

THE WORLD BANK AND INTERNATIONAL MONETARY FUND



**DEVELOPING A MEDIUM-TERM DEBT MANAGEMENT
STRATEGY (MTDS):
THE ANALYTICAL TOOL**

USER GUIDE

May 2009

Disclaimer

The Medium Term Debt Management Strategies (MTDS) Analytical Tool (AT) has been developed as a tool for illustrating the cost and risk trade-offs associated with different debt management strategies. Under certain circumstances, the AT can provide useful input for developing a country's borrowing. It is recommended that users of the consult with the staff of the World Bank and the International Monetary Fund (IMF) in utilizing the AT.

While the AT may be used as a quantitative tool in developing a borrowing strategy, any decisions on the borrowing strategy and its implementation should be undertaken with due regard to the instructions in the Guidance Note for Country Authorities issued together with the MTDS, after due consideration of all relevant factors specific to a specific country's situation, in conformity with all applicable laws and regulations and pursuant to all such authorizations as may be required.

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INTERNATIONAL MONETARY FUND

**Developing a Medium-Term Debt Management Strategy (MTDS)—
The Analytical Tool**

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I. INTRODUCTION

The Analytical Tool (AT) is an integral part of the MTDS Toolkit, developed to provide a quantitative analysis as input to the MTDS decision-making process. The AT is a spreadsheet-based application that allows projecting cash flows as a function of: (i) existing debt; (ii) macroeconomic assumptions, i.e. the primary balance; (iii) new borrowing strategies; and (iv) financial variables, including interest rates and exchange rates. The tool then simulates different cash-flows under various scenarios. The output of the tool is a quantification of the costs and risks associated with a particular debt management strategy.

The AT facilitates the quantification of costs and risks for each strategy under consideration. By illustrating the consequences of following a particular strategy under various scenarios for macroeconomic and market variables, it gives insight into the key vulnerabilities embedded in the specific strategy under consideration. The output, generated by the AT is a number of cost and risk indicators, for example annual interest payment-to-GDP and the nominal stock of debt-to-GDP. Risk is measured in terms of the increase in cost, given a particular macro and market scenario, relative to the baseline.¹ The AT different cost and risk indicators, allow countries to focus on those measures most relevant for their needs.

The AT has been designed to show the details of all cash flow calculations at every step of the process. Intermediate cash flows as well as Excel functions are explicitly shown at every stage, allowing the user to track the assumptions underlying the analysis. Thus, the AT is not only useful for the quantitative analysis underlying a debt strategy, but is also a useful device for building capacity in the debt office. Finally, once the desired debt management strategy is implemented, the AT can be used to measure adherence to the strategy, and re-evaluate the cost-risk alternatives should there be a change in market conditions or the authority's risk preference.

II. GENERAL ARCHITECTURE

The analytical tool is comprised of four separate spreadsheets: (i) SDModelV1.xls, (ii) StrategyFile.xls, (iii) ScenarioFile.xls, and (iv) ScenarioAnalysis.xls (see Figure 1 below). The input spreadsheet SDModelV1.xls² specifies the model, using information on existing debt, macroeconomic framework, interest rate trajectories for individual instrument groups and currencies, and the size and timing of shocks, among others. In particular, the initial input necessary to project future cash flows requires the following information:

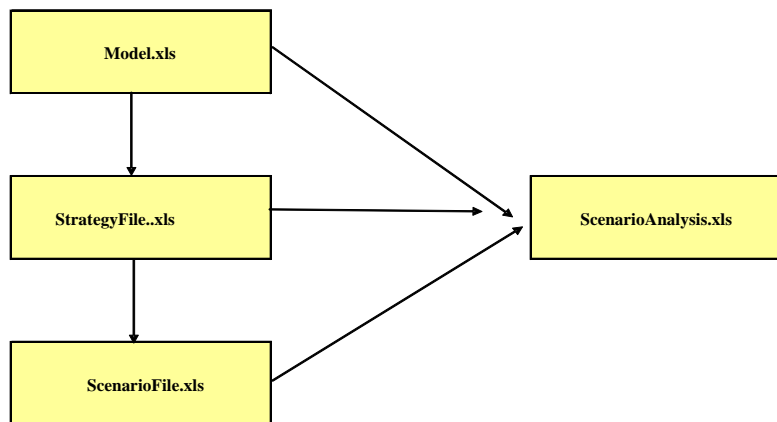
¹ The AT employs a deterministic framework for measuring risk. For a detailed discussion of cost and risk indicators, see Appendix 3 of World Bank and IMF (2009) "Developing a Medium-Term Debt Management Strategy (MTDS) – Guidance Note for Country Authorities", available at <http://siteresources.worldbank.org/INTDEBTDEPT/Resources/468980-1238442914363/MTDSGuidanceNoteCA.pdf>

² Before running the model please ensure that the following reference box in the VBA project is checked: atpvbaen.xls

- i) loan by loan information about the existing debt portfolio;
- ii) projection of market rates (yield curves and exchange rates);
- iii) government primary balance estimates and other macroeconomic variables (e.g., nominal GDP, foreign reserves, exports etc); and
- iv) future financing strategies.

The sheets StrategyFile and ScenarioFile detail alternative financing strategies and shock scenarios, respectively. Once these spreadsheets are populated and different shocks applied to each financing strategy, the model will simulate individual cash flows for each financing strategy. The Scenario Analysis.xls spreadsheet uses the specifications provided in the other three spreadsheets to run the model under alternative financing strategies and shocks, and generates the outputs.

