.33	-0.12	0.10	0.90
M7 1999	0.72	0.56	1.26	-1.48	-0.12	0.07	1.01
M8 1999	0.69	0.63	1.06	-1.66	-0.10	0.06	0.68
M9 1999	0.68	0.51	1.15	-1.40	-0.02	0.06	0.98
M10 1999	0.61	0.42	1.16	-1.26	0.05	0.06	1.03
M11 1999	0.62	0.40	1.05	-1.17	0.16	0.05	1.11
M12 1999	0.65	0.46	1.74	-1.22	0.27	0.04	1.95
M1 2000	0.68	0.58	0.63	-1.40	0.24	0.06	0.80
M2 2000	0.65	0.66	0.82	-1.56	0.24	0.08	0.89
M3 2000	0.62	0.67	1.35	-1.62	0.15	0.06	1.22
M4 2000	0.63	0.55	0.93	-1.33	0.15	0.06	0.99
M5 2000	0.61	0.53	1.05	-1.28	0.16	0.06	1.13
M6 2000	0.62	0.52	1.18	-1.20	0.16	0.06	1.33
M7 2000	0.61	0.47	1.24	-1.08	0.23	0.06	1.53
M8 2000	0.59	0.44	1.34	-1.02	0.18	0.10	1.63
M9 2000	0.57	0.37	1.40	-0.85	0.14	0.08	1.70
M10 2000	0.59	0.25	1.13	-0.45	0.10	0.06	1.67
M11 2000	0.57	0.20	1.06	-0.32	0.11	0.08	1.69
M12 2000	0.61	0.16	0.75	-0.08	0.18	0.04	1.66
M1 2001	0.65	0.13	0.49	0.17	0.25	0.08	1.77
M2 2001	0.63	0.08	0.50	0.32	0.33	0.09	1.94
M3 2001	0.56	-0.06	0.60	0.72	0.42	0.10	2.34
M4 2001	0.57	-0.12	0.33	1.00	0.57	0.08	2.43
M5 2001	0.55	-0.16	0.39	1.17	0.62	0.09	2.65
M6 2001	0.50	-0.15	0.30	1.05	0.44	0.08	2.23
M7 2001	0.48	-0.05	0.23	0.66	0.37	0.05	1.74
M8 2001	0.47	-0.01	0.28	0.54	0.30	0.10	1.68
M9 2001	0.47	0.15	0.25	0.08	0.28	0.12	1.34
M10 2001	0.48	0.18	0.35	0.02	0.14	0.09	1.26
M11 2001	0.48	0.22	0.29	-0.03	0.08	0.05	1.08
M12 2001	0.61	0.23	0.06	0.28	-0.02	-1.17	0.00
M1 2002	0.59	0.23	0.15	0.27	-0.08	-1.05	0.12
M2 2002	0.63	0.27	-0.19	0.28	-0.07	-1.02	-0.11
M3 2002	0.60	0.37	0.43	0.00	-0.18	-0.91	0.30
M4 2002	0.59	0.36	0.25	0.03	-0.20	-0.89	0.14
M5 2002	0.58	0.34	0.23	0.12	-0.17	-0.85	0.24
M6 2002	0.55	0.41	0.22	-0.09	-0.16	-0.78	0.14
M7 2002	0.52	0.42	0.37	-0.14	-0.17	-0.86	0.14
M8 2002	0.53	0.42	0.40	-0.09	-0.16	-0.86	0.25
M9 2002	0.52	0.39	0.35	0.01	-0.16	-0.79	0.32
M10 2002	0.52	0.37	0.49	0.08	-0.13	-0.63	0.70
M11 2002	0.54	0.39	0.42	0.05	-0.11	0.11	1.39
M12 2002	0.48	0.39	0.17	-0.05	-0.17	0.25	1.07
M1 2003	0.51	0.37	0.33	0.05	-0.20	0.23	1.30
M2 2003	0.49	0.36	-0.09	0.01	-0.17	0.26	0.86
M3 2003	0.48	0.35	0.44	0.05	-0.17	0.26	1.40
M4 2003	0.49	0.37	0.34	0.02	-0.20	0.22	1.24
M5 2003	0.51	0.42	0.30	-0.07	-0.23	0.19	1.13
M6 2003	0.52	0.44	0.33	-0.10	-0.24	0.19	1.14

Appendix 5 – 44: *Monthly factors and the computed CRR index - Malaysia*

Years	Rate of change of growth of M2	Rate of change of growth of reserves	Rate of change of growth of export	Rate of change of M2/ foreign reserves	Rate of change of foreign assets / foreign liabilities	Rate of change of growth of debt	CRR index
	Factor	Factor	Factor	Factor	Factor	Factor	Factor
M7 2003	0.52	0.50	0.37	-0.25	-0.23	0.20	1.10
M8 2003	0.51	0.50	0.39	-0.30	-0.21	0.22	1.11
M9 2003	0.51	0.62	0.46	-0.58	-0.22	0.24	1.02
M10 2003	0.51	0.79	0.67	-0.95	-0.23	0.25	1.05
M11 2003	0.52	0.78	0.32	-0.92	-0.15	0.02	0.57
M12 2003	0.48	0.82	0.76	-1.07	-0.15	0.12	0.96
M1 2004	0.49	0.97	0.45	-1.36	-0.11	0.02	0.45
M2 2004	0.50	1.04	0.18	-1.47	-0.02	0.09	0.32
M3 2004	0.54	1.14	0.82	-1.58	0.02	0.16	1.11
M4 2004	0.55	1.24	0.75	-1.74	0.01	0.18	0.99
M5 2004	0.52	1.23	0.63	-1.79	-0.02	0.18	0.75
M6 2004	0.54	1.19	0.72	-1.71	0.02	0.16	0.91
M7 2004	0.53	1.19	0.90	-1.74	0.02	0.14	1.03
M8 2004	0.51	1.17	0.80	-1.74	0.02	0.11	0.87
M9 2004	0.52	1.27	1.00	-1.90	0.10	0.11	1.12
M10 2004	0.54	1.38	0.96	-2.04	0.06	0.16	1.07
M11 2004	0.56	1.53	0.52	-2.24	0.04	0.14	0.56
M12 2004	0.57	1.69	0.88	-2.43	0.07	0.16	0.94
M1 2005	0.58	1.79	0.50	-2.56	-0.06	0.12	0.37
M2 2005	0.61	1.85	0.30	-2.60	-0.04	0.13	0.24
M3 2005	0.62	1.82	1.06	-2.58	0.03	0.12	1.07
M4 2005	0.58	1.82	0.78	-2.66	0.10	0.14	0.76
M5 2005	0.58	1.81	0.70	-2.68	0.17	0.15	0.73
M6 2005	0.55	1.76	0.82	-2.69	0.01	0.13	0.57
M7 2005	0.54	1.87	0.73	-2.79	-0.05	0.18	0.48
M8 2005	0.54	1.87	0.93	-2.83	-0.12	0.16	0.55
M9 2005	0.50	1.80	0.99	-2.84	-0.21	0.14	0.38
M10 2005	0.51	1.58	1.11	-2.60	-0.20	0.15	0.56
M11 2005	0.49	1.33	0.63	-2.34	-0.19	0.16	0.10
M12 2005	0.51	1.17	1.04	-2.09	-0.10	0.15	0.68
M1 2006	0.53	1.15	0.56	-2.01	-0.15	0.13	0.21
M2 2006	0.53	1.14	0.48	-1.94	-0.10	0.14	0.26
M3 2006	0.52	1.16	1.09	-1.95	-0.10	0.12	0.83
M4 2006	0.53	1.19	0.66	-1.90	-0.14	0.17	0.51
M5 2006	0.49	1.26	0.81	-2.08	-0.12	0.17	0.54
M6 2006	0.45	1.20	0.84	-2.10	-0.03	0.10	0.47
M7 2006	0.47	1.16	0.90	-1.98	0.01	0.10	0.66
M8 2006	0.48	1.11	1.06	-1.91	0.23	0.13	1.09
M9 2006	0.45	1.07	0.99	-1.90	0.38	0.10	1.10
M10 2006	0.48	1.03	0.63	-1.73	0.39	0.11	0.92
M11 2006	0.54	0.99	0.82	-1.53	0.31	0.12	1.25
M12 2006	0.61	1.07	0.85	-1.43	0.44	0.14	1.68
M1 2007	0.47	1.14	0.54	-1.74	0.39	0.07	0.86
M2 2007	0.52	1.15	0.07	-1.67	0.53	0.08	0.68
M3 2007	0.52	1.20	0.55	-1.68	0.46	0.05	1.10
M4 2007	0.53	1.38	0.35	-1.88	0.88	0.07	1.31
M5 2007	0.50	1.31	0.55	-1.81	0.76	0.12	1.44
M6 2007	0.52	1.25	0.49	-1.76	0.72	0.09	1.31
M7 2007	0.53	1.14	0.55	-1.57	0.60	0.06	1.31
M8 2007	0.51	1.13	0.72	-1.67	0.26	0.06	1.01
M9 2007	0.51	1.12	0.71	-1.51	0.19	0.01	1.03
M10 2007	0.51	1.11	0.73	-1.39	0.19	-0.04	1.11
M11 2007	0.48	1.07	0.67	-1.37	0.11	-0.04	0.94
M12 2007	0.53	1.25	0.63	-1.51	0.11	0.06	1.06

