The 25th International Symposium
on Automation and Robotics in Construction

June 26–29, 2008

ISARC-2008

**Institute of Internet and Intelligent Technologies**
Vilnius Gediminas Technical University
Saulėtekio al. 11, 10223 Vilnius, Lithuania
*http://www.isarc2008.vgtu.lt/*

# MODELLING COUNTRY RELIABILITY IN PUBLIC PRIVATE PARTNERSHIP INFRASTRUCTURE PROEJCTS

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**ABSTRACT**

Most Public Private Partnership (PPP) infrastructure projects especially in emerging markets carry a high amount of economic foreign exchange (FX) exposure. Risk mitigation instruments (RMI) are frequently implemented by governments to compensate FX loss in the Special Purpose Company (SPC). The experience of many investors is an underestimation of the risk that governments would refuse to readjust the contracts after or during a currency devaluation period. Therefore the value of the RMI depends on the affordability and the willingness of the government to compensate FX loss. Factors influencing country reliability can be identified in the government ability to repay debt obligations, liquidity difficulties and political difficulties. The overall objective of this paper is to analyze RMI instruments and to design a methodology to measure country reliability on RMI. The model has a dynamic framework which requires input data that are based on indicators and proxies. The focus however is on the micro-economic level. The purpose is to evaluate the impact of economic FX exposure on the cash flow of infrastructure projects designed under long term concession contracts. The methodology can be applied to support financial decisions and strategies in funding PPP infrastructure. Furthermore the outcome has an important impact on the evaluation of selected risk mitigating instruments (RMI) and the estimation of the necessary FX protection.

**KEYWORDS**

Public Private Partnership, Risk mitigation, Foreign exchange, Cash flow modelling

## 1. INTRODUCTION

Since the Asian financial crises, lenders and investors have been concerned with foreign exchange (FX) risk as well as the convertibility and transfer risk. It can significantly affect the project's internal rate of return (IRR) and net present value (NPV) of a special purpose company (SPC). 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 [4]. 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. The experience of investors is that contractual arrangements for infrastructure projects have been broken or renegotiated frequently. Furthermore Matsukawa et al. [6] state 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.

Especially in developing markets most PPP projects face the FX risk because they typically sell their outputs domestically and generate revenues in local currency, while their financing costs and O&M costs, e.g. fuel costs are denominated in U.S. dollars or other hard currencies. The FX exposure in Public Private Partnership (PPP) projects can be seen 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. Boey [1] states that the priority of the FX risk and political risks are rated equivalent by foreign lenders and equity investors. As long as the risk mitigation of the FX risk is not possible, investors are unable and unwilling to carry the risk at a competitive price level. According to Gray et al. [3] and Matsukawa et al. [6] investors will expect a higher rate of return on their investments as a compensation for bearing the FX risk. This compensation can be realized by incorporating a risk premium into the expected rate of return on investment or can be achieved by providing subsidies in construction costs or by implementing higher tariff rates.

### 1.1. FX risk allocation to the host country government

The host country government can be differentiated into three categories of (i) national government, (ii) local government, and (iii) contracting authority. Based on the type of infrastructure the relevant subcategory 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 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 fulfillments like compensational payments and tariff adjustment. 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 occasion to allocate the FX risk in full extent to the host government. In addition, the government has an informational advantage compared to all the other shareholders. Governments have 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 compensational payments, and (vi) the delay in tariff adjustment or other agreed risk mitigation instruments.

Investors can choose the country, sector, and project they will invest in. 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 the FX risk protection. Several mechanisms can be provided at the country level if long-term local debt is not available and derivative markets do not exist to mitigate the FX risk exposure. The most common RMI are (i) fixed exchange rate, (ii) exchange rate guarantees, (iii) public sector lending in local currency, (iv) local lending by Multi Lateral Agencies, (v) local currency fund schemes, (vi) partial credit guarantees, (vii) partial risk guarantee and political risk insurance, (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.

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 Matsukawa et al. [6], 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 compared to the project finance loan durations.

Exchange rates guarantees could be provided by the government and can protect lenders, sponsors, off-taker and consumers from cost increases caused by currency devaluation. The guarantee can mitigate the risk of government interventions to restrict currency convertibility and transfer. Government guarantee can also be written on the principal repayment of foreign currency loans.

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 et al. [6], the spread can be used between foreign currency fixed-interest rate loan and the local currency loan on-lending rate 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.

Partial credit guarantees (PRG) facilitate financing especially in situations where the borrower can access the local credit market but cannot realize sufficient long tenors. The guarantee can be used to cover later maturity payments or a certain amount of debt service payments over the duration of the credit.

