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Risk Models and Public Debt Management

by

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Should we trust models?



“Too large a proportion of mathematical economics are a mere concoction, as imprecise as the initial assumptions they rest on, which allow the author to lose sight of the complexities and interdependencies of the real world in a maze of pretentious and unhelpful symbols.”

John Maynard Keynes, 1936

“Beware of geeks bearing formulas.”

Warren Buffet, 2008

Outline



- What is a risk model? Why is it useful?
- Models in debt management
- The structure and output of a simple scenario analysis model
- Implementation issues
- Concluding remarks

What is a risk model? How can it be used?



- A simplified representation of a more complex system
- Designed to shed some insights on a problem that one is analyzing
- In the area of public debt management, models can be used to help make decisions about the composition of public debt
- Can provide a clearer picture of the trade-off between cost and risk in the portfolio
 - Requires clear definition of cost and risk

Cost and risk



- **Examples of cost measures**
 - Nominal interest payments
 - Interest cost adjusted for unrealized capital gains/losses (e.g. FX)
 - Interest cost as a percentage of revenues
 - Total debt as a percentage of GDP
- **Risk is defined as the difference between the expected cost (baseline case) and the cost under a specific negative scenario (in a deterministic model)**
- **Degree of vulnerability to market risk can be measured by a range of metrics**
 - Debt maturing within 1 year
 - Average time to maturity
 - Debt with interest rates re-fixing within 1 year
 - Average time to re-fixing
 - Currency mismatch between financial assets and liabilities
 - Etc.
- **Different cost and risk measures provide different information - do not rely on one cost and risk measure**

Why is a risk model useful?

- Allows analysis of different strategies under alternative scenarios for future interest rates and exchange rates
- Maintain integrity across different scenarios/strategies
 - Apples to apples comparison
- Forces discipline in the process: systematic analysis and examination of possible states of the world
- Gives deeper insight into the trade-offs and supports the identification of options and constraints

Is a model needed to develop a sound debt management strategy?



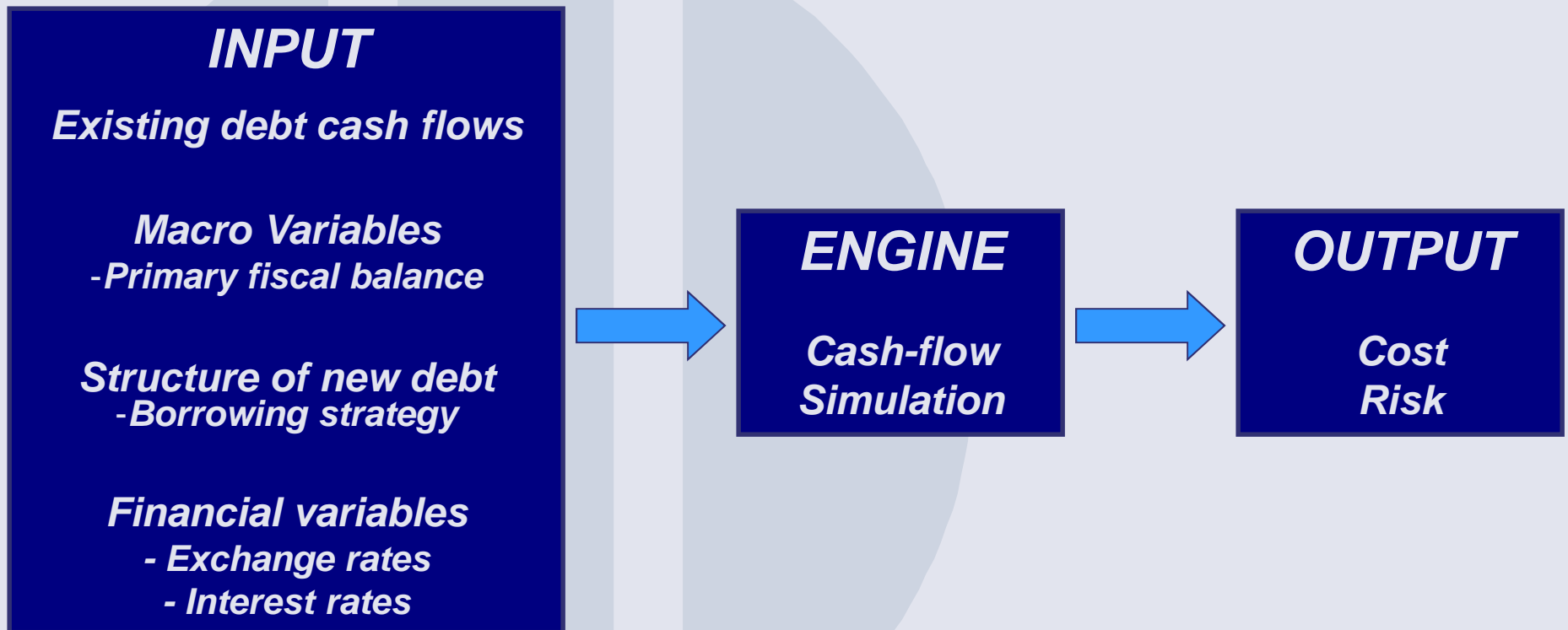
- No, recent examples include
 - Indonesia, Peru, Colombia
- In the above cases, the strategy was initially formulated as broad guidelines based on more qualitative analysis and judgment
 - More domestic debt, longer maturity, etc.
- A natural next step is providing more precision in the form of targets for specific risk indicators – this is supported by a model
 - As extreme risks are reduced, more granularity and higher precision are required