Appendix 5 – 45: *Monthly factors and the computed CRR index - Malaysia*

Years	Rate of change of growth of M2	Rate of change of growth of reserves	Rate of change of growth of export	Rate of change of M2/ foreign reserves	Rate of change of foreign assets / foreign liabilities	Rate of change of growth of debt	CRR index
	Factor	Factor	Factor	Factor	Factor	Factor	Factor
M1 2008	0.64	1.39	0.54	-1.43	0.00	0.04	1.17
M2 2008	0.65	1.43	0.17	-1.41	-0.03	-0.03	0.78
M3 2008	0.66	1.47	0.41	-1.46	0.00	0.00	1.08
M4 2008	0.65	1.42	0.62	0.00	0.00	0.00	2.70
M5 2008	0.63	1.37	0.88	0.00	0.00	0.00	2.89
M6 2008	0.60	1.29	0.70	0.00	0.00	0.00	2.58
M7 2008	0.63	1.16	0.94	0.00	0.00	0.00	2.72
M8 2008	0.58	0.78	0.70	0.00	0.00	0.00	2.06
M9 2008	0.57	0.50	0.82	0.00	0.00	0.00	1.89
M10 2008	0.53	0.41	0.32	0.00	0.00	0.00	1.26
M11 2008	0.52	0.23	0.22	0.00	0.00	0.00	0.96
M12 2008	0.59	0.20	-0.10	0.00	0.00	0.00	0.70
M1 2009	0.61	0.17	0.00	0.00	0.00	0.00	0.78
M2 2009	0.00	0.00	0.00	0.00	0.00	0.00	0.00
M3 2009	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Appendix V: CCRTM - Indonesia

Appendix 5 – 46: CCRTM – Indonesia (Years 1989 – 1994)

Year: 1989	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	83.367%	1.096%	0.163%	0.055%	0.000%	0.000%	0.041%	13.811%
Aa	3.255%	82.690%	3.035%	0.870%	0.117%	0.044%	0.088%	9.045%
A	0.499%	1.429%	83.190%	2.350%	0.680%	0.085%	0.243%	11.495%
Baa	0.227%	0.319%	1.216%	83.014%	5.190%	1.794%	1.589%	6.623%
Ba	0.056%	0.026%	0.365%	2.208%	78.953%	4.198%	7.667%	6.499%
B	0.000%	0.019%	0.021%	0.203%	0.420%	79.661%	13.011%	6.639%
Caa-C	0.000%	0.000%	0.000%	0.000%	0.061%	0.138%	80.477%	19.297%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 1990	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	88.864%	0.828%	0.123%	0.041%	0.000%	0.000%	0.031%	9.357%
Aa	5.546%	85.251%	2.205%	0.616%	0.082%	0.031%	0.062%	5.784%
A	1.001%	2.450%	86.732%	1.731%	0.492%	0.062%	0.174%	7.346%
Baa	0.484%	0.603%	2.092%	86.748%	3.774%	1.245%	1.072%	3.971%
Ba	0.132%	0.057%	0.716%	3.709%	82.901%	3.180%	5.406%	3.888%
B	0.000%	0.047%	0.047%	0.419%	0.786%	85.216%	9.493%	3.981%
Caa-C	0.000%	0.000%	0.000%	0.000%	0.141%	0.285%	86.364%	13.199%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 1991	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	80.227%	1.224%	0.183%	0.061%	0.000%	0.000%	0.046%	16.287%
Aa	2.479%	80.639%	3.455%	1.002%	0.135%	0.051%	0.102%	10.961%
A	0.351%	1.083%	80.753%	2.658%	0.776%	0.098%	0.278%	13.960%
Baa	0.156%	0.230%	0.920%	80.497%	5.907%	2.088%	1.873%	8.286%
Ba	0.037%	0.018%	0.259%	1.690%	76.272%	4.686%	8.857%	8.138%
B	0.000%	0.012%	0.014%	0.141%	0.306%	76.387%	14.794%	8.304%
Caa-C	0.000%	0.000%	0.000%	0.000%	0.040%	0.096%	77.111%	22.710%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 1992	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	86.219%	0.964%	0.143%	0.048%	0.000%	0.000%	0.036%	11.517%
Aa	4.243%	84.236%	2.620%	0.742%	0.099%	0.037%	0.075%	7.335%
A	0.704%	1.870%	85.184%	2.043%	0.586%	0.073%	0.208%	9.313%
Baa	0.330%	0.438%	1.594%	85.096%	4.482%	1.515%	1.323%	5.204%
Ba	0.086%	0.039%	0.510%	2.861%	81.166%	3.698%	6.522%	5.101%
B	0.000%	0.029%	0.031%	0.290%	0.574%	82.589%	11.252%	5.217%
Caa-C	0.000%	0.000%	0.000%	0.000%	0.092%	0.198%	83.539%	16.153%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 1993	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	88.426%	0.852%	0.126%	0.042%	0.000%	0.000%	0.032%	9.717%
Aa	5.296%	85.120%	2.276%	0.638%	0.085%	0.032%	0.064%	6.038%
A	0.942%	2.339%	86.503%	1.785%	0.508%	0.064%	0.180%	7.668%
Baa	0.453%	0.571%	1.997%	86.499%	3.895%	1.290%	1.114%	4.169%
Ba	0.122%	0.053%	0.675%	3.547%	82.643%	3.270%	5.594%	4.083%
B	0.000%	0.043%	0.044%	0.393%	0.744%	84.791%	9.793%	4.180%
Caa-C	0.000%	0.000%	0.000%	0.000%	0.131%	0.268%	85.898%	13.691%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 1994	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	95.701%	0.395%	0.058%	0.019%	0.000%	0.000%	0.014%	3.642%
Aa	13.645%	82.962%	0.971%	0.258%	0.034%	0.013%	0.025%	2.004%
A	3.376%	5.955%	86.994%	0.784%	0.215%	0.027%	0.075%	2.573%
Baa	1.834%	1.782%	5.117%	87.472%	1.665%	0.500%	0.408%	1.220%
Ba	0.605%	0.218%	2.280%	8.681%	83.256%	1.521%	2.249%	1.189%
B	0.001%	0.247%	0.205%	1.473%	2.266%	90.344%	4.240%	1.223%
Caa-C	0.000%	0.000%	0.000%	0.000%	0.642%	1.007%	93.027%	5.323%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%

