Measuring Cost and Risk of Public Debt: Use of an ALM Framework

Based on Client Presentation

May 2004

Drawing substantially on a presentation prepared by the World Bank

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Debt Profile: Summary of the portfolio's current risk position using a set of indicators

- Market Risk
  - external debt/total debt
  - currency structure
  - floating interest rate debt/total debt
  - duration
  - average life
  - amortization schedule
    - amount or percentage of principal payments due each period
- Fiscal sustainability
  - Total debt/GDP
  - Total debt/tax revenues
  - Debt service/total revenues
  - New borrowings/debt
- BoP sustainability
  - External debt/Exports
  - External debt service/exports

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Debt Profile is a Summary - not a Risk Measure

- A debt profile is a set of indicators that imply potential volatility of debt servicing
- Most government debt offices use cash flow simulations to measure cost and risk of debt
  - Cost is measured as the future debt servicing costs
  - Risk is measured as the potential increase in costs
  - But risk is a relative concept and it is useful to have a framework for modeling it

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Government ALM Framework

- An ALM framework examines the nature of the government's assets and liabilities, with the objective of reducing overall risk for the government
- Risk of the government's liabilities is measured relative to the government's assets, and its objectives for managing those assets
- This approach facilitates risk management by matching assets and liabilities (natural hedging), and providing a framework for measuring costs and risks

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Simplified sovereign balance sheet

Assets	Liabilities
PV of future taxes	Debt
	PV of future expenditures (excluding debt service)

PV of future taxes - PV of future expenditures = PV of debt

In this framework, debt is the equivalent of deferred taxes

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Risk Implications of the Simplified Balance Sheet

- Balance sheet risk is minimised when risk characteristics of debt matches that of future taxes minus future government expenditures (T – G = the primary surplus)

  If T and G are largely in domestic currency, risk is minimised when debt is in domestic currency

  As (T – G) is relatively insensitive to real interest rates, risk is minimised by issuing long-term, fixed rate debt (long duration)

  If domestic debt market is relatively undeveloped => trade-off between long-duration FX debt vs. short-duration domestic debt

  Best debt strategy requires measuring cost and risk of trade-offs

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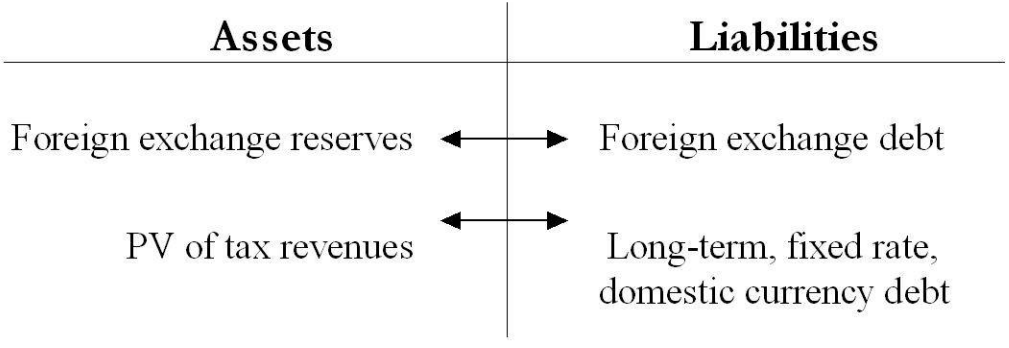
Managing risk on a sub-portfolio basis



- balance sheet risk is minimised by: matching the FX composition and interest rate characteristics of FX debt with FX reserves
- issuing the rest in long maturity, fixed rate domestic currency debt

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Methodology for Measuring Cost & Risk

Pure ALM methodology: for each debt strategy, simulate a range of paths of possible future debt servicing costs & future government revenues or primary surplus

- If the two flows move together when market prices change (i.e. sensitivity of A&L to market variables is the same), the liability portfolio is immunized
- Otherwise, debt servicing costs will be volatile relative to revenues. Risk is measured as the volatility.

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Methodology for Measuring Cost & Risk

- BUT: the joint modeling of debt servicing costs and revenues is highly complex
  - Requires jointly modeling interest and exchange rates, macro variables and the government's assets and liabilities
  - A few debt offices (Sweden, Brazil, UK) have begun experimenting with this approach
- Most debt offices simplify the process by comparing the range of future debt servicing costs against a notional reference representing the government's main assets
  - Assume assets denominated in local currency and of long duration.
  - Implies risk should be measured in terms of volatility of debt service in local currency over the medium- to long-term

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Step 1: Determine the cost

Step 1

- Debt service cost flows are projected forward for a medium- to long-term horizon under base case assumptions of the funding strategy and future market rates
- The base case assumptions of future market rates should be "market-neutral"; e.g.:
  - Based on survey of market participants
  - Derived from implied currency and interest rate forwards
  - Simple assumptions that rates remain constant
- The cost is measured as annual debt servicing costs under base case assumptions
  - Total debt service; or as a proportion GDP (proxy for power to tax)

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Step 2: Design risk scenario

Step 2

- New projections are made under alternative market rate assumptions
- These alternative cases can be generated using
  - statistical techniques
  - historical analysis
  - "worst case" scenarios, etc.