Figure 1. The General Schematic of the AT



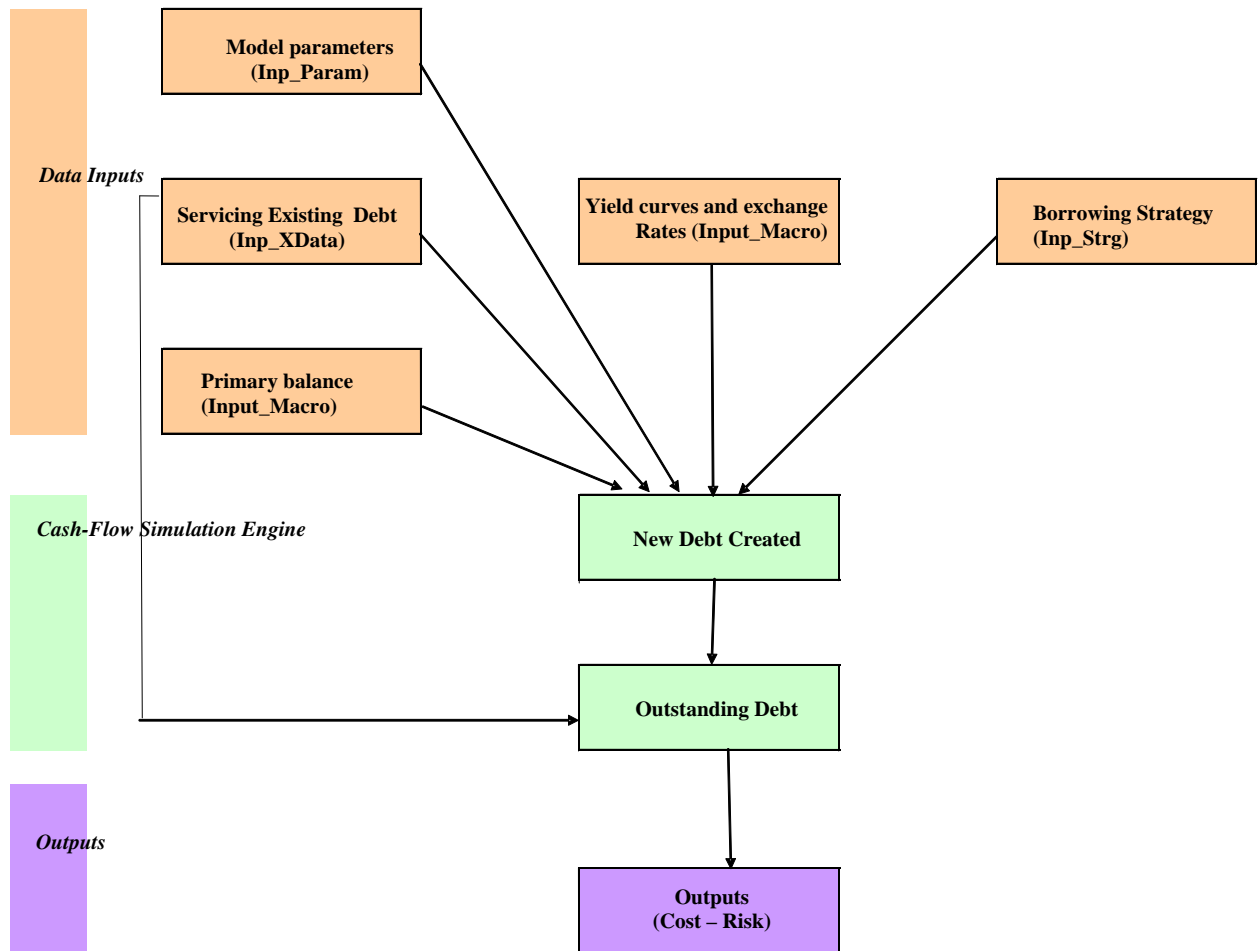
III. SETUP OF INITIAL CONDITIONS AND DATA PREPARATION (MODEL.XLS)

The workbook Model.xls contains 5 input data sheets (Inp_Param, Inp_XData, Inp_Macro, Inp_Scen, and Inp_Strg), a simulation engine and one output worksheet (Out_Annual). This spreadsheet also contains a Help worksheet that provides brief information on the Model.xls and some procedures.³ In Model.xls, tabs for input data sheets are colored in orange, while tabs for output sheets are in purple. Figure 2 provides an overview over the different sheets.

³ Specifically, the Help worksheet describes: (i) sheet names in Model.xls and their function; (ii) spreadsheet conventions (e.g., yellow cells require input; gray cells should be ignored); (iii) the sheet MainMenu and how to change the structure of the model; (iv) input of details for Existing Debt required in sheet Inp_Xdata; and (v) a schematic of the principle used for defining borrowing strategies.

The input data worksheets require the specification of model parameters, debt servicing cash flows stemming from existing debt, and macroeconomic variables, including the calculation of yield curves and other pricing factors. The borrowing strategies are specified in a separate workbook (Financing strategies.xls) for transparency and organizational reasons, but are then one by one copied into the model (Model.xls) to run through the engine and produce total cash flows (from existing debt and new debt). The interrelation of these building blocks is depicted in Figure 2 and will be described in more detailed in the corresponding sections.

Figure 2. Schematic of Model.xls



A. Input Parameters (worksheet Inp_param)

To start running the model, save all four spreadsheets on c:/Temp and open the template SDModelV1.xls. The model is initialized with the basic parameter values specified by the user in the worksheet Inp_Param.⁴

i) Model parameters and miscellaneous information

The left-hand tables in the sheet specify the following basic timing inputs:

- 1) Cash flow frequency - annual or semi-annual - defined by the number of interest payments and principal repayments per year as 1 or 2, respectively (Figure 3 below). The default value assumes annual data;
- 2) Existing debt as of: Year - denotes the year for which existing debt characteristics and cash flows forecasts are provided (i.e. the base year). The next year represents the first projection year of the model.
- 3) Maximum maturity of existing debt – depicts the horizon specification for the maximum maturity needed for calculation purposes;
- 4) Projection horizon: the horizon specification for the projection. The model shows projections for 10 years, but generates the full cash flows of loans beyond the projection horizon. If a longer projection horizon is desired, then the structure of the model needs to be changed as described in Appendix I.