Partial risk guarantees (PRG) and political risk insurances can be applied in structured finance transactions with the purpose to mobilize long-term local currency funding. The facility 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 [6]. PRG can also be used to guarantee the performance of regulatory agreements.

IFC and 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 would use initial capitalization in example reserve funds and issue bonds in the capital market. They lend the bonds to infrastructure projects and use the reserve fund in securing bond debt service payments [6].

Multi lateral agencies (MLA) also seek opportunities to lend local currency loans to infrastructure projects. Local currency loans are most likely available in currencies where cross currency swaps can be established to hedge the MLA exposure. Therefore it requires a swap counterparty that the donor can raise funds in the same currency in order to match its exposure.

According Outreville [7] governments of many developing countries historically held the view that the financial systems cannot serve their country development needs adequately. The financing need of infrastructure exceeds the local market capacity while the development of local capital markets is far beyond what government's 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.

Furthermore empirical work illustrates the close ties between financial and economic development [5]. 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 had put in considerable efforts to change the structure of these financial systems. However the development of a bank market offering long-term loans in 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, transfers the FX risk simply from the borrower back to the lender.

### FX risk allocation to the offtaker

Offtakers are often government owned companies. They are the buyers of the goods produced by the infrastructure. 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 hard currency payments 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 by the 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 currency devaluation periods, (ii) the willingness of the offtaker to adjust tariffs or to pay compensational payments, (iii) the feasibility of the offtaker to pay for the contractual payments during currency devaluation periods, and (iv) the risk that similar guarantees will be provided to other infrastructure projects which will increase the government overall risk exposure and make all guarantees less creditworthy by the possibility of multiple calls.

## 2. MODELLING COUNTRY RELIABILITY

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 1 is designed to evaluate risk mitigation instruments. The value of a risk mitigation instrument depends on the affordability and willingness of the government to compensate contingent claims on RMI.

Figure 1 shows the core structure of the model. The left side shows the face value of the RMI and the probability of currency devaluation resulting in a contingent claim. On the right side, the country reliability index is developed and modelled in a Conditional Country Rating Transition Matrix (CCRTM) to predict the FX risk mitigation probability.

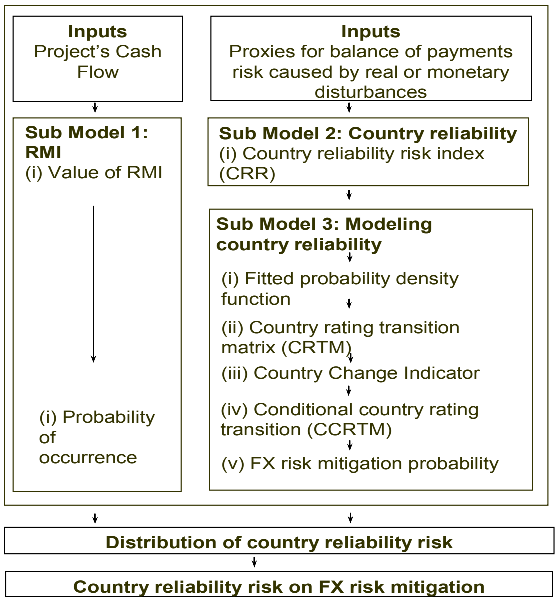


Figure 1. Country reliability risk model

Factors influencing country reliability can be identified in the government ability to repay debt obligations, liquidity difficulties and political difficulties. According Ciarrapico, [2] proxies for country risk regarding payment feasibility may be found in indicators like balance-of-payment difficulties, liquidity difficulties and political difficulties. As significant explanatory variables, Ciarrapico [2] chose the four proxies for country reliability risk evaluation: (i) growth of exports, (ii) growth of money supply, (iii) growth of international reserves, and (iv) growth of imports/reserves. Firstly, the growth of exports proxy measures balance-of-payments risk due to real disturbances. Secondly, the growth of money supply serves as proxy for balance-of-payments difficulties due to monetary risk. Thirdly, the growth of international reserves and fourthly the growth of imports/reserves serve as a proxy for liquidity risk.

