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Developing a Risk Management Framework for the Philippine Government

by

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Abstract

The rationale for this paper is the increasing amount of risk that the Philippine government has been assuming in the last ten years, primarily in the development of various modalities for encouraging private sector participation in infrastructure development and the provision of guarantees for loans of government-owned and controlled corporations (GOCCs). The Philippine government is often not prepared to deal with the financial and non-financial consequences of calls on such guarantees, some of which are triggered by circumstances under its control. With better coordination among line agencies, the DoF, and the BSP, better project preparation, and more prudent provision of guarantees, the large costs of state support could have been avoided. Henceforth, one of the major objectives of this task is to quantify the amount of risk that the government assumes in such activities using conventional scientific and statistical methods presently being employed by private financial institutions in their estimation of their own exposures to loss. The same framework and methodology presented in this paper is being used by international financial regulators in dictating the amount of capital to be set aside against losses by money center banks. Knowing the amount of risk the government assumes will help reduce the moral hazard in guarantee provision and risk assumption. The aim is ultimately to produce better projects and reduce government exposure to risk in the process.

I. Introduction

This working paper is an offshoot of the nascent research work done in the last two years by the author (Reside, 1999a amd 1999b), working in collaboration with colleagues in various government and multilateral institutions in estimating the contingent liabilities of the Philippine government. The rationale for this paper is the increasing amount of risk that the Philippine government has been assuming in the last ten years, primarily in the development of various modalities for encouraging private sector participation in infrastructure development. While the government has succeeded in developing a wide array of options for such participation, it has experienced limited success achieving its concomitant objective of reducing the risks it assumes when privatizing the activities of building, operating and maintaining infrastructure goods and services. The Philippine government is often not prepared to deal with the financial and non-financial consequences of calls on its guarantees, some of which are triggered by circumstances under its control. With better coordination among line agencies, the DoF, and the BSP, better project preparation, and more prudent provision of guarantees, the large costs of state support could have been avoided.

Henceforth, one of the major objectives of this task is to quantify the amount of risk that the government assumes in such activities using conventional scientific and statistical methods presently being employed by private financial institutions in their estimation of their own exposures to loss. The same framework and methodology presented in this paper is being used by international financial regulators in dictating the amount of capital to be set aside against losses by money center banks. Knowing the amount of risk the government assumes will help reduce the moral hazard in guarantee provision and risk assumption. The aim is ultimately to produce better projects and reduce government exposure to risk in the process.

The scope of the paper will also be broadened to include the quantification of risks assumed when the Philippine government provides guarantees on GOCC loans, as well as fiduciary guarantees. The other important objective is to value the guarantee so that perhaps, the government can charge a price for its provision in the future. Finally, reserves must be set aside to cover against possible losses, so the features of such a system will also be described in the paper.

II. How the Philippine Government Assumes Risks

The Philippine government assumes risk in a variety of ways: (1) through the assumption of various risks in Build-Operate-Transfer (BOT) projects; (2) in guaranteeing loans of government-owned and controlled corporations (GOCCs); and (3) in providing fiduciary guarantees.

With respect to BOT projects, the assumption of risk may take many forms (see **Table 1**).

Table 1: Selected Project-Specific Risks and Sectoral Examples

Type of Project-Specific Risks	Sectoral Examples (Risk-bearer)
Project performance risks High cost of service Bad/inefficient service	Power – Power purchase agreements refer to minimum power plant performance criteria which the proponent has to satisfy. Water – MWSS concession agreement states the minimum criteria for project performance to be satisfied by the proponent. The concessionaires would bear the risk of poor project performance if they are penalized by the MWSS Regulatory Office. Transport – Most toll road concession agreements state the minimum criteria for project performance to be satisfied by the proponent.
Project completion risks Delays Cost overruns Site availability	Power – NPC normally guarantees right-of-way and site availability for power projects. Water – The MWSS concession agreement stipulates that cost overruns in projects may be passed onto consumers provided they are covered in grounds for extraordinary price adjustments (EPA). Otherwise, such costs are borne by the concessionaires. Transport – Responsibility for constructing access and feeder roads necessary for ensuring the viability of many toll roads are assumed by the government.
Fuel and other inputs risk Fuel availability Skilled labor	Power – In many instances, power purchase agreements include commitments by National Power Corporation (also the off-taker) to guarantee the supply of fuel inputs for independent power producers. Water – The MWSS concession agreement transfers input risk to the concessionaire, unless there are grounds for extraordinary price adjustments. Transport – Inputs for road and bridge construction are usually carried by the

	contractor.
Market risk User demand for services	Power – At the height of the power crisis, the government agreed to bear significant market risks by adopting minimum off-take contracts with independent power producers. Water – The MWSS concession agreement transfers market risk to the concessionaire. However, a number of bulk water service contracts with pending approvals have minimum off-take provisions with government-owned off-takers. Transport – The MRT-3 contract includes a stipulation of minimum ridership levels below which government must compensate the contractor.
Payment risk Creditworthiness of buyers of output	Power – All power purchase agreements stipulate that NPC's commitments carry a full government guarantee for minimum offtake amounts. Thus, the relevant credit risk is that of NPC and government. All PPA's carry a buyout clause the IPP may invoke in case NPC commits a breach of contract or fails to make required payments to IPP's. Water – Many proposed service contracts between bulk water providers and offtakers, usually municipal water districts, carry guarantees of payment from the latter. Thus, the relevant credit risk is of the municipal water districts or the municipal government. Transport – There is no off-taker in most transport projects.

Source: Reside (1999a)

With respect to the guaranteeing of GOCC loans, the risk assumed is that of the credit risk of the GOCC. For fiduciary guarantees, on the other hand, risks assumed are primarily those of GOCC's involved in the supply of credit to the housing-sector.