Figure 3. Frequency and Horizon of Data

Frequency and Horizon	
Cash Flow Frequency N of Periods per Y	1 Annual
Existing Debt as of: Year Year	2007
Maximum Maturity of Existing Debt N of Years	50
Projection Horizon N of Years	10

⁴ For any questions regarding the tool, please contact Cbraga@worldbank.org and Udas@imf.org.

ii) *Miscellaneous Information Table*

This Table supports the data organization of the tool. It indicates the various sources of the data and ensures the consistent application of units by explicitly mentioning the unit of the cash flow (Figure 4).

Figure 4. Miscellaneous Information Table

Miscellaneous Information	
Source of Data	File Name
External Debt	C:\SDM...
Domestic Debt	C:\SDM.....
Macro Economic Data	C:\SDM...
Cash Flow Unit	
	Million

iii) *Currency Information Table*

Many countries have a substantial number of different currencies in their portfolios. From a modeling point of view, handling a large number of different currencies (as well as yield curves in each currency) is cumbersome, and does not add much value from the perspective of identifying the main risks to debt portfolios. Moreover, basket currencies such as the SDR is split into their component currencies as discussed below. The AT, therefore, only operates with a limited number of currencies (four in the typical set-up), such as for example the USD, EUR, JPY and the local currency. For the denomination of the remaining debt portfolio, the user needs to assign one of the main currencies (Figure 5).

Figure 5. Currency Information Table

Currency Information						
NCurr	4					
Currencies	Code	Description	Numeraire	ExchRate	DiscRate	Kch/USD
1	USD	US Dollar		1	5.000%	1
2	EUR	Euro		1	5.000%	1
3	JPY	Japanese Yen		1	5.000%	1
4	MYK	Domestic Cl	1	1	0.000%	1
Numeraire Currency			4	MYK		

The exchange rates with respect to USD are input in the column Xch/USD. In the ExchRate column, the conversion of exchange rates relative to the numeraire currency is undertaken automatically. The cell NCurr (K7) specifies the number of currencies used. The list can include up to seven currencies. The default is set at four.

For calculation of NPV's, the default for discount rates is set to match the rates in the Debt Sustainability Framework (DSF). For the time being, the DSF does not assign a discount rate to local currency debt, and this rate can be changed by the user if desired.

iv) Composition of Currency Baskets table

A currency basket is a selected group of currencies whose weighted average is used to the amount of an obligation, such as for example the Special Drawing Rights (SDR). They are typically used by multilateral lenders. Typically, the composition of the baskets are roughly similar to the Special Drawing Rights (SDR). In the model, the user can specify the SDR as well as a user-defined currency basket. To allow analysis of currency exposure, the loans expressed in currency baskets are split into component currencies and the components are treated as separate loans but with the same terms and tenure.

The values in the currency basket for the SDR can be downloaded from the IMF website.⁵ The basket is simplified to three currencies, with the English Pound added to the euro. A currency basket may be specified either in terms of the currency values in one unit of the basket, or in terms of a percentage composition by currency components.

Let us use an example to show how the SDR is broken up into different currencies. Each unit of SDR is, currently, a basket of 0.632 units of U.S. dollar, 0.41 units of Euro, 0.09 units of Pound Sterling and 18.4 units of Japanese yen. Multiplying each weight with the respective exchange rate expressed in U.S. dollar terms, yields the U.S. dollar equivalent for each of the currencies. For example, the U.S. dollar equivalent for the U.S. dollar would be 0.632 times 1 equal to 0.632. (see Figure 6)

Figure 6. Currency Basket Table

Composition of Currency Baskets		
Basket Number	1	2
Basket Name	SDR	IDI
by CurrencyValue/Pct	Value	Value
USD	0.632	0.632
EUR	0.536	0.536
JPY	18.4	18.4
MYK	0	0

In a basket defined in terms of percentage composition, the values of the portion of loan in different currencies are distributed according to the basket specification (e.g., 50 percent in U.S. dollar, 25 percent in Euro and 25 percent in Japanese yen) at the time of disbursement. In either case, exchange rate fluctuations will change both the value of the loan and its currency composition.

⁵ http://www.imf.org/external/np/fin/data/rms_sdrv.aspx

v) Borrowing instruments table

A critical part of defining the inputs in the AT is to describe the characteristics of the instruments that will be used to cover future funding needs in the table “Borrowing Instruments (see Figure 7). As a default, the tool allows for a maximum of 8 different instruments. Together with 4 currencies, this gives rise to 32 possible instrument combinations available to describe existing debt (see section III.B. Inp_XData) and specify various future borrowing strategies. Needless to say, every instrument need not be used in each currency.

Beside instruments that describe existing debt, the user also needs to specify new instruments that are envisaged for new borrowing and that are not already represented in the set of existing instruments. For instance, the borrowing strategy so far entailed 90 percent financing from multilaterals with the remaining 10 percent in domestic 1 year government securities. However, the government would like to consider a 10-year bilateral non-concessional loan as part of their borrowing strategy. Under such circumstances, the characteristics of this non-concessional loan need to be specified in the Borrowing Instruments table.

The model can be set up with a maximum of 20 instruments per currency, but reducing the analysis to a limited number of instruments (such as, say, 8) keeps the model tractable without losing valuable information. For more information on how to expand the number of instruments, please go to Appendix I.

Figure 7. Borrowing Instruments Table

Borrowing Instruments							
NRate	8	Type of Instrument	Short-/ Rate	Maturity	Grace	Basket	
Instruments	Instrument Name	Instrument Type Code	Long-Term Reference	(# Years)	(# Years)	Currency	
1	Variable Rate	Variable	1 LIBOR_ST	1	0	Market	
2	Variable Rate	Variable	2 Var_5Yr	5	4	Market	
3	Variable Rate	Variable	2 Var_10Yr	10	9	Market	
4	Fixed Rate	Fixed	2 Multi_Conc	40	10	1	
5	Fixed Rate	Fixed	2 Bi-Conc	10	5		
6	Fixed Rate	Fixed	2 Fixed_2Yr	2	1	Market	
7	Fixed Rate	Fixed	2 Fixed_5Yr	5	4	Market	
8	Fixed Rate	Fixed	2 Fixed_10Yr	10	9	Market	

The first four columns of the Borrowing Instruments Table contain basic identifiers such as the sequence number of the instrument for identification, the instrument’s name, its type in words as well as its type code. The code is described in Table 1.