To compute the CRR index it is important to transfer the variables into dimensionless ratios. The proxies chosen to develop the CRR index include (i) domestic debt to GDP, (ii) reserves to imports, (iii) debt service to exports, and (iv) M2 to foreign reserves. All ratios focus on the balance of payments risk caused by real or monetary disturbances. Ratio one and two are considered as solvency variables and ratio three and four as liquidity variables. The proxies help to obtain to easily generate and aggregate an opinion. The mechanism to summarize the four indicators in the country reliability risk (CRR) index is shown in formula one as follow:

$$CRR = -(1/\sigma_{D/GDP})*(\frac{\Delta D/GDP_t}{D/GDP_t}) + (1/\sigma_{R/I})*(\frac{\Delta R/I_t}{R/I_t}) +$$
$$+ (1/\sigma_{DS/E})*(\frac{\Delta DS/E_t}{DS/E_t}) + (1/\sigma_{M2/FR})*(\frac{\Delta M2/FR_t}{M2/FR_t})$$

(equation 1)

where $\sigma_{D/GDP}$ is the standard deviation (SD) of domestic debt to GDP, $\sigma_{R/I}$ is the SD of reserves to imports, $\sigma_{DS/E}$ is the SD of debt service to exports, $\sigma_{M2/FR}$ is the SD of M2 to foreign reserves. All data can be obtained from the IMF-IFS database.

Figure 2 illustrate the CRR index in the case of the Philippines. Positive values illustrate a higher reliability and strength than negative values. The purpose of the index is to evaluate risk mitigation instruments. Therefore the proxies chosen for the CRR index focus on the balance of payments risk caused by real or monetary disturbances. Figure 3 illustrates the fitted density function of the index in the case of the Philippines.

The normal distribution is fitted on the historical CRR index. The index covers 250 data points from 1988 to 2007.

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 $\lambda^t_{i,j}$ :

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

(equation 2)

The Country Rating Transition Matrix at time t, $\Omega^t$ can thus be represented by elements of $\lambda^t_{i,j}$ :

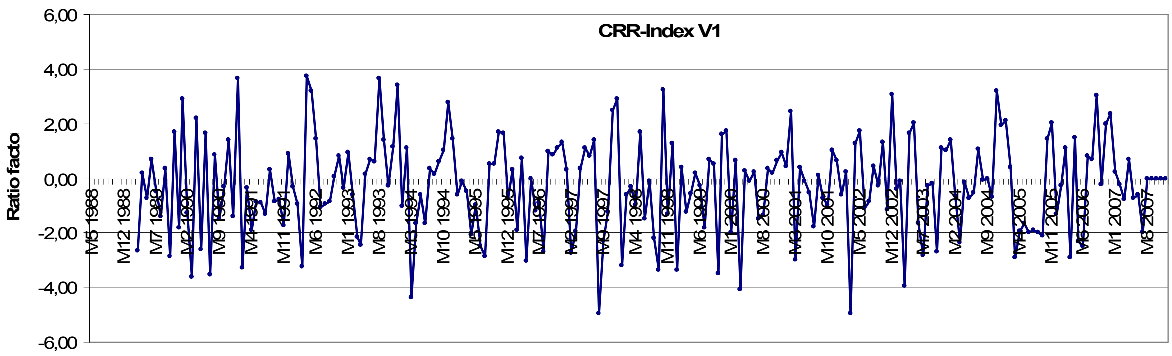


Figure 2. CRR index – Philippines

**Table 1.** Moody's rating migration and credit quality correlation 1920-1996

| | 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% |

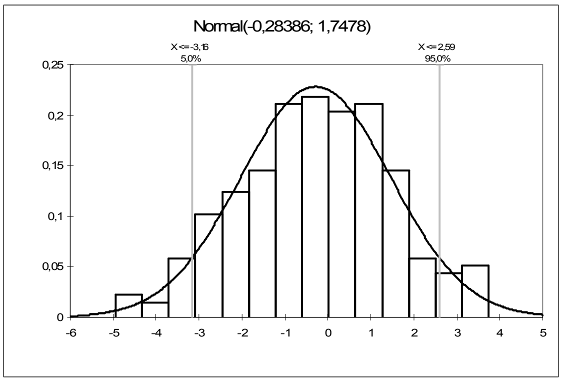


Figure 3. Fitted CRR index,-Philippines

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

(equation 3)

The *j* column of the matrix $\Omega^t$ can also be conveniently labelled as $\Omega^t_j$. As general country rating transition matrix (CRTM) Moody's rating migration and credit quality correlation 1920–1996 is implemented as shown in Table 1.

If it is positive, it is more possible to transit to higher reliability rating grade; if it is negative, it is more possible to transit to lower reliability rating grade. Based on the CRTM probabilities the z-value of the fitted normal density function of the CRR index is computed. With the z value of the fitted normal distribution plus the CRR index it is possible to derive the conditional country rating transition (CCRTM) matrix as shown in equation 4:

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

(equation 4)

where *y* is element of the CRTM and the z-value is substituting the annual CRR index. The CRR index is therefore used as country change indicator and a shift of the probability density function of ratings towards better or poorer country stages. As shown in Figure 4 a positive CRR index shifts the transition towards better country reliability condition, while a negative shifts the transition towards poorer country reliability condition.