***Appendix 5 – 47:** CCRTM – Indonesia (Years 1995 – 2000)*

Year: 1995	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	96.464%	0.336%	0.049%	0.016%	0.000%	0.000%	0.012%	2.995%
Aa	15.719%	81.515%	0.815%	0.215%	0.028%	0.011%	0.021%	1.613%
A	4.111%	6.817%	86.066%	0.661%	0.180%	0.022%	0.063%	2.078%
Baa	2.281%	2.113%	5.864%	86.636%	1.398%	0.413%	0.333%	0.961%
Ba	0.778%	0.271%	2.741%	9.873%	82.234%	1.296%	1.868%	0.937%
B	0.001%	0.325%	0.260%	1.804%	2.674%	90.400%	3.570%	0.964%
Caa-C	0.000%	0.000%	0.000%	0.000%	0.825%	1.233%	93.528%	4.414%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 1996	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	97.116%	0.283%	0.041%	0.014%	0.000%	0.000%	0.010%	2.441%
Aa	18.004%	79.760%	0.677%	0.177%	0.023%	0.009%	0.017%	1.287%
A	4.977%	7.748%	84.838%	0.552%	0.150%	0.018%	0.052%	1.664%
Baa	2.819%	2.487%	6.670%	85.502%	1.163%	0.338%	0.270%	0.751%
Ba	0.996%	0.335%	3.273%	11.150%	80.884%	1.094%	1.538%	0.731%
B	0.002%	0.426%	0.329%	2.193%	3.134%	90.183%	2.979%	0.753%
Caa-C	0.000%	0.000%	0.000%	0.000%	1.053%	1.499%	93.818%	3.629%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 1997	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	93.374%	0.558%	0.082%	0.027%	0.000%	0.000%	0.021%	5.605%
Aa	9.525%	85.141%	1.421%	0.386%	0.051%	0.019%	0.038%	3.243%
A	2.063%	4.197%	88.001%	1.134%	0.316%	0.039%	0.111%	4.137%
Baa	1.067%	1.156%	3.597%	88.270%	2.435%	0.761%	0.635%	2.075%
Ba	0.325%	0.127%	1.432%	6.214%	84.353%	2.149%	3.371%	2.027%
B	0.000%	0.125%	0.113%	0.886%	1.485%	89.144%	6.162%	2.081%
Caa-C	0.000%	0.000%	0.000%	0.000%	0.346%	0.605%	90.995%	8.050%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 1998	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	55.999%	1.764%	0.269%	0.090%	0.000%	0.000%	0.068%	33.132%
Aa	0.388%	59.870%	5.564%	1.729%	0.237%	0.089%	0.180%	26.072%
A	0.034%	0.160%	58.656%	4.117%	1.263%	0.161%	0.461%	34.723%
Baa	0.013%	0.026%	0.135%	58.107%	9.509%	3.821%	3.706%	24.260%
Ba	0.002%	0.001%	0.026%	0.266%	53.000%	6.723%	15.602%	23.955%
B	0.000%	0.001%	0.001%	0.012%	0.035%	51.363%	23.867%	24.301%
Caa-C	0.000%	0.000%	0.000%	0.000%	0.003%	0.008%	51.911%	47.655%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 1999	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	61.452%	1.705%	0.259%	0.087%	0.000%	0.000%	0.065%	29.765%
Aa	0.583%	64.967%	5.259%	1.612%	0.221%	0.083%	0.167%	22.709%
A	0.057%	0.244%	63.901%	3.922%	1.191%	0.152%	0.433%	29.822%
Baa	0.022%	0.041%	0.206%	63.385%	8.986%	3.520%	3.361%	20.201%
Ba	0.004%	0.002%	0.043%	0.401%	58.369%	6.503%	14.474%	19.926%
B	0.000%	0.001%	0.002%	0.021%	0.057%	56.888%	22.519%	20.237%
Caa-C	0.000%	0.000%	0.000%	0.000%	0.005%	0.014%	57.451%	42.252%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 2000	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	72.273%	1.484%	0.224%	0.075%	0.000%	0.000%	0.056%	22.303%
Aa	1.313%	74.493%	4.363%	1.298%	0.176%	0.066%	0.133%	15.914%
A	0.157%	0.564%	73.936%	3.309%	0.984%	0.125%	0.355%	20.465%
Baa	0.065%	0.108%	0.477%	73.535%	7.457%	2.764%	2.553%	12.934%
Ba	0.014%	0.007%	0.117%	0.901%	68.903%	5.670%	11.552%	12.729%
B	0.000%	0.004%	0.005%	0.061%	0.145%	68.060%	18.659%	12.960%
Caa-C	0.000%	0.000%	0.000%	0.000%	0.015%	0.041%	68.674%	31.164%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%