III. Government Guarantees and Conventional Insurance Contracts: The Similarities

By its nature, a government guarantee is very similar to an insurance contract. Both cases involve promises by the insurer to indemnify the injured party based on the value stipulated in the contract. The granting of a government guarantee gives rise to the same incentive and information problems that any conventional insurance company would face. This includes problems with respect to moral hazard and adverse selection.

In this regard, many of the principles behind insurance management may also be applied to government risk management. Perhaps the only major difference will lie in the fact that a private insurer will not have at its disposal the many sources of funds available to the government, such as taxation, seigniorage, and sovereign borrowing. However, if a government is facing constraints with respect to the unpopularity and ill-effects of additional taxes, inflation, and foreign debt, it will be forced reckon with risk in much the same way as the private insurance company. In many developing countries, the demands for prudent macroeconomic management has given rise to calls for more prudent risk management and more sustainable modalities for assuming risk.

In light of the similarities between government guarantees and conventional insurance contracts, the developing science of government risk management may be analogous to private insurance risk management.

The maximization of the value of an insurance firm entails achieving an optimal balance between the company's reserves and the number of insurance contracts they write. Insufficient reserves means that the firm goes insolvent when insurance claims are filed. Too many insurance contracts may mean that the firm has exercised reckless imprudence in writing insurance contracts, undermining the actuarial soundness of the firm. Analogously, if the government provides too many guarantees, it has been proven to undermine the budget process, and impair the government's cash flows, increasing uncertainty of government finances.

The Philippine government presently charges a flat guarantee fee (1 percent of outstanding). If government guarantees are analogous to private insurance, then guarantee premiums paid should be accumulated as part of an insurance reserve, to finance claims being filed. The similarities between government guarantees and private insurance may also extend into the determination of expected losses and the charging of premia.

Just as actuaries build loss models that can be used to determine the probability or risk that an accident might occur, and use these models for determining insurance claims, premia and reserves, analysts of government guarantees may build models that rely on historical government loss data in order to quantify exposure and possible guarantee calls, price guarantees and determine reserves to be set aside versus losses.

If historical loss data is not available, this loss data may be simulated using statistical techniques. Some of the loss data generated is thus necessarily synthetic in nature. In order to quantify government exposure, price guarantees and determine reserves, we therefore need to use a mixture of actual loss data and synthetic loss data.

IV. Risks, Outcomes, and Financial Payoffs

In the finance sense, risk may be defined as the burden of holding an asset or liability with an uncertain value, payoff or outcome. The value of a financial asset, such as a share of stock, a bond, or other types of securities, or the payoff to holding them, is subject to uncertainty. In this case, the value, payoff or outcome of the financial asset is a random variable.

The uncertain payoff to holding certain types of assets or insuring many types of risks is a random variable whose value can be determined a number of ways. These include the following:

Table 2: Common risks, outcomes, and financial payoffs

Risk assumed	Possible scenarios or states of the world (random variable)	Ignoring transactions costs, payoff pattern to the party assuming the risk (also a random variable)
a. Fire insurance	A fire does not burn down the house	Zero
	A fire burns down the house	Value of the insurance policy
b. Buying a call option on a share of stock	The stock price (S) does not rise above the exercise price (X)	Zero (or cost of buying the option)
	The stock price (S) rises above the exercise price (X)	S – X
c. Guaranteeing GOCC debt	GOCC does not default on its debt	Zero
	GOCC defaults on its debt	Value of GOCC debt
d. NAPOCOR assumes market risk	Power off-take exceeds the contracted amount	Zero
	Power off-take does not exceed the contracted amount	CP – P
e. NAPOCOR assumes buyout risk	Force majeure does not occur	Zero
	Force majeure forces the government to buyout the proponent's contract	Termination price or NPV of future payments to the proponent
f. NG assumes currency risk (for example, if NAPOCOR)	Exchange rate appreciates	NG gains
	Exchange rate depreciates	NG loses
h. NG assumes fuel risk	Fuel price falls below projections	NG gains
	Fuel price rises above projections	NG loses
i. NG assumes debt service risk	Cash flow (CF) is above the level needed to service debt and provide a reasonable rate of return to the proponent (L)	Zero
	Cash flow falls below level needed to service debt and provide a reasonable rate of return to the proponent	NG loses the amount (L – CF)

Note from the second column of **Table 2** that the pattern of states of the world may take several forms:

(a) Two states of the world only in cases a, c, d, and e. We call the state of the world random variable in this case a DISCRETE RANDOM VARIABLE because the number of possible outcomes is finitely countable; and

(b) Many possible states of the world in cases b, f, g, h, and i. We call the state of the world random variable in this case a CONTINUOUS RANDOM VARIABLE because the number of possible outcomes is infinite.

In reality, intermediate cases may occur. The states of the world, or the number of scenarios, may be greater than two and still be finitely countable (for example, suppose there are three or four possible outcomes). Note that the third column is the second column translated into a financial cost or payoff based on the terms of an agreement or contract between the insurer and the insured party.

In this sense, the third column of **Table 2** is analogous to a financial derivative whose value depends on some underlying risk factor (in the second column).

Note from the third column of **Table 2** that the payoff pattern may take several forms:

(a) Zero or loss to the party assuming the risk; or

(b) Many possible loss outcomes and many possible gain outcomes (especially with respect to currency risk and other continuous risks).

Note that the determination of the payoff may be very simple, as in the case of the value of the insurance policy on the house or the value of debt. The payoff may also be determined by a formula, as in the case of buyout risk, where the adverse payoff is the net present value of future contracted payments. In the case of toll roads, for example, the amount of loss may be determined by the projected or contracted number of cars multiplied by the toll price.