Table 1. Types and Type Codes of Debt Instruments

Instrument Type	Instrument Type Code	Characteristics of Cash Flows
Variable	1	Debt with variable rates, where the interest rate is linked to a market rate and is reset periodically.
Fixed	2	Fixed rate debt where the interest rate is fixed at issuance and the rate remains constant until maturity.

There may be multiple debt instruments of the same type with different values for the debt parameters. For instance, there may be 3 fixed rate debt (type 2) instruments with maturities of 2, 5 and 10 years, respectively.

The next column specifies whether debt is short term (code 1) or long term (code 2). Debt which matures originally up to one year is considered in the model as short term. Instruments with an original maturity above one year is considered long term.

The Rate Reference identifies and provides a short description of the instrument. Examples are Fixed-10Y for a loan with a fixed interest rate and a 10 year maturity or Conc for a concessional loan.

The column Basket Currency is relevant for the interest rate determination. Numeric value(s) indicate the relevant currency basket – the standard multi-currency baskets such as SDR for IDA debt could be marked as 1, while 2 is used for the user-defined basket. The indicator “Market” refers to debt for which interest rates are generated from yield curve projections (see Section IV.C describing exchange rate and interest rate trajectories). If the cell in the AD column is left blank, then the user is assumed to define the relevant rate(s).

B. Existing Debt Data (worksheet Inp_XData)

This worksheet consists of four tables: 1. Outstanding amount and classification variables (A20:Q52); 2. Projection of Repayments (AA20:CD52); 3. Projection of Average Interest Rate (fixed-rate debt) or Average Spread relative to Reference Rate (variable rate debt). (AA70:CD102); 4. Summary statistics of existing debt (B68:H165). Shortcuts to these tables are provided at the top of the worksheet (B5:B9).

The first three tables represent required inputs, while the function of the fourth table is to provide a summary of existing debt.

There are three options for entering debt service cash flows stemming from existing debt into the worksheet Inp_XData.⁶ The first option is to calculate projections of interest and

⁶ Existing debt may here also include loans that have been signed but not yet disbursed.

principal payments according to aggregated instruments as defined in table “Borrowing Instruments” in sheet Inp_Param and to paste them into Tables 2 (Projections of Repayments) and 3 (Projection Average Interest Rate). Note that projections of repayment and average interest rate have to be provided for the entire maturity of the loan. Moreover, if data has been prepared externally, then the original and outstanding amount, the instrument, rate and currency code, and repayment and interest projection code (columns P and Q, respectively) needs to be filled into Table 1 (see Figure 8). The second option is to enter the aggregated information requested in row 20 of Table 1 for all instruments and to have the model project repayments and interest rates by setting the repayment and interest projection codes to 1. Note that if the user wants to generate interest and principal payments within the tool, all the fields of Table 1 have to be populated (e.g., grace and grace period, spread and so on). Finally, loan by loan data could be entered into the worksheet.⁷

Figure 8. Inputting Instrument Data

Existing Debt (Amounts in Millions of Indicated Currency)														
Number	DebtID	Year	Semester	Original Amount (Millions)	Maturity	Grace	Current Outstanding (Millions)	Instrument Type	Rate Code	Interest Rate	Spread	Currency Number	Currency Code	Exchange Rate
1	FBC1_1	2007	1	130.7315			130.73	2	5			1	USD	1
2	FBC2_2	2007	1	140.5899			140.59	2	5			2	EUR	1
3	FBC3_3	2007	1	115.3501			115.35	2	5			3	JPY	1
4		2007	1											
5	FMC1_1	2007	1	686.2182			686.22	2	4			1	USD	1
6	FMC2_2	2007	1	616.3174			616.32	2	4			2	EUR	1
7	FMC3_3	2007	1	138.5594			138.56	2	4			3	JPY	1
8		2007	1											
9		2007	1											
10	FOC1_1	2007	1	72.2812			72.28	2	5			1	USD	1
11	FOC2_2	2007	1	76.3911			76.39	2	5			2	EUR	1
12	FON1_1	2007	1	846.8188			846.82	2	8			1	USD	1
13	FON2_2	2007	1	6.4993			6.50	2	8			2	EUR	1
14		2007	1											
15	VON1_1	2007	1	78.1694			78.17	1	3			1	USD	1
16	VON2_2	2007	1	195.9462			195.95	1	3			2	EUR	1

Table 2 and 3 contain the principal repayments and average interest rate/spread relative to reference rate,⁸ respectively (Figures 9 and 10).

Figure 9. Principal Repayment Cash Flows

Principal Repayments (Amounts in Millions of Indicated Currency)				
Number	DebtID	2008	2009	2010
1	FBC1_1	3.52	4.31	5.87
2	FBC2_2	2.10	2.25	2.48
3	FBC3_3	4.23	4.24	4.24
4				
5	FMC1_1	26.01	15.00	9.03

Figure 10. Interest Rates and Spreads (variable debt)

Average Interest Rate/Spread				
Number	DebtID	2008	2009	2010
1	FBC1_1	2.09	2.08	2.06
2	FBC2_2	1.09	1.15	1.19
3	FBC3_3	1.99	1.95	1.90
4				
5	FMC1_1	0.75	0.76	0.77
6	FMC2_2	0.76	0.77	0.77
7	FMC3_3	0.75	0.76	0.77

⁷ If the third option is chosen, then it seems unlikely that the 32 rows, defined by default, will suffice for listing all loans. In that case, the user will need to change the structure in the following way: insert necessary amount of rows without interfering with the Summary table. Once the rows have been populated, open the hidden worksheet MainMenu and click on the button existing debt. This runs a macro, which ensures that the interest and principal payments are appropriately calculated using the entered existing debt data. More information can be found in Appendix 1.