Appendix 5 – 48: *CCRTM – Indonesia (Years 2001 – 2006)*

Year: 2001	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	69.834%	1.546%	0.233%	0.078%	0.000%	0.000%	0.059%	24.064%
Aa	1.090%	72.433%	4.598%	1.378%	0.187%	0.070%	0.141%	17.448%
A	0.124%	0.466%	71.730%	3.473%	1.038%	0.132%	0.375%	22.527%
Baa	0.051%	0.087%	0.394%	71.297%	7.859%	2.952%	2.748%	14.479%
Ba	0.011%	0.006%	0.093%	0.749%	66.557%	5.905%	12.287%	14.258%
B	0.000%	0.003%	0.004%	0.047%	0.117%	65.521%	19.667%	14.507%
Caa-C	0.000%	0.000%	0.000%	0.000%	0.011%	0.032%	66.118%	33.705%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 2002	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	88.304%	0.858%	0.127%	0.042%	0.000%	0.000%	0.032%	9.817%
Aa	5.229%	85.080%	2.295%	0.644%	0.086%	0.032%	0.064%	6.110%
A	0.926%	2.309%	86.437%	1.800%	0.513%	0.064%	0.182%	7.758%
Baa	0.445%	0.562%	1.971%	86.428%	3.928%	1.303%	1.126%	4.225%
Ba	0.120%	0.052%	0.665%	3.503%	82.568%	3.295%	5.647%	4.138%
B	0.000%	0.042%	0.043%	0.386%	0.733%	84.671%	9.877%	4.236%
Caa-C	0.000%	0.000%	0.000%	0.000%	0.129%	0.263%	85.768%	13.828%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 2003	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	94.164%	0.505%	0.074%	0.025%	0.000%	0.000%	0.019%	4.941%
Aa	10.663%	84.668%	1.272%	0.343%	0.045%	0.017%	0.034%	2.815%
A	2.405%	4.688%	87.872%	1.018%	0.282%	0.035%	0.099%	3.598%
Baa	1.263%	1.324%	4.021%	88.203%	2.181%	0.674%	0.558%	1.774%
Ba	0.394%	0.150%	1.656%	6.908%	84.217%	1.945%	2.996%	1.732%
B	0.000%	0.154%	0.136%	1.039%	1.696%	89.666%	5.528%	1.779%
Caa-C	0.000%	0.000%	0.000%	0.000%	0.419%	0.709%	91.738%	7.131%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 2004	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	91.306%	0.689%	0.102%	0.034%	0.000%	0.000%	0.025%	7.336%
Aa	7.304%	85.603%	1.794%	0.494%	0.066%	0.025%	0.049%	4.389%
A	1.443%	3.226%	87.732%	1.419%	0.400%	0.050%	0.141%	5.583%
Baa	0.721%	0.840%	2.761%	87.867%	3.071%	0.987%	0.837%	2.910%
Ba	0.208%	0.085%	1.018%	4.831%	84.033%	2.648%	4.325%	2.846%
B	0.000%	0.077%	0.073%	0.612%	1.086%	87.481%	7.747%	2.917%
Caa-C	0.000%	0.000%	0.000%	0.000%	0.222%	0.418%	88.923%	10.431%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 2005	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	91.576%	0.673%	0.099%	0.033%	0.000%	0.000%	0.025%	7.110%
Aa	7.547%	85.592%	1.746%	0.481%	0.064%	0.024%	0.048%	4.237%
A	1.508%	3.333%	87.805%	1.383%	0.389%	0.048%	0.137%	5.391%
Baa	0.757%	0.874%	2.853%	87.956%	2.990%	0.958%	0.811%	2.797%
Ba	0.219%	0.090%	1.062%	4.984%	84.117%	2.585%	4.203%	2.735%
B	0.000%	0.081%	0.077%	0.641%	1.129%	87.716%	7.545%	2.805%
Caa-C	0.000%	0.000%	0.000%	0.000%	0.234%	0.437%	89.201%	10.121%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 2006	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	96.840%	0.306%	0.045%	0.015%	0.000%	0.000%	0.011%	2.675%
Aa	16.966%	80.574%	0.736%	0.193%	0.025%	0.009%	0.019%	1.424%
A	4.577%	7.328%	85.419%	0.599%	0.163%	0.020%	0.057%	1.838%
Baa	2.569%	2.316%	6.306%	86.041%	1.263%	0.370%	0.296%	0.839%
Ba	0.894%	0.305%	3.028%	10.575%	81.522%	1.180%	1.678%	0.817%
B	0.002%	0.378%	0.297%	2.013%	2.924%	90.313%	3.231%	0.841%
Caa-C	0.000%	0.000%	0.000%	0.000%	0.946%	1.376%	93.716%	3.962%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%

Appendix 5 – 49: *CCRTM – Indonesia (Years 2007 – 2009)*

Year: 2007	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	95.619%	0.401%	0.059%	0.020%	0.000%	0.000%	0.015%	3.711%
Aa	13.452%	83.088%	0.987%	0.263%	0.035%	0.013%	0.026%	2.046%
A	3.309%	5.874%	87.070%	0.797%	0.219%	0.027%	0.076%	2.627%
Baa	1.795%	1.752%	5.047%	87.538%	1.693%	0.510%	0.416%	1.248%
Ba	0.590%	0.213%	2.238%	8.568%	83.338%	1.545%	2.289%	1.217%
B	0.001%	0.240%	0.200%	1.444%	2.228%	90.324%	4.310%	1.252%
Caa-C	0.000%	0.000%	0.000%	0.000%	0.626%	0.986%	92.966%	5.420%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 2008	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	95.293%	0.425%	0.062%	0.021%	0.000%	0.000%	0.016%	3.987%
Aa	12.728%	83.544%	1.052%	0.281%	0.037%	0.014%	0.028%	2.216%
A	3.066%	5.569%	87.332%	0.847%	0.233%	0.029%	0.082%	2.841%
Baa	1.649%	1.639%	4.783%	87.766%	1.805%	0.547%	0.448%	1.362%
Ba	0.535%	0.196%	2.083%	8.143%	83.627%	1.637%	2.449%	1.329%
B	0.001%	0.216%	0.182%	1.334%	2.088%	90.223%	4.588%	1.366%
Caa-C	0.000%	0.000%	0.000%	0.000%	0.569%	0.912%	92.713%	5.805%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 2009	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	84.721%	1.035%	0.154%	0.051%	0.000%	0.000%	0.039%	12.727%
Aa	3.682%	83.470%	2.842%	0.810%	0.109%	0.041%	0.082%	8.229%
A	0.586%	1.620%	84.169%	2.208%	0.637%	0.080%	0.227%	10.452%
Baa	0.270%	0.369%	1.380%	84.032%	4.861%	1.663%	1.464%	5.938%
Ba	0.068%	0.031%	0.426%	2.491%	80.037%	3.968%	7.131%	5.824%
B	0.000%	0.023%	0.025%	0.240%	0.486%	81.059%	12.193%	5.953%
Caa-C	0.000%	0.000%	0.000%	0.000%	0.074%	0.163%	81.931%	17.810%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%

Appendix V: CCRTM - Philippines

Appendix 5 – 50: CCRTM – Philippines (Years 1989 – 1994)

Year: 1989	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	88.089%	9.556%	1.807%	0.499%	0.048%	0.000%	0.000%	0.000%
Aa	0.681%	88.408%	9.107%	1.237%	0.349%	0.062%	0.000%	0.155%
A	0.034%	1.413%	89.076%	7.724%	1.224%	0.212%	0.040%	0.277%
Baa	0.016%	0.130%	2.533%	87.493%	7.889%	1.187%	0.129%	0.622%
Ba	0.008%	0.040%	0.223%	3.153%	85.431%	8.170%	0.735%	2.239%
B	0.000%	0.017%	0.065%	0.363%	4.153%	84.052%	5.027%	6.321%
Caa-C	0.000%	0.008%	0.017%	0.183%	0.817%	3.912%	75.314%	19.746%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 1990	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	88.264%	9.430%	1.773%	0.487%	0.046%	0.000%	0.000%	0.000%
Aa	0.698%	88.555%	8.982%	1.213%	0.341%	0.060%	0.000%	0.151%
A	0.036%	1.444%	89.191%	7.614%	1.200%	0.207%	0.039%	0.270%
Baa	0.017%	0.134%	2.584%	87.589%	7.778%	1.164%	0.127%	0.607%
Ba	0.008%	0.042%	0.229%	3.213%	85.530%	8.063%	0.722%	2.193%
B	0.000%	0.017%	0.067%	0.372%	4.227%	84.135%	4.967%	6.213%
Caa-C	0.000%	0.008%	0.018%	0.188%	0.835%	3.978%	75.467%	19.503%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 1991	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	68.107%	21.807%	6.765%	2.846%	0.475%	0.000%	0.000%	0.000%
Aa	0.075%	69.860%	21.798%	4.858%	1.807%	0.374%	0.000%	1.229%
A	0.002%	0.189%	72.489%	19.228%	4.860%	1.068%	0.216%	1.947%
Baa	0.001%	0.011%	0.404%	71.578%	19.280%	4.480%	0.577%	3.669%
Ba	0.000%	0.003%	0.021%	0.545%	68.932%	18.516%	2.267%	9.716%
B	0.000%	0.001%	0.005%	0.039%	0.789%	68.289%	10.249%	20.587%
Caa-C	0.000%	0.000%	0.001%	0.016%	0.106%	0.790%	54.726%	44.315%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 1992	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	77.557%	16.544%	4.208%	1.492%	0.199%	0.000%	0.000%	0.000%
Aa	0.193%	78.885%	16.214%	2.966%	0.987%	0.192%	0.000%	0.563%
A	0.007%	0.451%	80.864%	14.085%	2.954%	0.590%	0.116%	0.935%
Baa	0.003%	0.031%	0.899%	79.832%	14.230%	2.779%	0.335%	1.890%
Ba	0.001%	0.009%	0.058%	1.174%	77.478%	14.100%	1.527%	5.654%
B	0.000%	0.003%	0.015%	0.101%	1.635%	76.651%	8.159%	13.422%
Caa-C	0.000%	0.001%	0.003%	0.046%	0.257%	1.600%	64.677%	33.400%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 1993	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	70.525%	20.552%	6.080%	2.455%	0.388%	0.000%	0.000%	0.000%
Aa	0.095%	72.193%	20.446%	4.346%	1.574%	0.321%	0.000%	1.025%
A	0.003%	0.234%	74.685%	17.970%	4.344%	0.933%	0.188%	1.643%
Baa	0.001%	0.014%	0.494%	73.756%	18.052%	4.024%	0.510%	3.149%
Ba	0.000%	0.004%	0.027%	0.660%	71.178%	17.469%	2.077%	8.585%
B	0.000%	0.001%	0.006%	0.049%	0.947%	70.501%	9.775%	18.688%
Caa-C	0.000%	0.000%	0.001%	0.021%	0.133%	0.943%	57.246%	41.621%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 1994	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	86.793%	10.480%	2.072%	0.594%	0.060%	0.000%	0.000%	0.000%
Aa	0.571%	87.299%	10.029%	1.425%	0.412%	0.074%	0.000%	0.190%
A	0.027%	1.204%	88.188%	8.537%	1.411%	0.249%	0.047%	0.336%
Baa	0.013%	0.106%	2.195%	86.726%	8.705%	1.362%	0.151%	0.742%
Ba	0.006%	0.032%	0.185%	2.751%	84.644%	8.958%	0.829%	2.595%
B	0.000%	0.013%	0.053%	0.304%	3.654%	83.373%	5.463%	7.137%
Caa-C	0.000%	0.006%	0.014%	0.150%	0.696%	3.462%	74.132%	21.536%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%