The payoff may be determined explicitly contractually, as in the case of buyout risk, or implicitly (not in the contract), as usually is the case of currency risk. In addition, note that the discrete risks can often have well-defined payoffs, since the number of outcomes is countable. On the other hand, continuous risks don't often have well-defined payoffs, since the number of outcomes is infinite.

Moreover, depending on the contract, note that financial payoffs may or may not be bounded from below or bounded from above. For example, the cost of assuming currency risk may theoretically be not bounded from above. Finally, note that for certain risks, such as currency and market risks, the amount to be paid (in dollars or corresponding to the contracted amount of power, riders or water) has already been determined with certainty. The random variable in each case is simply the difference between the actual exchange rate or riders and the projected exchange rate or riders.

V. The Challenge in Risk and Exposure Estimation

Given the preceding discussion on risks and their associated outcomes and payoffs, the challenge in estimating risk is to:

(a) Exploit the uncertainty involved in assuming various risks by evaluating a wide range of outcomes and financial payoffs. This involves choosing the appropriate probability distributions for simulation;

(b) Determine that particular financial amount that the risk-bearing party stands to lose within a given period of time (the expected loss).

(c) Set aside reserves may be set aside against possible losses within that period, and

(d) Value and price the assumption of risk, using risk-adjusted pricing methods.

This activity may include addressing even infrequently occurring events/risks.

For private financial institutions, computing exposure to risk factors on a portfolio of financial assets is straightforward given certain assumptions about the behavior of the payoffs to holding such assets (e.g., that the payoffs to currency risk follow a lognormal distribution). Using this information, along with knowledge about the mean and standard distribution of changes in the exchange rate, exposure to currency risk may be computed easily by hand for a portfolio comprised of a single asset.

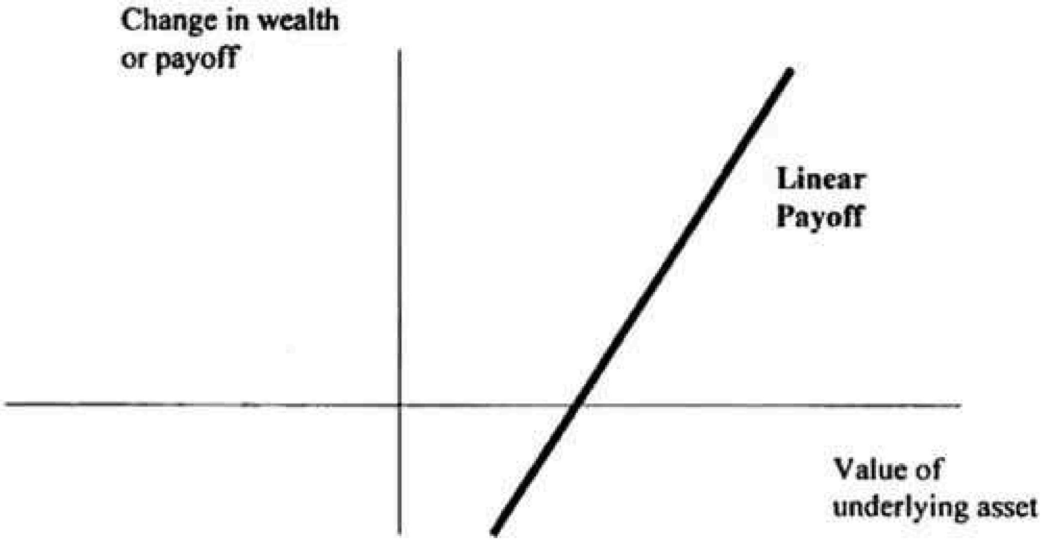
For exposure to be easily computed in this manner, the payoffs must be a linear function of the value of the underlying asset.[1] This means that if the relationship between the value of the underlying asset and the change in wealth or payoff is graphed, a straight line is obtained (see **Figure 1**). A straight line payoff could apply to the following:

(a) the purchase of a share of stock; and
(b) the purchase of foreign exchange.

If payoffs to holding financial assets are non-linear in nature (such as for options), the approach recommended for private institutions to estimate exposure is to simulate the payoff using a method called Monte Carlo or stochastic simulation. Nonlinearity of the payoff means that if the relationship between the value of the underlying asset and the investors' change in wealth or payoff is graphed, a line with a kink is obtained (see **Appendix A** for a brief explanation of payoffs to put and call options).

[1] This method is known as "Value-at-Risk," or VaR. VaR methodology was developed by JP Morgan in the mid-1990's to satisfy the growing demand for risk-management tools. Initially, it was applied to evaluate the level of risk in financial institution portfolios, but it's usefulness has since been broadened to include the evaluation of credit and corporate risk.

Figure 1: Example of a straight line payoff



It has been established that when an institution obtains a government guarantee, it is equivalent of buying an asset and the purchasing a put option whose exercise price is the current market value of the asset (Merton, 1977). Since put options have payoffs that are non-linear with respect to the value of underlying assets, then methods for valuing put options may also be applied to the valuation of government guarantees. Likewise, methods for measuring the exposure of purchasing a put option may also be applicable to the measurement of the exposure and risk in a government guarantee transaction. For how the payoff to a put option may be analogous to the provision of a government guarantee, see **Figure 2.** A similar illustration may be made for the case of GOCC loan guarantees.