⁸ The reference rate is specified in Inp_Scen (see Section V.3)

The information provided in Sheet Inp_XData feeds into the worksheet XDebt (colored in light blue), where cash flows for each instrument by currency are generated as a function of the debt parameters and the forecasted market rates.

IV. BASELINE ASSUMPTIONS

The baseline represents the most likely future trajectory of the required macro and market variables. The key variables for the baseline are the macroeconomic variables (Inp_Macro), the current market information, such as yield curve and credit risk premium (Inp_Macro) as well as the future market rates (Inp_Scen).

A. Macroeconomic Variables (worksheet Inp_Macro)

In the top table (A28:P54) of the Inp_Macro worksheet, the user will input macroeconomic variables (see Figure 11). The primary fiscal balance (overall fiscal balance net of interest payments) is the central input for the calculation of future funding needs, and therefore, future cost. Other macro variables are used for calculating cost and risk indicators. The external financing minimum and domestic financing minimum (rows 48 and 49) represent amounts envisaged to close the balance of payments financing gap and/or implement domestic market development plans, respectively. Typically, the baseline macro-variables will be taken from the most recent debt sustainability analysis, or prepared by the entity in the Ministry of Finance responsible for fiscal planning/forecasting.

Figure 11. Input of Macroeconomic Variables

Year	2007	2008	2009	2010
Running Count of Year	0	1	2	3
Macroeconomic Information (Amounts in Million MYK)				
Source:	C:\SDM\...			
Primary Deficit				
Primary Deficit		1,067	1,113	1,119
Macroeconomic Indicators				
Government revenues including grants	3,776	4,799	5,364	6,455
Government revenue	3,776	4,799	5,364	6,455
Grants				
Government expenditure	4,484	5,866	6,477	7,574
Government interest expenditure				
Government non interest expenditure	4,484	5,866	6,477	7,574
Other Expenditure				
Overall balance (deficit)	707	1,067	1,113	1,119
Primary deficit	707	1,067	1,113	1,119

B. Yield Curve and Credit Risk Premium

Assumptions about future yield curves determine the cost of future borrowing. In some cases, only limited information about existing domestic yields is available and observations may be limited to the short end of the yield curves.

The data in the second section of the worksheet Inp_Macro (from row 58 onward) provides the input for estimating the yield curve (see Figure 12). The user is asked to enter data on the four yield curves: USD, EUR, JPY and the domestic currency in table "Yield Curve" (rows 60-65). A choice for fitting the curve is provided in column C and entails the piecewise linear and cubic spline functions, which extrapolates a value on the yield curve for every year based

on point information of the outstanding securities. Row E specifies the maximum maturity of the yield curve, which in the default case represents 30 years, while cell E65 represents the numeric code for the currency on which the domestic yield curve will be calculated. It can take values 1, 2, 3 (one of the foreign currencies) or 0 (if a domestic yield curve is available).

Figure 12. Input of Yield Curve Data and Inflation

Market Information									
Yield Curve									
Currency	Curve Fitting Method	Terms (Years) ==>	30	0	1	2	3	4	5
1 USD	1				1.800%	1.963%			2.764%
2 EUR	1				1.800%	1.963%			2.764%
3 JPY	1				1.800%	1.963%			2.764%
4 MYK	1	1			12.300%	12.800%	13.950%	14.475%	15.000%

Credit Risk Premium for Country									
Currency	Curve Fitting Method	Terms (Years) ==>	0	1	2	3	4	5	
1 USD	1				2.500%				
2 EUR	1				2.500%				
3 JPY	1				2.500%				
4 MYK	1								

Inflation Rate Forecast									
Currency	Terms (Years) ==>	0	1	2	3	4	5		
1 USD			1.836%	1.836%	1.836%	1.836%	1.836%		
2 EUR			1.836%	1.836%	1.836%	1.836%	1.836%		
3 JPY			1.836%	1.836%	1.836%	1.836%	1.836%		
4 MYK			11.066%	8.551%	10.020%	5.861%	5.369%		

In the context of deriving the external yield curve, the user has to input the credit risk premium in rows 70 – 75. The credit risk premium for the country is estimated according to the difference of comparable securities that exist in the market relative to reference securities. If no such securities exist, then the user needs to specify an estimate of the sovereign risk premium or use premiums from other similar countries for which this estimate is available.

In the context of deriving the domestic yield curve, the final ingredients for constructing the yield curves are the relevant inflation rates. Usually, these rates would be assumed to differ within a, say, 3-5 forecasting period, and assumed constant thereafter (representing the steady state assumption). The user need to specify inflation rate forecasts in rows 80 to 85. With all these data specified, the user has now prepared the ground for estimating the yield curves and for defining the reference rate basis for the variable loan instruments.

C. Future Market Rate (worksheet Inp_Scen)

This worksheet is used to input interest and exchange rates assumptions/scenarios. The first part of the worksheet deals with market scenario information encompassing interest rates, exchange rates, and spreads/indexes/premiums relative to the reference rate. This part starts in row 14. Its total size depends on the number of defined currencies and instruments. The second part of the worksheet starts at row 401 and entails calculations of the forward rates of individual currencies. The ordering of the currencies depends on the ordering of the currencies in the Currency Information table in sheet Inp_Param.

i) Market scenarios

The market scenario table consists by default of four currency boxes (one for USD, EUR, JPY, and domestic currency.) Each currency box displays all instruments (eight by default) defined in the worksheet Inp_Param with the accompanying characteristics: the number of each instrument type, and the name of the instrument in column C (see tag 1 in Figure 13) and the maturity in column E. Below the name of the instrument in column C the user can find the type of inputted interest rate, which coincides with the last column in the Borrowing Instruments Table. The first line of each instrument represents the reference rate, while the line below reflects the spread, used for loans with variable interest rate (see tag 2 in Figure 13).