Appendix 5 – 51: *CCRTM – Philippines (Years 1995 – 2000)*

Year: 1995	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	96.931%	2.698%	0.311%	0.057%	0.003%	0.000%	0.000%	0.000%
Aa	3.788%	93.485%	2.461%	0.202%	0.044%	0.007%	0.000%	0.013%
A	0.344%	6.427%	90.971%	2.002%	0.198%	0.027%	0.005%	0.027%
Baa	0.187%	0.933%	9.650%	86.860%	2.079%	0.201%	0.019%	0.071%
Ba	0.101%	0.354%	1.379%	11.078%	84.282%	2.306%	0.151%	0.349%
B	0.001%	0.186%	0.512%	2.014%	13.299%	81.111%	1.553%	1.323%
Caa-C	0.000%	0.101%	0.166%	1.217%	3.715%	11.658%	76.986%	6.156%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 1996	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	96.160%	3.340%	0.414%	0.081%	0.005%	0.000%	0.000%	0.000%
Aa	3.026%	93.546%	3.066%	0.272%	0.061%	0.009%	0.000%	0.019%
A	0.253%	5.292%	91.597%	2.509%	0.266%	0.038%	0.007%	0.038%
Baa	0.135%	0.720%	8.158%	87.992%	2.600%	0.269%	0.025%	0.100%
Ba	0.072%	0.265%	1.088%	9.479%	85.574%	2.856%	0.196%	0.471%
B	0.001%	0.135%	0.390%	1.614%	11.535%	82.718%	1.900%	1.707%
Caa-C	0.000%	0.072%	0.123%	0.950%	3.065%	10.227%	78.080%	7.483%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 1997	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	97.636%	2.100%	0.223%	0.039%	0.002%	0.000%	0.000%	0.000%
Aa	4.819%	93.092%	1.903%	0.144%	0.030%	0.004%	0.000%	0.008%
A	0.481%	7.900%	89.903%	1.536%	0.141%	0.018%	0.003%	0.017%
Baa	0.267%	1.232%	11.517%	85.180%	1.600%	0.144%	0.013%	0.048%
Ba	0.147%	0.482%	1.778%	13.041%	82.400%	1.794%	0.111%	0.247%
B	0.001%	0.266%	0.685%	2.550%	15.419%	78.870%	1.225%	0.984%
Caa-C	0.000%	0.147%	0.229%	1.589%	4.554%	13.341%	75.244%	4.896%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 1998	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	97.543%	2.180%	0.234%	0.041%	0.002%	0.000%	0.000%	0.000%
Aa	4.656%	93.170%	1.977%	0.151%	0.031%	0.005%	0.000%	0.009%
A	0.458%	7.672%	90.083%	1.598%	0.148%	0.019%	0.003%	0.018%
Baa	0.253%	1.184%	11.232%	85.452%	1.664%	0.151%	0.014%	0.051%
Ba	0.139%	0.461%	1.714%	12.744%	82.702%	1.862%	0.117%	0.260%
B	0.001%	0.253%	0.657%	2.466%	15.101%	79.225%	1.269%	1.028%
Caa-C	0.000%	0.139%	0.219%	1.529%	4.424%	13.092%	75.531%	5.066%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 1999	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	95.599%	3.801%	0.494%	0.100%	0.006%	0.000%	0.000%	0.000%
Aa	2.616%	93.445%	3.503%	0.325%	0.075%	0.012%	0.000%	0.025%
A	0.207%	4.661%	91.832%	2.879%	0.319%	0.046%	0.008%	0.048%
Baa	0.109%	0.608%	7.304%	88.524%	2.978%	0.321%	0.031%	0.124%
Ba	0.057%	0.220%	0.932%	8.551%	86.193%	3.251%	0.230%	0.565%
B	0.000%	0.109%	0.327%	1.397%	10.496%	83.530%	2.145%	1.996%
Caa-C	0.000%	0.057%	0.101%	0.808%	2.701%	9.371%	78.537%	8.424%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 2000	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	92.776%	6.049%	0.938%	0.220%	0.017%	0.000%	0.000%	0.000%
Aa	1.437%	92.026%	5.662%	0.629%	0.159%	0.026%	0.000%	0.060%
A	0.092%	2.751%	91.586%	4.723%	0.620%	0.097%	0.018%	0.113%
Baa	0.047%	0.305%	4.593%	89.249%	4.858%	0.613%	0.062%	0.273%
Ba	0.023%	0.103%	0.493%	5.535%	87.148%	5.176%	0.410%	1.111%
B	0.000%	0.047%	0.159%	0.769%	7.022%	85.165%	3.308%	3.529%
Caa-C	0.000%	0.023%	0.046%	0.417%	1.596%	6.435%	78.570%	12.913%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%