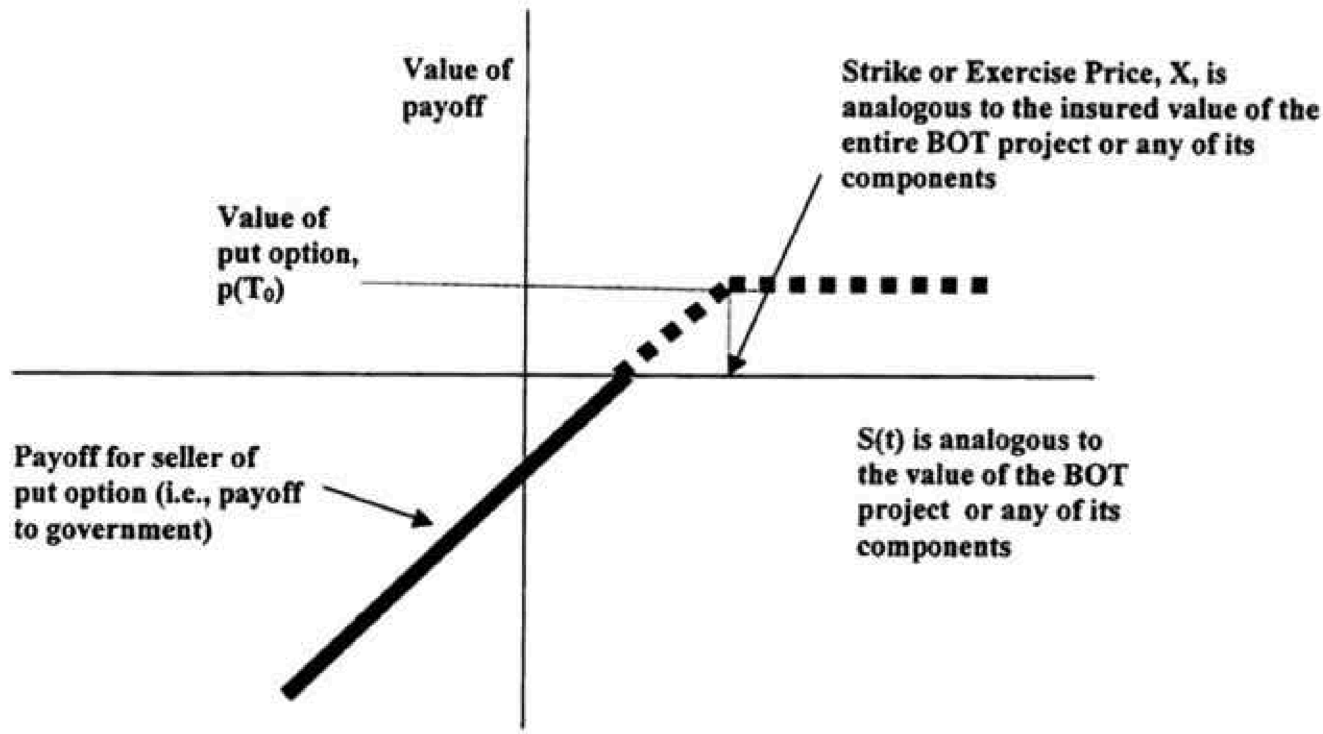
The information contained in **Table 3** and **Figure 2** suggests that some sort of mapping method may be need to be developed to properly value government guarantees. This is a matter left for future work on guarantee valuation.

The equivalence between government guarantees and the purchase of put options on assets have more important implications. Since government guarantees are equivalent to put options on the value of the underlying loan or infrastructure project, stochastic simulation is also the recommended approach for estimating exposure of government. Simulation is also the recommended approach to simulating the value of a portfolio comprised of assets with both linear and non-linear payoffs.

Table 2: Analogy between a financial put option and a government guarantee

Payoff Scenario	To seller of financial put option	To government as guarantor
Market value of the underlying asset (S) is equal to or greater than the exercise price (X) within the term of the option contract	Zero	Zero; proponent has not yet perceived a loss in the value of the project, so no call has been made
Market value of the underlying asset (S) falls below the exercise price (X) within the term of the option contract	The buyer of the put option exercises his option to sell the underlying asset at a price equal to X. The seller of the put option buys the underlying asset at a price equal to X. The payoff to the seller is the difference between the exercise price (X) and current market value of the asset (S), $X - S$	Because of a perceived loss in the value of the project, the proponent exercises his prerogative to call on a guarantee. The payoff to the government in this case is compensation whose amount is based on computations dictated by the contract. In general, this amount is equivalent to the value of the project (X), or the exercise price, minus the current market value of the asset, S, $X - S$

Figure 2: Seeing the government guarantee as a put option on the value of a BOT project or its component parts



VI. Introduction to Stochastic, or Monte Carlo Simulation

There are two ways to simulate the value of a payoff: (1) historical; and (2) ex-ante simulation.

Historical simulation entails gathering information about the uncertain risk factors affecting the value of an asset (such as the exchange rate or the price of a share of a share of stock), and then building synthetic probability distributions which will then be used to generate a large number of scenarios of the underlying risk factor. These scenarios will in turn determine the expected value of the asset.

Ex-ante simulation, on the other hand, entails formulating hypotheses and gathering best expert judgments about the underlying risk factors in order to assign subjective probabilities to outcomes when building probability distributions to be used in simulation.

Ex-ante simulation is the preferred method to use when there is a lack of data or when observations about the actual outcomes of underlying risk factors are unavailable (see **Table 3**).

Table 3: Determining the Appropriate Exposure Estimation Methodology Under Various Conditions

Nature of payoffs	All payoffs are linear	Some or all of the payoffs are non-linear
Presence of historical data about the risk factor		
Historical data about the underlying risk factors is available	Apply conventional risk estimation techniques, which (simplistically) assumes that most underlying risk factors are normally distributed	Apply historical simulation
Historical data about the underlying risk factors is not available	Apply ex-ante simulation	Apply ex-ante simulation
Some historical data about the underlying risk factors is available and some data is not available	Apply ex-ante simulation	Apply both historical and ex-ante simulation

Note: The shaded area represents the preferred method for evaluating contingent liabilities arising from the provision of government guarantees

Note that if payoffs are non-linear in nature, and that historical data about the underlying financial risk factor is not available, ex-ante simulation is used. This observation is crucial, since in most infrastructure projects, the payoffs to assuming some (but not all) risks are non-linear (all cases of insurance, in fact, are the equivalent of the proponent purchasing a put option from the government), and no historical data about such payoffs are available, suggesting that a mixture of historical and ex-ante simulation would be the appropriate method to employ to estimate exposure.