Figure 13. Market Rates in Inp_Scen Worksheet

Market Scenario (Interest Rate, Spread/Premium/Index, Exchange Rate)				Interest Rate Projection				Exchange Rate Projection				
Rates	Instruments	SB\$15:\$RS\$95	Maturity	0	2	3	4	5	6	7	8	
USD	01 Variable	LIBOR_ST	1	2.12646131	2.765998276	3.301955897	3.838603219	3.950246587	4.346063072	4.742250596	5.138807735	
	Market	Spread/Premium/Index		2.375	2.375	2.375	2.375	2.375	2.375	2.375	2.375	
	02 Variable	Var_5Yr	5	2.12646131	2.765998276	3.301955897	3.838603219	3.950246587	4.346063072	4.742250596	5.138807735	
	Market	Spread/Premium/Index		2.875	2.875	2.875	2.875	2.875	2.875	2.875	2.875	
	03 Variable	Var_10Yr	10	2.12646131	2.765998276	3.301955897	3.838603219	3.950246587	4.346063072	4.742250596	5.138807735	
	Market	Spread/Premium/Index		3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	
	04 Fixed	Multi_Conc	40	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	
	Market	1 Spread/Premium/Index		0	0	0	0	0	0	0	0	
	05 Fixed	Bi-Conc	10	2	2	2	2	2	2	2	2	
	Market	0 Spread/Premium/Index		0	0	0	0	0	0	0	0	
	06 Fixed	Fixed_2Yr	2	2.44573074	3.033628596	3.831979	3.894409907	4.147966792	4.369157	4.940341848	5.337083446	
	Market	Spread/Premium/Index		2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	
	07 Fixed	Fixed_5Yr	5	3.19439923	3.639112154	4.034689435	4.402061861	4.741120226	4.7880311	4.771227035	4.69095672	
	Market	Spread/Premium/Index		2.875	2.875	2.875	2.875	2.875	2.875	2.875	2.875	
08 Fixed	Fixed_10Yr	10	3.98816238	4.20363213	4.362307223	4.4747969	4.541158841	4.604251689	4.63553812	4.635098565		
Market	Spread/Premium/Index		3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5		
Exchange Rate				0.09514748	0.09514748	0.095147479	0.095147479	0.095147479	0.095147479	0.095147479	0.095147479	
Parity Rate				0.09514748	0.08726153	0.08007047	0.073503442	0.067503626	0.061998988	0.05696085	0.052348209	0.048123795
Interest Rate for Parity				5	2.12646131	2.765998276	3.301955897	3.838603219	3.950246587	4.346063072	4.742250596	5.138807735
Maturity of Parity Reference Rate (This is the rate used for Parity Exchange Rate Computation)												
EUR	01 Variable	LIBOR_ST	1	2.12646131	2.765998276	3.301955897	3.838603219	3.950246587	4.346063072	4.742250596	5.138807735	
	Market	Spread/Premium/Index		2.375	2.375	2.375	2.375	2.375	2.375	2.375	2.375	
	02 Variable	Var_5Yr	5	2.12646131	2.765998276	3.301955897	3.838603219	3.950246587	4.346063072	4.742250596	5.138807735	
	Market	Spread/Premium/Index		2.875	2.875	2.875	2.875	2.875	2.875	2.875	2.875	

The user can define the type of interest rate and exchange rate projection by changing the two green drop-down menus at the top of the Market scenario in row 14 (see tag 3 in Figure 13). In both cases, the user has three choices, of which two are common: user defined and constant rates. The third choice for the interest rate projection is the term structure, while for the exchange rate projection one can use the interest rate parity (see Box 1). In the case of constant rates, in column F (or at time 0) the user is required to input the interest rate which is going to be constant over time.

Box 1. Uncovered Interest Rate Parity (UIP) and Term Structure

UIP

- Interest rate parity is an identity relating interest rates and exchange rates. In brief, interest rate parity states that the spot price and the forward or futures price of a currency incorporates any interest rate differential between two currencies.
- The identity is defined as follows: $(1 + i_{US\$}) = \frac{E_t(S_{t+1})}{S_t} (1 + i_{LC})$

where: $i_{US\$}$ - U.S. interest rate implied by debt of a given maturity; i_{LC} - local currency interest rate implied by given maturity; S_t - spot rate; $E_t(S_{t+1})$ - expected spot rate in the next period

- Thus, it follows that the risk premium is assumed to be 0, implying risk-neutral investors.
- Although empirically this cannot be confirmed, it represents a useful approximation

Term structure

- The term structure of interest rates is associated with the yield curve, which reflects the market's future expectation for interest rates. Thus, forward interest rates include a term structure, which depicts the different forward rates offered to loans of different maturities.
- Example: yield in t is 10 percent and yield in t-1 was 8 percent. Therefore, the forward rate, $r(2)$, say, the forward LIBOR for year 2 is equivalent to:
- $$r^{2,f} = \frac{(1 + 0.1)^2}{(1 + 0.08)} - 1 = 0.12 \text{ or } 12 \text{ percent}$$

The last two lines in every currency box refer to the input for calculating the exchange rate. In the row named Interest rate for parity, the input for the number refers to the relevant maturity to be considered for the parity condition. The default maturity is 1 year.

ii) The yield curve

The ordering of the currencies when calculating the yield curve reflects the ordering defined in the Inp_param worksheet. Also, the choice of the algorithm for fitting the yield curve (linear or cubic spline) for every year is provided next to the name of the currency. The foreign currency yield curves are automatically generated for each year based on the observed yield provided in the macroeconomic data sheet (Inp_Macro). Similarly, the foreign yield curve benchmark for the domestic yield curve is taken from macro sheet (Inp_Macro). The domestic yield curve does not have to have all the observed points. Typically, only the first few years will be represented. This, however, does not prevent the user to make forecasts of the possible slope of the yield curve through discussion with potential market participants (see Guidance Note on the process).