Appendix 5 – 52: *CCRTM – Philippines (Years 2001 – 2006)*

Year: 2001	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	92.018%	6.634%	1.068%	0.258%	0.021%	0.000%	0.000%	0.000%
Aa	1.254%	91.506%	6.231%	0.720%	0.186%	0.031%	0.000%	0.073%
A	0.077%	2.438%	91.292%	5.215%	0.709%	0.114%	0.021%	0.135%
Baa	0.038%	0.261%	4.127%	89.126%	5.356%	0.699%	0.072%	0.321%
Ba	0.019%	0.087%	0.427%	5.003%	87.051%	5.676%	0.461%	1.276%
B	0.000%	0.038%	0.135%	0.671%	6.393%	85.197%	3.602%	3.962%
Caa-C	0.000%	0.019%	0.039%	0.359%	1.414%	5.890%	78.216%	14.063%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 2002	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	91.344%	7.149%	1.188%	0.295%	0.025%	0.000%	0.000%	0.000%
Aa	1.118%	91.015%	6.733%	0.803%	0.211%	0.036%	0.000%	0.085%
A	0.066%	2.201%	90.984%	5.650%	0.792%	0.129%	0.024%	0.156%
Baa	0.033%	0.229%	3.768%	88.950%	5.796%	0.777%	0.081%	0.366%
Ba	0.016%	0.075%	0.378%	4.591%	86.889%	6.116%	0.507%	1.428%
B	0.000%	0.033%	0.118%	0.598%	5.902%	85.137%	3.858%	4.353%
Caa-C	0.000%	0.016%	0.033%	0.316%	1.276%	5.461%	77.827%	15.069%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 2003	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	91.937%	6.697%	1.082%	0.263%	0.021%	0.000%	0.000%	0.000%
Aa	1.236%	91.448%	6.292%	0.729%	0.189%	0.032%	0.000%	0.074%
A	0.076%	2.407%	91.257%	5.267%	0.719%	0.115%	0.021%	0.137%
Baa	0.038%	0.257%	4.081%	89.108%	5.409%	0.708%	0.073%	0.326%
Ba	0.019%	0.085%	0.421%	4.951%	87.035%	5.730%	0.466%	1.294%
B	0.000%	0.038%	0.133%	0.661%	6.331%	85.194%	3.633%	4.009%
Caa-C	0.000%	0.019%	0.038%	0.353%	1.396%	5.835%	78.173%	14.185%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 2004	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	91.281%	7.197%	1.199%	0.298%	0.025%	0.000%	0.000%	0.000%
Aa	1.106%	90.968%	6.780%	0.811%	0.213%	0.036%	0.000%	0.086%
A	0.065%	2.180%	90.953%	5.690%	0.800%	0.130%	0.024%	0.158%
Baa	0.032%	0.226%	3.736%	88.930%	5.838%	0.785%	0.082%	0.370%
Ba	0.016%	0.074%	0.374%	4.555%	86.870%	6.157%	0.511%	1.443%
B	0.000%	0.032%	0.117%	0.591%	5.859%	85.128%	3.882%	4.390%
Caa-C	0.000%	0.016%	0.033%	0.312%	1.264%	5.423%	77.788%	15.163%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 2005	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	93.279%	5.657%	0.854%	0.196%	0.015%	0.000%	0.000%	0.000%
Aa	1.579%	92.348%	5.283%	0.571%	0.142%	0.023%	0.000%	0.053%
A	0.105%	2.991%	91.742%	4.397%	0.563%	0.087%	0.016%	0.100%
Baa	0.053%	0.341%	4.947%	89.277%	4.526%	0.557%	0.056%	0.243%
Ba	0.027%	0.116%	0.546%	5.935%	87.152%	4.840%	0.377%	1.006%
B	0.000%	0.053%	0.178%	0.845%	7.493%	85.074%	3.109%	3.247%
Caa-C	0.000%	0.027%	0.052%	0.463%	1.735%	6.839%	78.744%	12.139%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 2006	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	94.501%	4.689%	0.658%	0.142%	0.010%	0.000%	0.000%	0.000%
Aa	2.027%	93.027%	4.351%	0.437%	0.105%	0.017%	0.000%	0.037%
A	0.147%	3.728%	91.951%	3.599%	0.430%	0.064%	0.011%	0.071%
Baa	0.076%	0.454%	6.007%	89.103%	3.714%	0.429%	0.042%	0.176%
Ba	0.039%	0.159%	0.711%	7.122%	86.895%	4.012%	0.298%	0.764%
B	0.000%	0.076%	0.241%	1.084%	8.869%	84.543%	2.611%	2.576%
Caa-C	0.000%	0.039%	0.072%	0.610%	2.162%	8.010%	78.892%	10.214%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%

Appendix 5 – 53: *CCRTM – Philippines (Years 2007 – 2009)*

Year: 2007	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	93.571%	5.427%	0.806%	0.182%	0.013%	0.000%	0.000%	0.000%
Aa	1.672%	92.525%	5.061%	0.538%	0.133%	0.022%	0.000%	0.049%
A	0.113%	3.146%	91.816%	4.207%	0.530%	0.082%	0.015%	0.092%
Baa	0.058%	0.364%	5.173%	89.269%	4.333%	0.526%	0.053%	0.226%
Ba	0.029%	0.125%	0.580%	6.189%	87.129%	4.644%	0.358%	0.946%
B	0.000%	0.058%	0.191%	0.895%	7.789%	84.990%	2.992%	3.085%
Caa-C	0.000%	0.029%	0.056%	0.493%	1.825%	7.093%	78.818%	11.685%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 2008	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	89.388%	8.610%	1.552%	0.412%	0.038%	0.000%	0.000%	0.000%
Aa	0.822%	89.486%	8.169%	1.057%	0.291%	0.050%	0.000%	0.124%
A	0.044%	1.672%	89.904%	6.902%	1.045%	0.177%	0.033%	0.224%
Baa	0.021%	0.161%	2.947%	88.170%	7.061%	1.018%	0.109%	0.513%
Ba	0.010%	0.051%	0.272%	3.639%	86.120%	7.364%	0.642%	1.901%
B	0.000%	0.021%	0.082%	0.439%	4.750%	84.612%	4.573%	5.521%
Caa-C	0.000%	0.010%	0.022%	0.225%	0.968%	4.445%	76.414%	17.913%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 2009	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	89.747%	8.345%	1.483%	0.389%	0.035%	0.000%	0.000%	0.000%
Aa	0.867%	89.776%	7.908%	1.009%	0.275%	0.048%	0.000%	0.116%
A	0.047%	1.755%	90.118%	6.673%	0.997%	0.167%	0.031%	0.211%
Baa	0.023%	0.171%	3.077%	88.337%	6.831%	0.973%	0.104%	0.484%
Ba	0.011%	0.055%	0.288%	3.792%	86.288%	7.138%	0.617%	1.811%
B	0.000%	0.023%	0.087%	0.463%	4.936%	84.740%	4.445%	5.303%
Caa-C	0.000%	0.011%	0.024%	0.239%	1.016%	4.610%	76.698%	17.399%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%

Appendix V: CCRTM - Malaysia

Appendix 5 – 54: CCRTM – Malaysia (Years 1989 – 1994)