In general, a mixture of historical and ex-ante stochastic simulation techniques will be used to simulate the value of the underlying risk factors, which in turn determine the value of the payoffs, and create a frequency or probability distribution of payoffs.

In general, the proposed risk simulation and exposure evaluation exercise involves the following steps:

(a) First build probability distributions of the underlying risk factors (e.g., those factors on the second column of Table 1) using historical data or assignment of subjective probabilities. The distributions to be used should be constructed in such a way that they reasonably mimic the stochastic process generating outcomes of the underlying risk factors within the period in which reserves are to be set aside;

(b) Second, generate many thousands of scenarios of the **one-period-ahead** outcome of these risk factors (one at a time, or in combinations with others);

(c) Third, translate each of the thousands of scenarios into a financial payoff, accumulating statistics on this payoff. In this manner, we are able to derive a separate distribution for the payoffs to each of the risks assumed (keeping other risks fixed), or to any combination of risks;

(d) Rank these payoffs from worst to best, and select that payoff above which x% of all other payoffs lie (that is, the payoff at the (100 – x)th percentile). Any payoff worse than this is not expected to occur more than x percent of the time;

(e) The value of x (the degree of confidence) will be user-defined, and it will depend on one's attitudes towards risk. The DoF's risk managers will have to decide on what this will be.

(f) The payoff at the (100 – x)th percentile may be the amount of loss for which reserves may be set aside. In the banking paradigm, this is usually the first percentile for purposes of conservatism. Capital may be set aside by the bank to cover the loss at the first percentile of all possible payoffs ranked from worst to best.

Note that the higher the risk manager defines x, the higher could be the adverse payoff for which capital is set aside. If computed in this manner, the amount of capital, or reserves set aside to cover against expected loss will depend on: (a) the time horizon for which exposure is computed; and (b) the degree of confidence chosen by the risk manager. **Also note that the payoff at the (100 – x)th percentile is not the mean, or expected payoff.** The mean payoff is the average payoff.

Table 4 illustrates the advantages of using stochastic simulation over stress testing:

Table 4: Comparison and Contrast: Simulation vs. Stress Testing

Simulation	Stress Testing
Scientific method of analysis which properly models and accounts for uncertainty in the generation of one period-ahead outcomes.	Ad hoc method of analysis which does not properly account for uncertainty in the generation of outcomes.
Generates much more precise (though still inexact) measures of exposure and other variables, such as time-to-default, since simulation is stress-testing run thousands of times.	Less precise measure of exposure.
Outcomes generated for the relevant period are probability-adjusted outcomes based on historical data or based on best expert judgment.	Outcomes generated for the relevant period are not probability-adjusted outcomes.
Refines sensitivity analysis by iterating on the relevant variables thousands of times.	
Enables risk manager to undertake an analysis of exposure using widely accepted techniques for analyzing exposure in the financial sector.	Is no longer the method of choice for analyzing exposure in the financial sector.
Will enable the guarantee to be valued/priced	Will not enable the guarantee to be valued/priced.

The reason we need to assign probability distributions to the relevant risk factors is that we need to generate a set of one-period-ahead outcomes for these factors. For this purpose, a wide array of modeling techniques one-period ahead outcomes are available. Economic modeling techniques may be used to augment the statistical techniques to be used. Trends, correlations, random walks and other statistical properties of the data may also be embedded into the macros that run the simulations. **Table 5** lists the relevant risk factors that have the greatest potential influence the payoffs or outcomes of risks assumed in BOT projects.

For example, we could use a conventional economic model to forecast the one-year-ahead exchange rate, and we could simulate the parameters of this model to generate a distribution of the exchange rate. On the assumption that the relevant budgeting period is one year, we have already obtained annual data on exchange rates and prices of oil and some other commodities. The author will present the results of distribution-fitting exercises in a future paper.

The fitted distributions will be our synthetic distributions from which we can draw repeatedly during simulation. This method of simulation does not rely on any economic model. In using probability distributions alone to generate one-period-ahead forecast ranges of outcomes, the model is the probability distribution itself.

In order to refine our one-period-ahead forecasts and broaden our range of analysis, we may simulate any widely accepted economic model of the risk factors. This may apply to one-period-ahead forecasts of the exchange rate, inflation, interest rates, etc.

Stochastic simulation to roughly determine exposure to risk factors may be performed on Excel-based spreadsheets. The basic ingredients for simulation are:

(a) For BOT projects: the financial model of the project, the financial statements of the GOCC, the main contract and interviews with sectoral experts; and

(b) For GOCC's which have incurred loans guaranteed by NG: the financial statements of the GOCC and the financial models of their projects, the main contract and interviews with financial officers.

We need all of the above information because the most important ingredient for simulation is the construction of appropriate probability distributions for the underlying risk factors. As for fiduciary guarantees, the author feels that since GOCC's are involved, their credit risks are likewise at stake, so the assessment of exposure to fiduciary guarantees will demand the same information as the assessment of exposure to GOCC loans.

VII. Modeling the Most Common Risks and Contingent Liabilities in Actual Projects and GOCC Loans

Based on initial inquiries with relevant stakeholders in BOT projects, several risks appear to have the greatest potential impact on government exposure to contingent claims (see **Table 6**).