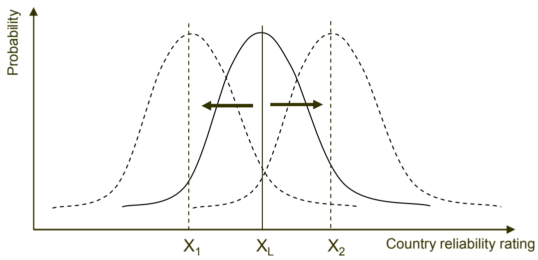


Figure 4. CRR index with effect on country reliability rating transition

Like shown in equation 5 the country reliability state $\alpha_t$ depends on the CCRTM and the distribution of the previous state vector.

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

(equation 5)

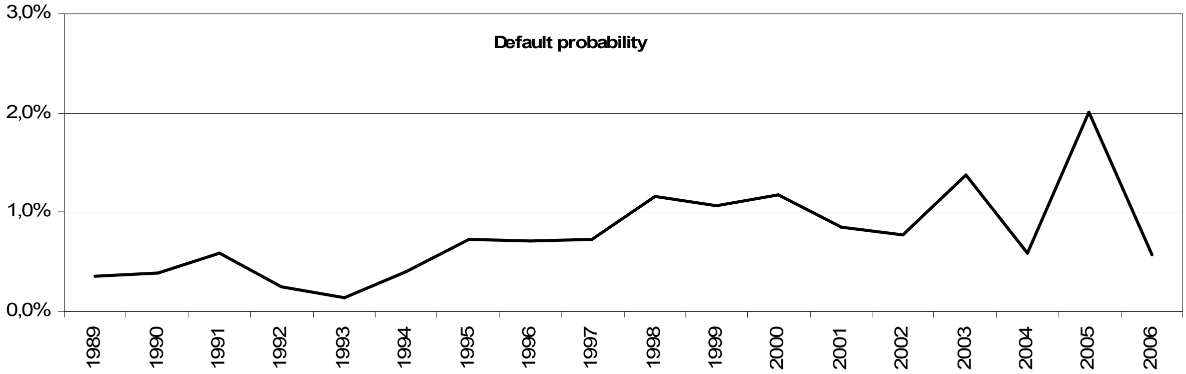


Figure 4. Default probability

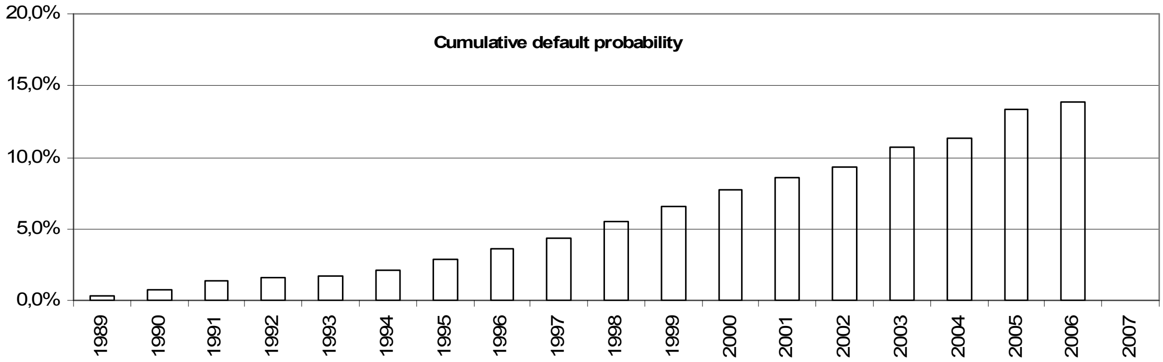


Figure 5. Cumulative default probability

It also follows that:

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

(equation 6)

If $\alpha_0$ the initial country reliability and $\Omega^t$ the CRTM are known, the country reliability can be calculated for every time period. Figure 4 and 5 show the default probability risk on RMI in the Philippines.

## 3. CONCLUSION

This research analyzes country reliability on RMI in PPP projects by incorporating the developed CRR index into a Country Rating Transition Matrix. The CRR model can estimate the conditional transition matrix and improves the prediction of government reliability on RMI. 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 RMI. The model has a dynamic framework which requires input data that are based on indicators and proxies. It can be applied to support financial strategies in funding PPP infrastructure. It helps investors to evaluate RMI and to estimate the necessary FX protection and prevents underestimation of the risk that governments would refuse to readjust the contracts after or during a currency devaluation period. The model can be applied to infrastructure projects as power, water or transportation.

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