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Step 3: Measure risk

Step 3

- Risk is measured as the volatility or potential increase of debt servicing costs relative to the base case
- Risk can be modeled using deterministic scenarios or stochastic simulations
- Best to start with simple scenario models and move to stochastic simulation later
  - Scenario models handle economic shocks more easily (stochastic models tend to assume normally distributed variables; real world variables have "fat-tails")
  - Try to consider impact of shocks on GDP and primary surplus as well as interest and exchange rates – step towards integrated macro model

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Step 4: Repeat process for other strategies

Step 4

- Steps 1 - 3 are repeated for alternative funding strategies, and costs and risks of strategies are compared
- e.g., strategy A: 75% fixed, 25% floating; strategy B: 25% fixed, 75% floating
- [if available] explore impact of index-linked bonds – more resilient in event of demand shocks

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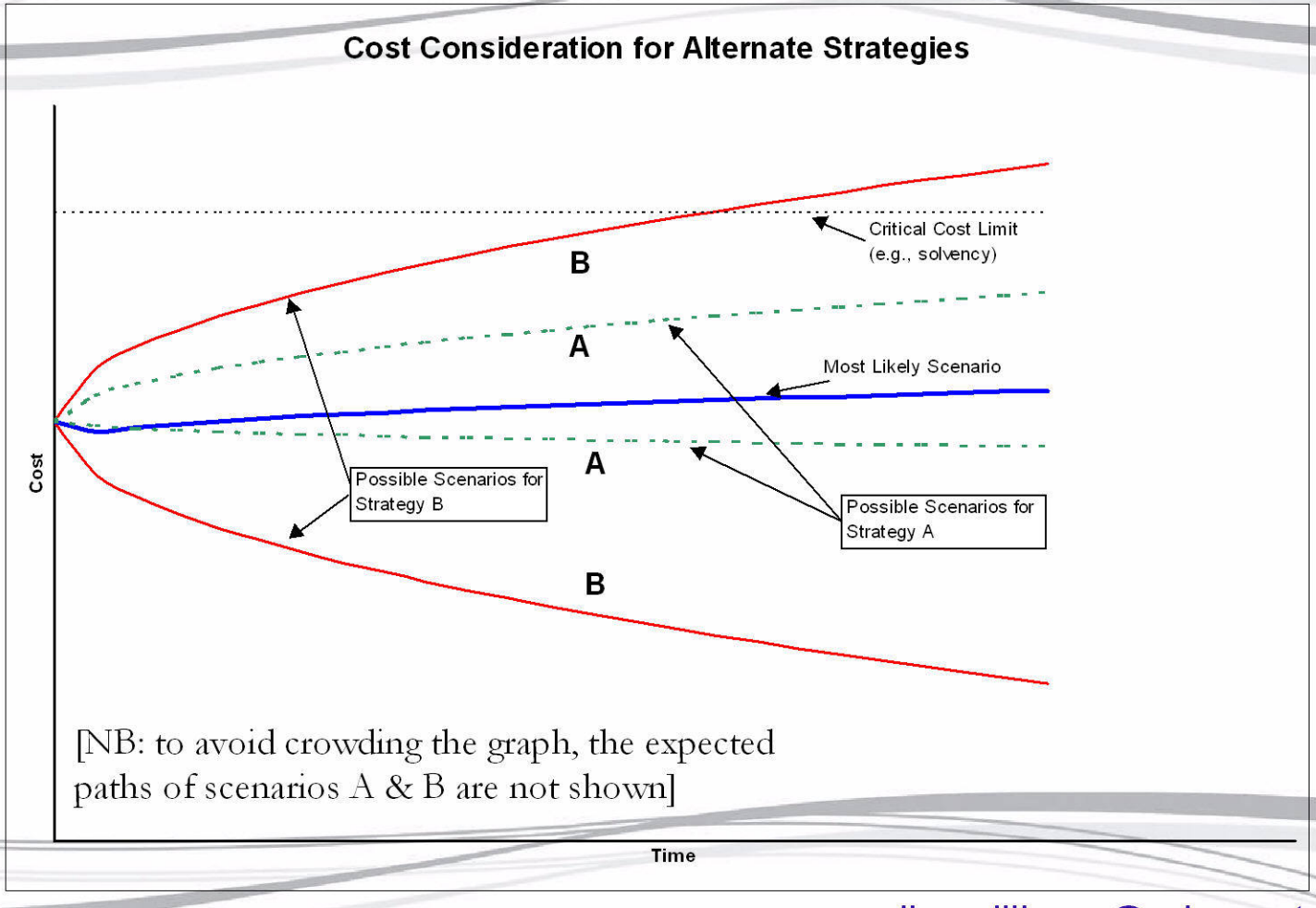
Expected Cost and Risk