Risk models and the debt management problem



- The debt portfolio is exposed to future changes in market rates – such changes will impact the government's budget
 - Central to a risk model is the following identity:
$$\text{Primary balance} + \text{Interest payments on debt} = \text{Budget balance} + \text{Amortization of debt} = \text{Funding need}$$
- Deterministic scenario analysis
 - Few strategies, few market scenarios
- Stochastic scenario analysis
 - Few strategies, many market scenarios
 - Allows analysis of statistical distributions, requires ability to model the generation of market rates, typically based on historical data

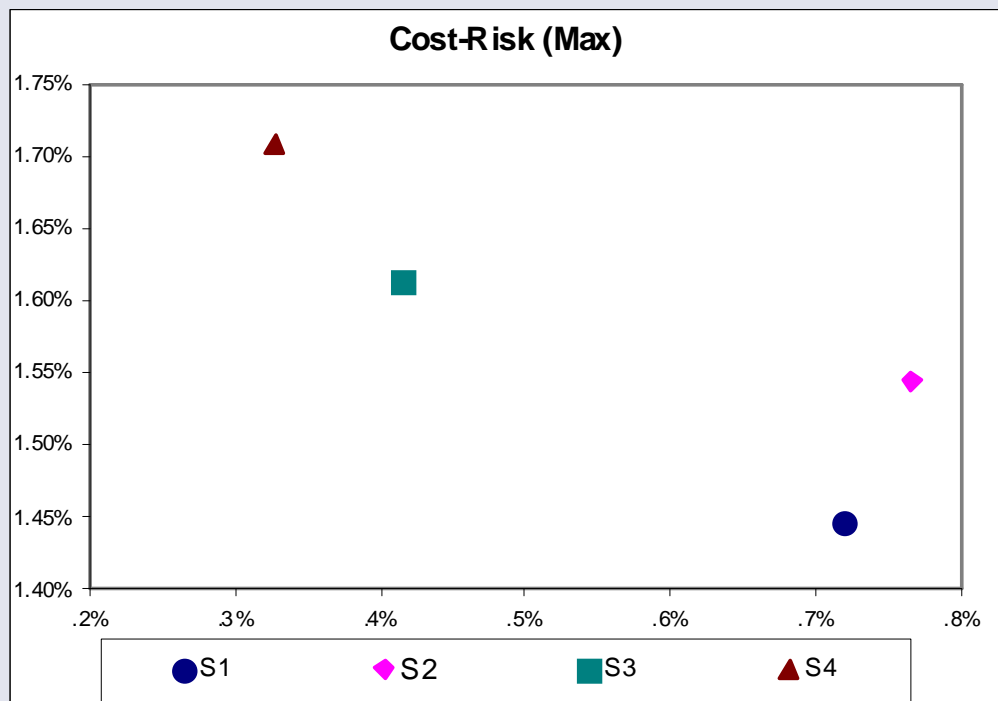
The structure of a risk model



Cash flow simulation

- Starting point is the cash flow on existing debt
 - High quality and timely data is a requirement
- Decide on the time frame of analysis, e.g. 10 year - the choice of time horizon is critical
- Main outputs from a risk model are cash-flows
 - These can be used to calculate a range of cost and risk indicators
- The cost generated by the base scenario for market rates for a given borrowing strategy will be defined as the **expected cost**
- **Risk** is defined as the deviation from expected cost, when using a deterministic model