Table 5: For BOT projects, the following items need to be modeled based on the following important risk factors:

Risk	Relevant risk factors to be simulated or modeled using standard economic models to generate one-period-ahead forecasts	The level of risk is correlated with, or is influenced by the following factors
Currency risk	Exchange rate RP inflation rate US Inflation rate	Macroeconomic conditions, current account and capital account conditions
Market risk	Power: GWh of power generated by a plant in the next period; actual off-take by utility	Macroeconomic conditions; GDP growth, prices of substitute goods and services
	Transport: Number of riders	Macroeconomic conditions; GDP growth, prices of substitute goods and services
	Water: Actual water off-take by utility	Macroeconomic conditions; GDP growth, prices of substitute goods and services
	Others	
Buyout	Frequency of force majeure	
Other event risks	Frequency of legal actions undermining project	Level of uncertainty with respect to the legal system
Financial viability of the project company	Frequency and timing of default	Completion risk, price of relevant inputs and outputs, currency risk
Completion risk	Frequency and length of project delays caused by various institutions	Level of competency of institutions involved in the project or phase; quality of coordination among institutions involved
Price of relevant inputs	Power: Coal prices, oil prices	Currency risk, vendor or supply risk
	Transport: Price of electricity, coal or oil	Currency risk, vendor or supply risk

	Water: Price of electricity	Currency risk, vendor or supply risk
	Others	
Price of relevant outputs	Power: Wholesale price of power plant	Degree to and flexibility with which regulators allow prices to adjust
	Transport: Train fare; toll	Degree to and flexibility with which regulators allow fares and tolls to adjust
	Water: Price of water	Degree to and flexibility with which regulators allow water prices to adjust
	Others	

Table 6: Based on initial inquiries with relevant stakeholders in BOT projects, the following risks appear to have the greatest potential impact on government exposure to contingent claims:

Risk	Adverse Financial Payoff
Currency risk	Exchange rate depreciates beyond the rate expected in the financial model of a project
Market risk	Demand for the service or good falls below the contractually-determined take-or-pay amount
Buyout	Present value of future stream of payments is paid in one installment
Financial viability of the project company	Amount of additional cash needed to pay off contractors or creditors in the event of default
Completion risk	Project, or parts of the project, are not completed on time, leading to cost overruns

a. Modeling Time-to-Default and Expected Cost of Default

From the standpoint of the DoF, there appears to be great interest in modeling (a) the time it takes for an institution to default on its debt; and (b) the expected amount or cost of default. The latter is the contingent liability assumed by the government, while the former is valuable information in determining the actuarial soundness of institutions whose liabilities have been guaranteed by the government.

The significance of this approach in computing time-to-default is that even before a project begins or a GOCC defaults, it is possible to model the frequency and timing of defaults (perhaps years in advance). We create a basis for evaluating a project's potential for default with a certain amount of confidence.

Using any financial model (for any BOT project or any GOCC), we can simulate the frequency and expected cost of default (and its timing) using stochastic (Monte Carlo) simulation:

(a) First, identify the relevant risk factors in the financial model (those factors subject to the greatest uncertainty);

(b) Second, assign and construct the appropriate parametric distributions to each of these risk factors;

(c) Third, generate many thousands of scenarios of the outcome of these risk factors in the period under observation;

(d) Fourth, enter these scenarios into financial model in order to determine whether each scenario produces a default or not;

(e) Lastly, using statistics accumulated for each scenario, determine the average time to default and the average exposure upon default.

A detailed example in this regard has been worked out and will be presented in future work. For GOCC loans guaranteed by NG, the initial approach to be taken involves simulating cash flow or financial models in order to simulate the frequency of default on debt. However, the same thing can be done for BOT projects where project corporations are servicing debt with a government guarantee. The credit risk of the project corporation is at issue in this case.

b. Modeling Market Risk and Currency Risk

The costs of bearing market risk and currency risk in BOT projects can be modeled using a mixture of historical and ex-ante simulation techniques. The results will also be available in a future paper.

As mentioned earlier, the costs of bearing market risk and currency risk will depend on the differences between the expected one-period-ahead exchange rate in the approved financial model and the actual exchange rate, and the expected one-period-ahead demand and actual demand.

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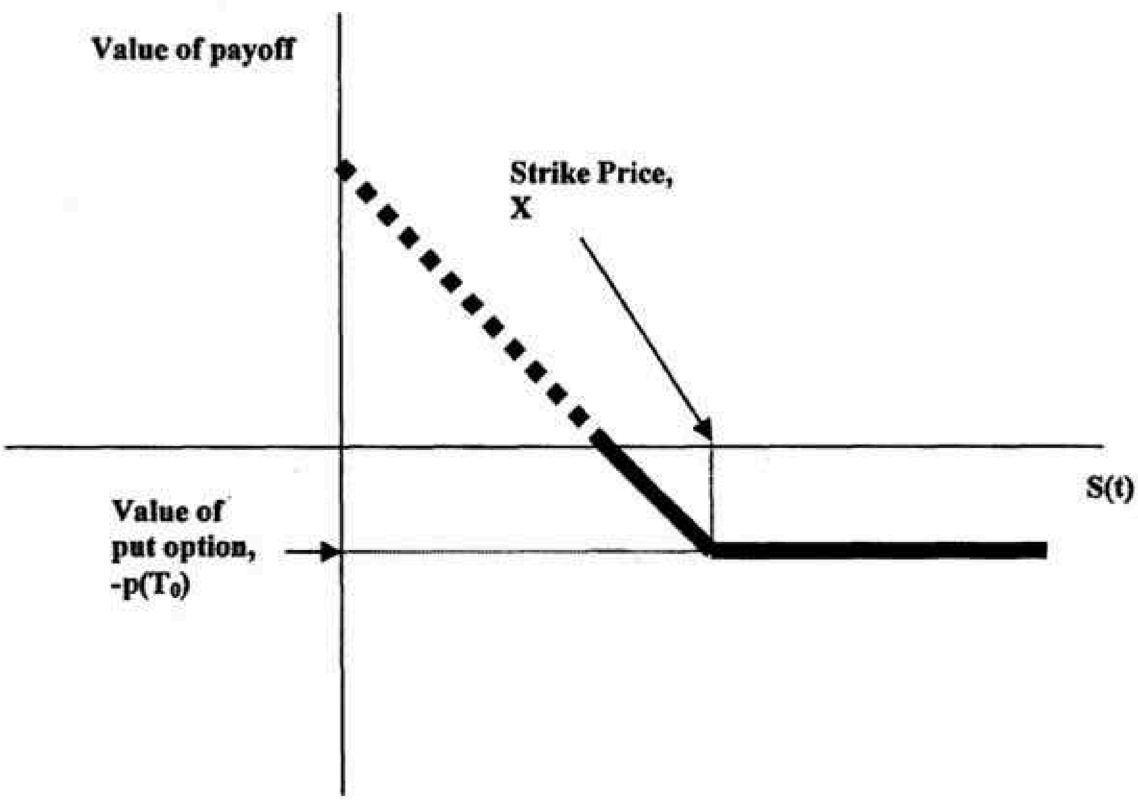
APPENDIX A