[NB: to avoid crowding the graph, the expected paths of scenarios A & B are not shown]

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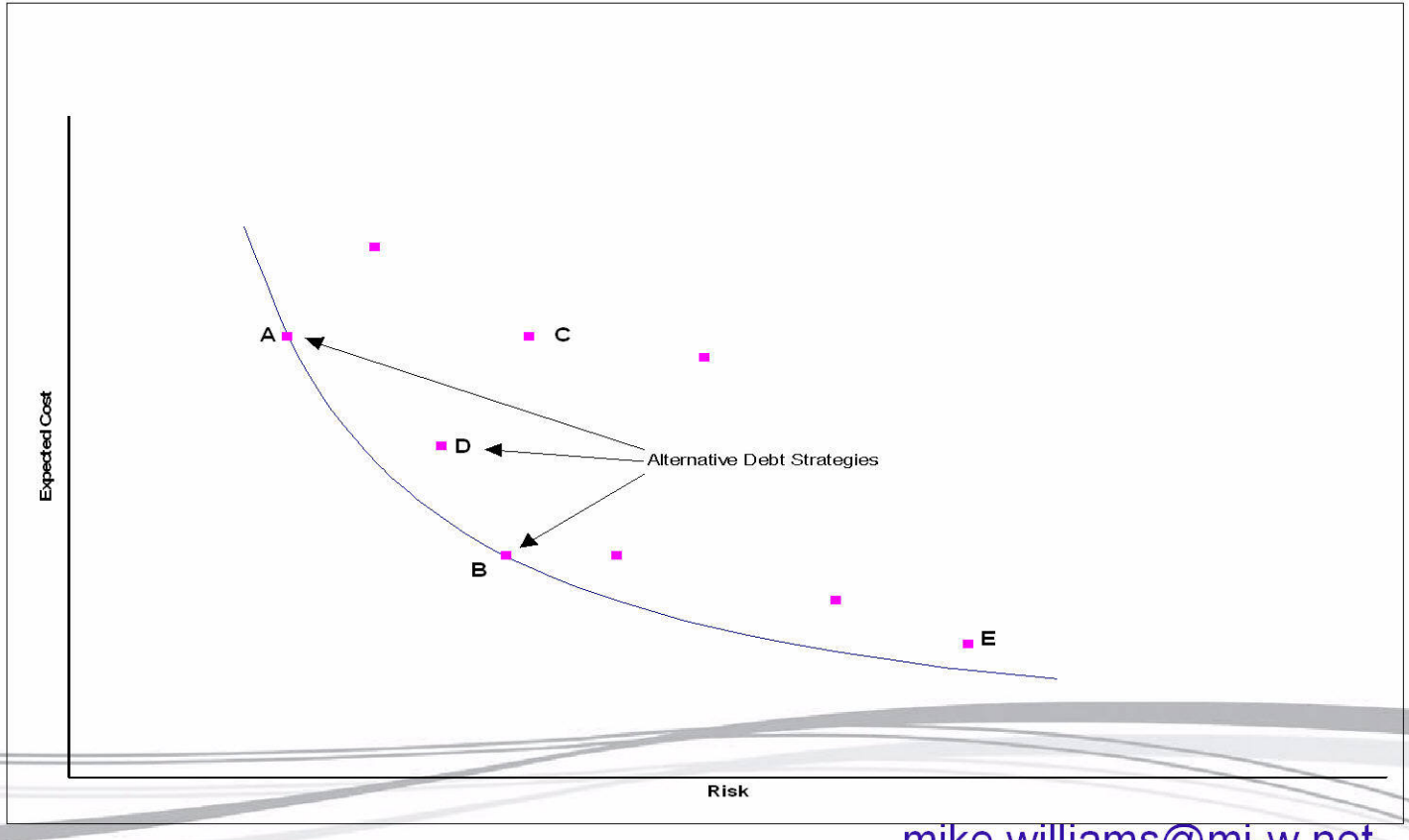
The Costs and Risks of Alternative Strategies are Compared



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Step 5: Select the Strategy

Step 5

- These models are not "optimisation" models, but merely present information on the costs and risks of the alternative strategies to the decision makers
- The strategy is selected on the basis of the risk tolerance of the government

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Note on Tax Smoothing

- Hedging against exogenous shocks to the government's finances, to avoid unexpected changes in taxes.
- Supply shocks
  - negative correlation prices and real output
  - positive correlation return on nominal debt and tax revenues
- Demand shocks
  - positive correlation prices and output.
  - nominal debt adds to variation – cost of nominal debt rises when output and tax revenue fall
- Effects increase as maturity of debt lengthens - persistent changes in price level have greater effect on LT than ST debt
- Advantage of index-linked debt for economy subject to demand shocks (e.g. UK in past)

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