Box 2. An Example of Deriving the Domestic Currency and Domestic U.S. Dollar Yield Curves

- The average par yield on U.S. Treasury bond with maturity m is denoted as:

$$i_{US,t}^m \quad (1)$$

where m is the maturity, $m = 1, \dots, 30$ years. The average par yields are calculated over the period January 1997 – June 2008. The par yield data are obtained from the website of the Federal Reserve Board, <http://www.federalreserve.gov/pubs/feds/2006/200628/feds200628.xls>. This average yield curve is used as the reference curve upon which the domestic yield curve in U.S. dollar terms and domestic yield curves in domestic currency terms are constructed

- The sovereign credit spread (δ_t) over the U.S. Treasury yield curve is:

$$\delta_t = 700bp \quad (2)$$

as the country's foreign currency debt has a B3 rating, and countries within the same category currently issue with a spread of 700 basis points over U.S. Treasuries.

- The U.S. dollar denominated yield curve facing the government of a country is computed as:

$$i_{DOM,US,t}^m = i_{US,t}^m + \delta_t \quad (3)$$

where $i_{DOM,US,t}^m$ is the yield on a U.S. dollar denominated bond with maturity m , $m = 1, \dots, 30$ years, that the government of the country would pay were it to issue that bond.

- The domestic government yield curve is calculated as the yield curve in U.S. dollar terms adjusted for the inflation differential between the local currency (LC) and the U.S. dollar country's:

$$i_{DOM,LC,t}^m = i_{DOM,US,t}^m + \pi_{LC,t} - \pi_{US,t} \quad (4)$$

where $i_{DOM,LC,t}^m$ = the LC yield on a domestic bond with maturity m , $m = 1, \dots, 30$ years, that the government of Moldova would pay were it to issue that bond, $\pi_{LC,t}$ = domestic inflation, and $\pi_{US,t}$ = U.S. inflation.

In future periods of the scenario analysis, the forward U.S. Treasury yield curves are used as the reference curves upon which the U.S. dollar and domestic yield curves for Moldova are built using steps (2) to (4).

A more detailed description of the steps necessary to define the yield curve is provided in Appendix III.

V. FINANCING STRATEGIES (INP_STRG)

A key determinant of the output of the analysis is how future funding needs are covered, i.e. the user will have to formulate a strategy for covering the annual funding needs with the objective of eventually achieving a debt structure reflecting the borrowing mix. As the first step, the user should ensure that the 1. Flow strategy button is activated (see tag 1 in Figure 14). This choice allows analyzing different strategies for covering the annual funding needs. Initially, the user would typically work with strategies that are kept constant throughout the period analyzed. Once feasible strategies have been identified, this assumption may be relaxed, and the financing strategies can be adjusted from year to year. This may be useful in situation where there is a strong focus on market development, and where the maturity of domestic securities is gradually extended.

The model allows for managing the rollover of existing debt through choices of how much of the annual funding needs to be covered through the so-called “free pool”, and “FX” and “DX” pools, respectively. The background for this choice is the fact that public debt portfolios in practice are often quite skewed in the sense that domestic debt has short maturity, while FX debt has longer maturities. A strategy where the funding need is covered 50/50 in domestic and FX borrowing, would quickly lead to a debt structure that is even more skewed towards FX debt moving away from the structure implied by the borrowing strategy. The free pool/FX-DX pool-distinction allows the user to control the development of the overall structure of the debt. It forces a portion of annual funding needs to be financed according to a different borrowing strategy than the one systematically applied to the residual.

As mentioned above, the first step of the analysis would typically be to focus on flow strategies that are kept constant through time. Similarly, the initial choice for the rollover would be to choose zero percent for both “DX pool” and “FX pool”, implying that maturing debt as well as the overall budget deficit (i.e. the funding need) is covered by the strategy for the free pool. The user needs to specify the free pool instrument mix (i.e. the financing strategy), which allocates the distribution of financing to be entered in cells F16:F23.

If the user, after following the above approach, decides that there is a need to control the debt composition more tightly, he can choose shares of the funding need stemming from maturing debt to be covered by the DX and FX pools, respectively. It is advised to initially choose 1 for both of these pools. The implication is that domestic debt maturing will be refinanced with new domestic debt, and FX debt maturing will be replaced by new FX debt. Next, the user has the possibility to specify the instruments to be used for the DX and FX pools. It is advised that the strategies chosen (in cells in cells F156:F163 for the DX pool, and cells F86:F93 for the FX pool) are identical to the financing strategy chosen for the free pool. If not, the user may easily lose track of the overall strategies analyzed, which are the basis for the cost and risk analysis.

Note that the user has the option of choosing variables for the DX and FX pools that are different from 0 or 1. If alternatives are chosen, the same warning stated above – the risk of losing sight of what is analyzed and where effects stem from – applies.

Note that all outstanding instruments as well as new instruments need to be specified in the Borrowing instruments table in worksheet Inp_param.

Figure 14. The Input Strategy Worksheet (Inp_strg)

Year	Existing	Projection	2007	2008	2009	2010	2011
Running Count of Year	0	1	2	3	4		
Proportion of FX debt service to FX pool	0.500	0.500	0.500	0.500	0.500	0.500	0.500
Proportion of DX debt service to DX pool	0.400	0.400	0.400	0.400	0.400	0.400	0.400

Borrowing Strategy (Instrument and Currency Mix)			Strategy Choice for New Borrowing				
Free Pool	Instrument Mix						1 Flow Strategy
	1 Variable	01 LIBOR_ST	0.282	0.282	0.282	0.282	
	2 Variable	02 Var_5Yr	0	0	0	0	
	3 Variable	03 Var_10Yr	0.001	0.001	0.001	0.001	
	4 Fixed	04 Multi_Conc	0.441	0.441	0.441	0.441	