OPTIONS

Payoffs to Sellers and Buyers of Put Options

A put option on an asset is also a form of contingent claim. The buyer of a put option purchases the right to *sell* an asset, whose value is S(t), at a particular strike, or exercise price (X) within some specified period. Thus, the owner of a put option gets a positive payoff if he exercises his option to sell the asset when its price is *below* the strike price (i.e., if $S(t) < X$). If the period ends without the strike price ever being reached, the put is worthless and expires unexercised.

For purposes of the discussion on government guarantees, it is the put option that is the relevant option. This is because it has been shown (Merton, 1973) that insuring an asset is equivalent to taking a long position on (or buying) the asset and purchasing a put option on the same asset. The payoff to the buyer of a put can be graphed in the following manner:

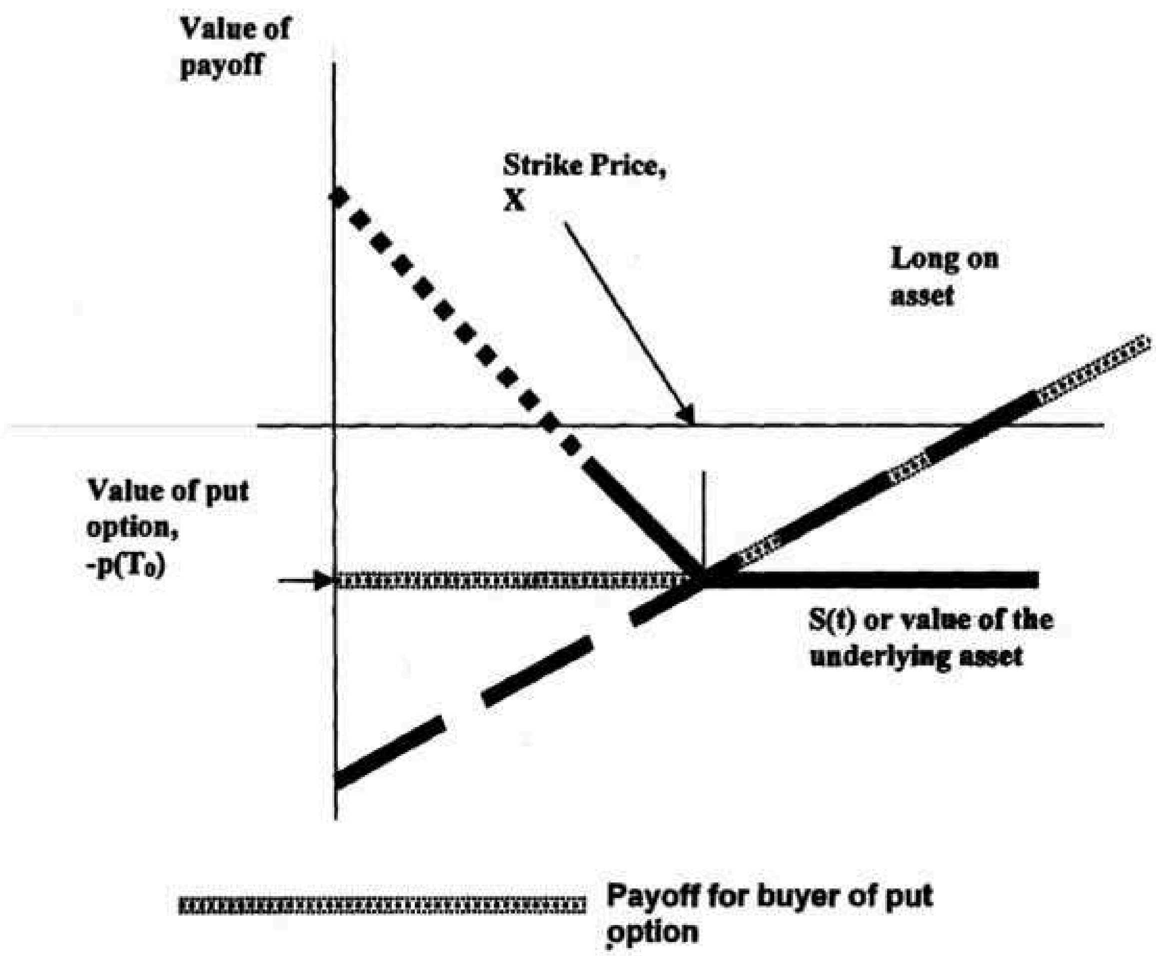


Value of Payoff to Buyer of Put Option

The end-of-period payoff to the buyer of a put option is

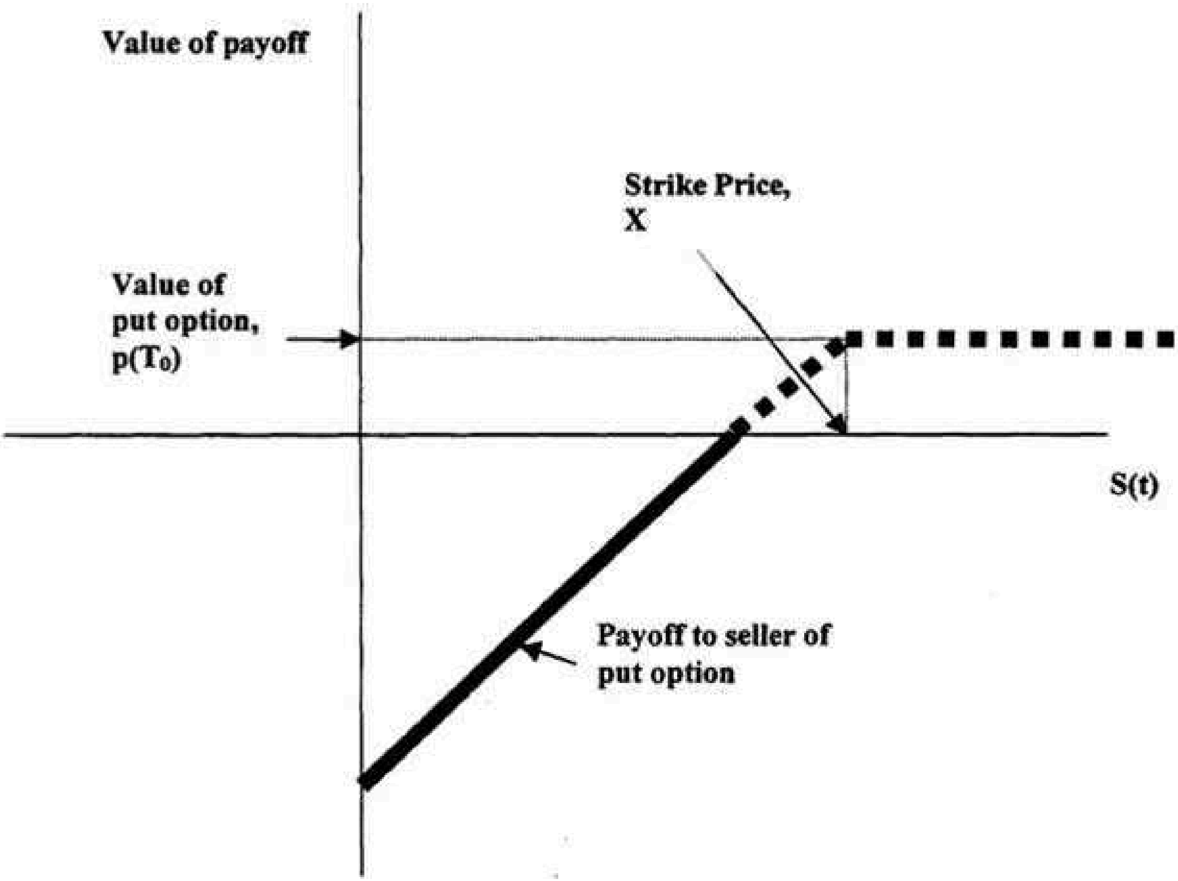
$$\pi_{bp} = \begin{cases} F - S(T_E) - p(T_0) & \text{if } S(T_E) > X \\ -p(T_0) < 0 & \text{if } X > S(T_E) \end{cases}$$

Note that if one is long on an asset and buys a put on the same asset, one is in effect limiting his downside losses to the cost of buying the put:



Note that the minimum payoff for the buyer of the put is the price of the put. It is this "protective put" position that is equivalent to a guarantee on the value of a long asset. ***Analogously, should a firm incur debt with a face value of F and the equity owners purchase a guarantee that the debt will be repaid at full face value, this is equivalent to saying that the owners of the firm have purchased a put option to sell the assets of the firm (valued at S(t)) to the debtors at the exercise price, X within a specified period (say, from now on until the asset expires).***

On the other hand, the seller of a put option (the provider of the guarantee), faces a payoff that can be graphed in the following manner:



At its maturity, the payoff faced by the seller of a put is:

$$\pi_{sp} = \begin{cases} p(T_0) > 0 & \text{if } \mathrm{S(T_{\mathit{E}}) > X} \\ -[X - S(T_E)] + p(T_0) & \text{if } \mathrm{X > S(T_{\mathit{E}})} \end{cases}$$

Note that the seller of a put option faces a limited positive payoff, but great downside risks. ***This is the essence of the problem when the government provides a guarantee or is short on the put option: besides facing large downside risks, it does not charge a risk-adjusted price for the provision of the protective put option.***

Thus, at maturity date, if the value of the asset is less than the exercise price, the payoff to the seller of the put option could be a loss if the difference between the exercise price and current value of the asset is more than the price of the put option.

Since the government guarantee is the equivalent of a put option which reduces the downside risks of purchasing an asset, then it must have value to the owners of an asset subjected to volatile price movements.

If the government provides the put for free, for assets such as infrastructure projects, then it is not being adequately compensated for agreeing to bear downside risks for the asset. The challenge then is to seek ways to estimate the value of put options when they come in the form of government guarantees.