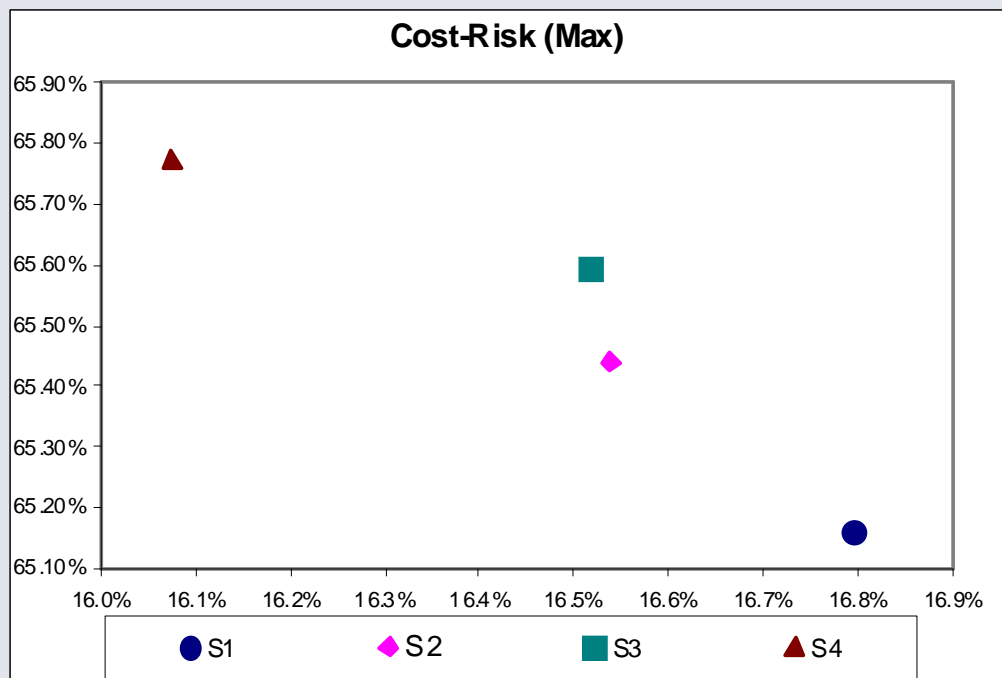
Model output example: interest cost/GDP



- S1: “Status quo”
 - 70% ext / 30% dom
 - Heavily concessional
- S2: “Shift to quasi-concessional”
 - 70% ext / 30% dom
 - Less concessional, reflecting graduation to blend status
- S3: “Develop domestic market”
 - 70% ext / 30% dom
 - Rebalance mix of domestic tenors to widen and deepen investor demand
- S4: “Pessimistic”
 - 60% ext / 40% dom
 - Less concessional
 - Closure of long-term domestic segment

Differences from base	S1	S2	S3	S4
Base				
parallel shift	0.21%	0.28%	0.30%	0.33%
flattening of curve	0.21%	0.28%	0.30%	0.33%
reevaluation of peg	0.31%	0.30%	0.30%	0.25%
repeat 2008 ER shock	-	-	-	-
Combination shock	0.72%	0.77%	0.42%	0.15%

Model output example: debt stock/GDP



- S1: “Status quo”
 - 70% ext / 30% dom
 - Heavily concessional
- S2: “Shift to quasi-concessional”
 - 70% ext / 30% dom
 - Less concessional, reflecting graduation to blend status
- S3: “Develop domestic market”
 - 70% ext / 30% dom
 - Rebalance mix of domestic tenors to widen and deepen investor demand
- S4: “Pessimistic”
 - 60% ext / 40% dom
 - Less concessional
 - Closure of long-term domestic segment

Differences from base	S1	S2	S3	S4
Base				
parallel shift	0.56%	0.73%	0.79%	0.84%
flattening of curve	0.56%	0.73%	0.79%	0.84%
reevaluation of peg	16.79%	16.54%	16.52%	16.07%
repeat 2008 ER shock	2.14%	2.11%	2.07%	2.05%
Combination shock	3.07%	3.18%	2.28%	1.62%

The use of model-output



- Different borrowing strategies can be analyzed by comparing cost and risk for a range of future scenarios for market rates
- The debt manager should be careful to cover all dimensions of cost and risk
 - Examples:
 - Nominal interest cost versus outstanding debt - where the latter would reflect the effect on the debt of a currency depreciation
 - Debt maturing in 1 year versus average time to refinancing
- The debt manager should carefully select and use a set of cost and risk indicators to ensure that important risks are not ignored

Typical experiences from working with risk models



- Not the main basis for decision-making, rather a supplement to experience, sound judgment, etc. – provide additional foundation for making better informed choices
- A scenario analysis model will not provide an “optimal” debt portfolio, but provides information that will allow cost-risk comparisons, and increases knowledge of the options and constraints facing the debt manager
- Clarifies framework for decision-making
- Working with risk models requires a considerable investment in resources, and model development is an ongoing process
- Typically, the incentive structure in a debt office is different from Wall Street
 - Abuse less likely (and no examples of abuse)
 - Rather than abuse, the main risk seems to be that the model is “inaccurate” by not capturing the characteristics of the existing and new debt

Off-the-shelf or in-house-developed model?



- Model development requires
 - Adequate staff and software
 - Time – often trial and error
 - Focus on key person risk
- Buying an off-the-shelf model is tempting, but supply is very limited – and will often imply acquiring a black box
 - Flexibility and ability to adjust model is important, especially if country-specific circumstances needs to be reflected
 - Building and maintaining your own model allows you to obtain a deeper understanding of the dynamics of the debt portfolio
- The MTDS Analytical Tool could provide a starting point

Concluding Remarks



1. A risk model will not tell you how to structure the public debt
 - But it will provide information in a systematic way to help make decisions
2. Use models to analyze the problems and questions that you face
 - Country circumstances vary
3. The modeling process is an art as well as a mathematical exercise, because you are making choices to simplify the real world
 - Repeated experimentation deepens the understanding of the dynamics of the debt portfolio
4. There is no evidence that models used in public debt management are “abused”
 - Problems relate more to poorly specified models and scenarios, and one-dimensional view of risks

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