Year: 1989	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	89.064%	8.848%	1.615%	0.433%	0.040%	0.000%	0.000%	0.000%
Aa	0.783%	89.221%	8.405%	1.102%	0.305%	0.053%	0.000%	0.132%
A	0.041%	1.602%	89.704%	7.108%	1.089%	0.185%	0.034%	0.237%
Baa	0.020%	0.153%	2.836%	88.011%	7.268%	1.060%	0.114%	0.539%
Ba	0.010%	0.048%	0.259%	3.509%	85.959%	7.567%	0.665%	1.984%
B	0.000%	0.020%	0.077%	0.418%	4.591%	84.485%	4.688%	5.719%
Caa-C	0.000%	0.010%	0.021%	0.213%	0.927%	4.303%	76.149%	18.375%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 1990	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	68.383%	21.667%	6.686%	2.800%	0.464%	0.000%	0.000%	0.000%
Aa	0.077%	70.127%	21.646%	4.798%	1.779%	0.368%	0.000%	1.204%
A	0.002%	0.193%	72.741%	19.087%	4.800%	1.053%	0.213%	1.910%
Baa	0.001%	0.011%	0.414%	71.829%	19.142%	4.427%	0.570%	3.608%
Ba	0.000%	0.003%	0.022%	0.557%	69.190%	18.400%	2.245%	9.583%
B	0.000%	0.001%	0.005%	0.040%	0.806%	68.544%	10.197%	20.367%
Caa-C	0.000%	0.000%	0.001%	0.017%	0.109%	0.806%	55.012%	44.011%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 1991	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	77.480%	16.590%	4.228%	1.502%	0.200%	0.000%	0.000%	0.000%
Aa	0.192%	78.813%	16.263%	2.980%	0.993%	0.193%	0.000%	0.567%
A	0.007%	0.447%	80.798%	14.129%	2.968%	0.593%	0.116%	0.941%
Baa	0.003%	0.031%	0.893%	79.769%	14.274%	2.792%	0.337%	1.902%
Ba	0.001%	0.008%	0.058%	1.166%	77.411%	14.139%	1.533%	5.683%
B	0.000%	0.003%	0.015%	0.100%	1.625%	76.587%	8.178%	13.477%
Caa-C	0.000%	0.001%	0.003%	0.045%	0.256%	1.590%	64.595%	33.493%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 1992	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	94.501%	4.689%	0.658%	0.142%	0.010%	0.000%	0.000%	0.000%
Aa	2.027%	93.027%	4.350%	0.437%	0.105%	0.017%	0.000%	0.037%
A	0.147%	3.728%	91.951%	3.599%	0.430%	0.064%	0.011%	0.071%
Baa	0.076%	0.454%	6.007%	89.103%	3.714%	0.429%	0.042%	0.176%
Ba	0.039%	0.159%	0.711%	7.122%	86.894%	4.011%	0.298%	0.764%
B	0.000%	0.076%	0.241%	1.084%	8.869%	84.543%	2.611%	2.576%
Caa-C	0.000%	0.039%	0.072%	0.610%	2.162%	8.011%	78.892%	10.213%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 1993	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	97.072%	2.579%	0.293%	0.053%	0.003%	0.000%	0.000%	0.000%
Aa	3.963%	93.438%	2.350%	0.190%	0.041%	0.006%	0.000%	0.012%
A	0.366%	6.681%	90.804%	1.908%	0.186%	0.025%	0.004%	0.025%
Baa	0.200%	0.983%	9.978%	86.583%	1.984%	0.190%	0.017%	0.066%
Ba	0.109%	0.375%	1.446%	11.425%	83.971%	2.204%	0.143%	0.328%
B	0.001%	0.199%	0.541%	2.105%	13.678%	80.734%	1.488%	1.254%
Caa-C	0.000%	0.108%	0.176%	1.280%	3.860%	11.962%	76.707%	5.907%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 1994	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	98.231%	1.588%	0.155%	0.025%	0.001%	0.000%	0.000%	0.000%
Aa	6.147%	92.298%	1.429%	0.099%	0.019%	0.003%	0.000%	0.005%
A	0.677%	9.711%	88.346%	1.145%	0.096%	0.012%	0.002%	0.011%
Baa	0.384%	1.633%	13.715%	82.934%	1.196%	0.099%	0.009%	0.031%
Ba	0.216%	0.661%	2.295%	15.306%	79.918%	1.356%	0.080%	0.169%
B	0.002%	0.382%	0.922%	3.232%	17.805%	76.009%	0.939%	0.709%
Caa-C	0.000%	0.216%	0.319%	2.078%	5.575%	15.188%	72.830%	3.794%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%

Appendix 5 – 55: *CCRTM – Malaysia (Years 1995 – 2000)*

Year: 1995	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	99.257%	0.684%	0.052%	0.007%	0.000%	0.000%	0.000%	0.000%
Aa	11.300%	88.057%	0.603%	0.032%	0.006%	0.001%	0.000%	0.001%
A	1.628%	16.043%	81.818%	0.473%	0.032%	0.004%	0.001%	0.003%
Baa	0.979%	3.306%	20.738%	74.434%	0.498%	0.033%	0.003%	0.009%
Ba	0.584%	1.467%	4.322%	22.215%	70.747%	0.582%	0.029%	0.055%
B	0.009%	0.971%	1.940%	5.777%	24.704%	65.912%	0.418%	0.268%
Caa-C	0.001%	0.583%	0.735%	4.060%	9.061%	20.212%	63.590%	1.756%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 1996	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	99.083%	0.839%	0.068%	0.009%	0.000%	0.000%	0.000%	0.000%
Aa	9.893%	89.311%	0.743%	0.042%	0.008%	0.001%	0.000%	0.002%
A	1.340%	14.406%	83.617%	0.586%	0.041%	0.005%	0.001%	0.004%
Baa	0.795%	2.834%	19.012%	76.685%	0.616%	0.043%	0.004%	0.012%
Ba	0.468%	1.231%	3.768%	20.562%	73.147%	0.715%	0.037%	0.072%
B	0.007%	0.789%	1.648%	5.097%	23.107%	68.502%	0.509%	0.339%
Caa-C	0.001%	0.467%	0.612%	3.509%	8.174%	19.095%	66.024%	2.118%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 1997	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	98.487%	1.365%	0.127%	0.020%	0.001%	0.000%	0.000%	0.000%
Aa	6.948%	91.727%	1.223%	0.081%	0.015%	0.002%	0.000%	0.004%
A	0.806%	10.761%	87.359%	0.976%	0.079%	0.010%	0.002%	0.008%
Baa	0.462%	1.882%	14.948%	81.575%	1.021%	0.081%	0.007%	0.024%
Ba	0.263%	0.775%	2.609%	16.554%	78.430%	1.164%	0.066%	0.138%
B	0.003%	0.459%	1.070%	3.637%	19.094%	74.329%	0.812%	0.594%
Caa-C	0.000%	0.263%	0.377%	2.379%	6.162%	16.164%	71.352%	3.303%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 1998	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	96.790%	2.816%	0.329%	0.062%	0.004%	0.000%	0.000%	0.000%
Aa	3.627%	93.518%	2.572%	0.215%	0.047%	0.007%	0.000%	0.014%
A	0.324%	6.190%	91.119%	2.094%	0.210%	0.029%	0.005%	0.029%
Baa	0.175%	0.887%	9.344%	87.110%	2.175%	0.213%	0.020%	0.076%
Ba	0.095%	0.334%	1.317%	10.751%	84.566%	2.407%	0.159%	0.370%
B	0.001%	0.175%	0.486%	1.930%	12.942%	81.458%	1.617%	1.392%
Caa-C	0.000%	0.095%	0.157%	1.160%	3.580%	11.370%	77.237%	6.401%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 1999	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	92.790%	6.038%	0.935%	0.219%	0.017%	0.000%	0.000%	0.000%
Aa	1.440%	92.035%	5.652%	0.628%	0.159%	0.026%	0.000%	0.060%
A	0.093%	2.757%	91.590%	4.715%	0.618%	0.097%	0.018%	0.113%
Baa	0.047%	0.306%	4.602%	89.251%	4.849%	0.611%	0.062%	0.272%
Ba	0.024%	0.103%	0.495%	5.545%	87.149%	5.167%	0.409%	1.108%
B	0.000%	0.047%	0.160%	0.770%	7.034%	85.164%	3.303%	3.522%
Caa-C	0.000%	0.024%	0.046%	0.418%	1.599%	6.445%	78.575%	12.892%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 2000	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	94.014%	5.077%	0.735%	0.163%	0.012%	0.000%	0.000%	0.000%
Aa	1.828%	92.778%	4.723%	0.489%	0.119%	0.019%	0.000%	0.043%
A	0.128%	3.404%	91.902%	3.917%	0.481%	0.073%	0.013%	0.082%
Baa	0.065%	0.403%	5.546%	89.219%	4.038%	0.479%	0.048%	0.202%
Ba	0.034%	0.140%	0.638%	6.608%	87.050%	4.344%	0.329%	0.858%
B	0.000%	0.065%	0.213%	0.978%	8.276%	84.815%	2.812%	2.841%
Caa-C	0.000%	0.034%	0.063%	0.544%	1.975%	7.508%	78.887%	10.988%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%

Appendix 5 – 56: *CCRTM – Malaysia (Years 2001 – 2006)*

Year: 2001	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	94.988%	4.297%	0.584%	0.123%	0.008%	0.000%	0.000%	0.000%
Aa	2.260%	93.241%	3.976%	0.386%	0.091%	0.014%	0.000%	0.031%
A	0.170%	4.102%	91.944%	3.280%	0.380%	0.056%	0.010%	0.060%
Baa	0.088%	0.514%	6.532%	88.908%	3.388%	0.380%	0.037%	0.152%
Ba	0.046%	0.183%	0.798%	7.703%	86.652%	3.676%	0.268%	0.674%
B	0.000%	0.088%	0.274%	1.208%	9.535%	84.171%	2.406%	2.316%
Caa-C	0.000%	0.046%	0.084%	0.688%	2.379%	8.570%	78.806%	9.427%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 2002	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	90.579%	7.725%	1.327%	0.339%	0.029%	0.000%	0.000%	0.000%
Aa	0.987%	90.434%	7.298%	0.900%	0.241%	0.041%	0.000%	0.099%
A	0.056%	1.970%	90.590%	6.141%	0.888%	0.147%	0.027%	0.181%
Baa	0.028%	0.199%	3.413%	88.686%	6.293%	0.869%	0.092%	0.421%
Ba	0.014%	0.064%	0.331%	4.181%	86.634%	6.609%	0.559%	1.608%
B	0.000%	0.028%	0.102%	0.527%	5.408%	84.986%	4.143%	4.804%
Caa-C	0.000%	0.014%	0.028%	0.275%	1.141%	5.028%	77.318%	16.194%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 2003	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	93.130%	5.774%	0.879%	0.203%	0.015%	0.000%	0.000%	0.000%
Aa	1.535%	92.255%	5.395%	0.588%	0.147%	0.024%	0.000%	0.055%
A	0.101%	2.917%	91.699%	4.494%	0.579%	0.090%	0.016%	0.104%
Baa	0.051%	0.330%	4.838%	89.274%	4.625%	0.574%	0.058%	0.251%
Ba	0.026%	0.112%	0.529%	5.812%	87.157%	4.940%	0.387%	1.037%
B	0.000%	0.051%	0.172%	0.821%	7.348%	85.108%	3.168%	3.330%
Caa-C	0.000%	0.026%	0.050%	0.448%	1.692%	6.715%	78.698%	12.370%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 2004	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	92.338%	6.388%	1.013%	0.242%	0.019%	0.000%	0.000%	0.000%
Aa	1.327%	91.730%	5.992%	0.681%	0.174%	0.029%	0.000%	0.067%
A	0.083%	2.563%	91.424%	5.008%	0.671%	0.107%	0.019%	0.125%
Baa	0.042%	0.279%	4.314%	89.189%	5.146%	0.662%	0.068%	0.300%
Ba	0.021%	0.093%	0.453%	5.218%	87.104%	5.466%	0.439%	1.205%
B	0.000%	0.042%	0.145%	0.710%	6.648%	85.198%	3.479%	3.779%
Caa-C	0.000%	0.021%	0.041%	0.382%	1.487%	6.111%	78.378%	13.580%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 2005	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	91.193%	7.264%	1.215%	0.303%	0.025%	0.000%	0.000%	0.000%
Aa	1.090%	90.902%	6.845%	0.822%	0.217%	0.037%	0.000%	0.087%
A	0.064%	2.152%	90.909%	5.747%	0.811%	0.132%	0.024%	0.160%
Baa	0.032%	0.223%	3.693%	88.902%	5.895%	0.795%	0.083%	0.377%
Ba	0.016%	0.073%	0.368%	4.506%	86.844%	6.214%	0.517%	1.463%
B	0.000%	0.032%	0.114%	0.583%	5.799%	85.114%	3.915%	4.442%
Caa-C	0.000%	0.016%	0.032%	0.307%	1.248%	5.371%	77.732%	15.293%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 2006	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	92.157%	6.528%	1.044%	0.251%	0.020%	0.000%	0.000%	0.000%
Aa	1.285%	91.604%	6.128%	0.703%	0.181%	0.030%	0.000%	0.070%
A	0.080%	2.491%	91.350%	5.125%	0.693%	0.111%	0.020%	0.131%
Baa	0.040%	0.269%	4.206%	89.155%	5.265%	0.683%	0.070%	0.312%
Ba	0.020%	0.090%	0.438%	5.094%	87.076%	5.585%	0.452%	1.245%
B	0.000%	0.040%	0.139%	0.687%	6.501%	85.200%	3.549%	3.882%
Caa-C	0.000%	0.020%	0.040%	0.368%	1.445%	5.984%	78.288%	13.854%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%

Appendix 5 – 57: *CCRTM – Malaysia (Years 2007 – 2009)*

Year: 2007	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	93.208%	5.712%	0.865%	0.199%	0.015%	0.000%	0.000%	0.000%
Aa	1.558%	92.304%	5.336%	0.579%	0.145%	0.024%	0.000%	0.054%
A	0.103%	2.956%	91.722%	4.443%	0.570%	0.089%	0.016%	0.102%
Baa	0.052%	0.335%	4.895%	89.276%	4.573%	0.565%	0.057%	0.247%
Ba	0.026%	0.114%	0.538%	5.877%	87.155%	4.887%	0.382%	1.021%
B	0.000%	0.052%	0.176%	0.834%	7.424%	85.091%	3.137%	3.286%
Caa-C	0.000%	0.026%	0.051%	0.456%	1.715%	6.781%	78.723%	12.248%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 2008	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	95.057%	4.241%	0.573%	0.120%	0.008%	0.000%	0.000%	0.000%
Aa	2.296%	93.268%	3.923%	0.379%	0.089%	0.014%	0.000%	0.030%
A	0.173%	4.159%	91.937%	3.235%	0.373%	0.055%	0.010%	0.059%
Baa	0.091%	0.524%	6.612%	88.873%	3.342%	0.373%	0.036%	0.149%
Ba	0.047%	0.187%	0.812%	7.791%	86.610%	3.629%	0.263%	0.661%
B	0.000%	0.090%	0.280%	1.227%	9.635%	84.110%	2.377%	2.280%
Caa-C	0.000%	0.047%	0.085%	0.700%	2.412%	8.654%	78.786%	9.316%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%
Year: 2009	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	90.011%	8.150%	1.433%	0.373%	0.033%	0.000%	0.000%	0.000%
Aa	0.903%	89.987%	7.716%	0.974%	0.264%	0.045%	0.000%	0.111%
A	0.050%	1.819%	90.272%	6.505%	0.962%	0.161%	0.030%	0.201%
Baa	0.024%	0.180%	3.178%	88.454%	6.661%	0.940%	0.100%	0.464%
Ba	0.012%	0.058%	0.301%	3.909%	86.405%	6.971%	0.599%	1.746%
B	0.000%	0.024%	0.091%	0.482%	5.079%	84.827%	4.350%	5.144%
Caa-C	0.000%	0.012%	0.025%	0.250%	1.054%	4.737%	76.901%	17.020%
Default	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	100.000%