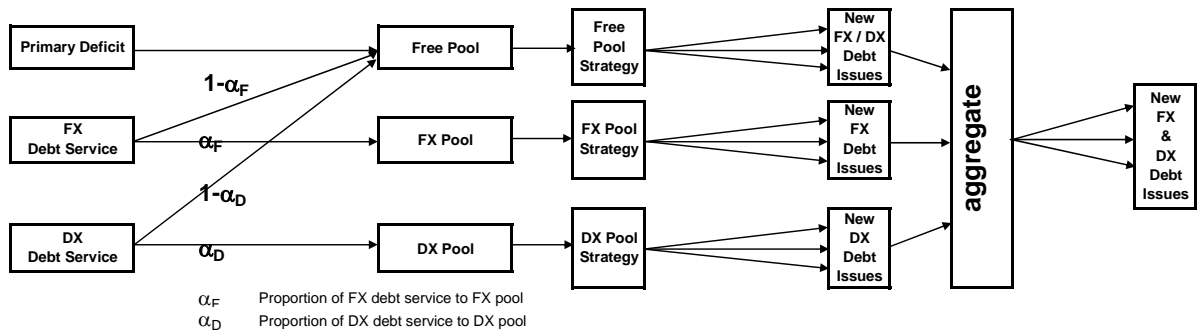
Borrowing Strategy (Instrument and Currency Mix)			Strategy Choice for New Borrowing				
Free Pool	Instrument Mix						
	1 Variable	01 LIBOR_ST		0.282		0.282	
	2 Variable	02 Var_5Yr				0	

Foreign Pool			Strategy Choice for New Borrowing				
	1 Variable	01 LIBOR_ST		0.282		0.282	0.282
	2 Variable	02 Var_5Yr				0	0

Domestic Pool			Strategy Choice for New Borrowing				
	1 Variable	01 LIBOR_ST		0.282		0.282	
	2 Variable	02 Var_5Yr				0	
	3 Variable	03 Var_10Yr		0.001		0.001	
	4 Fixed	04 Multi_Conc		0.441		0.441	

Figure 15 depicts the above described individual steps.

Figure 15 Schematic Description of Defining a Financing Strategy



VI. OUTPUT (OUT_ANNUAL)

The output sheet (colored purple) Out_Annual summarizes the main components of the total cash flow, and provides the option to graph some of the indicators. It provides detailed information on:

(i) total debt; (ii) debt service flows divided into interest payment and principals; (iii) debt servicing capacity, including various ratios of GDP and exports; (iv) measures of refinancing risk; (v) interest rate risk; (vi) debt composition; (vii) debt stabilizing primary balance; (viii) debt growth, and finally; and (ix) the cost measures—annual interest payments/GDP, annual nominal debt service/GDP, and NPV of Debt/GDP.

VII. FINANCING STRATEGIES (STRATEGY FILE.XLS)

Having completed the sheet SDModelV1.xls, the user should open the StrategyFile. This worksheet lists all the different financing strategies, which the user would like to analyze. Each sheet in this template has exactly the same format as the sheet Inp_Strg in the template SDModelV1.xls. To analyze the impact of different borrowing strategies, the user should proceed as follows: 1. Run the baseline and save the SDModelV1.xls under a given name. 2. Paste the next strategy specified in the StrategyFile in the worksheet Inp_Strg located in SDModelV1.xls. 3. Run the model with the new financing strategy and save it under a different name. These costs and risks associated with these different financing strategies will later be compared in the spreadsheet ScenarioAnalysis.xls.

VIII. ALTERNATIVE SCENARIOS (SCENARIOFILE.XLS)

The robustness of a given strategy is tested under alternative scenarios, which are defined in the spreadsheet ScenarioFile.xls. In general, the scenarios are generated to estimate the effects of i) changes in interest rates; ii) changes in exchange rates; iii) combination of the above.

Different market scenarios for interest rates and spreads as well as the exchange rates are provided in the worksheet Inp_Scen in the workbook SDModelV1.xls. Each worksheet in the ScenarioFile.xls file has the same structure as Inp_Scen. The spreadsheet is set up for 5 different scenarios, the Base scenario and 4 alternative scenarios, which are described in detail below.

The stress tests in the AT are flexible and can accommodate a shock of any size and of any length (e.g., one period, two period shocks, up to a permanent shock). The default shocks in the current set up is for a permanent interest rate shock in period 1, and a permanent devaluation in period 3. In addition, the user also has the option to create additional scenarios, which are also explained in this section.

To run the alternative scenarios, the user should first copy the worksheet Inp_Scen from the workbook SDModelV1.xls into the worksheet Base. As can be seen in Figure 16, the structure of the Base sheet is identical to the worksheet Inp_Scen of workbook SDModelV1.xls. The example represents a setup of 4 currencies (USD, EUR, JPY, MYK) and 8 instruments. The rates for USD borrowing are shown in rows 16 through 35 followed by EUR rates in rows 36 through 55, JPY rates in rows 56 through 75 and MYK rates in rows 76 through 95.

Next, the user has to specify the desired changes in market interest rates and exchange rates in cells B1:B5 for the interest scenario and in cells D2:D4 for the exchange rate scenario..

Consistent with the default assumption of 4 exchange rates, 4 parameters (DInt_USD, DInt_EUR, DInt_JPY, DInt_MYK) are used to define the amount of parallel shift for the market rates in the 4 currencies in the model.

	Parameter (Col A)	Used for (Col B)
Row 2	DInt_USD	Shift in USD interest rates
Row 3	DInt_EUR	Shift in EUR interest rates
Row 4	DInt_JPY	Shift in JPY interest rates
Row 5	DInt_MYK	Shift in MYK interest rates

For example, an interest rate shock in period 1 for USD (cell G16) is implemented with the formula `'=Base!G16+DInt_USD'` in the worksheet for the shock scenario.

Three parameters (Deval_USD, Deval_EUR, Deval_JPY) are used to define the domestic currency depreciation shock relative to each of the three foreign currencies in the model.

	Parameter (Col C)	Used for (Col D)
Row 2	Deval_USD	Depreciation of MYK vs. USD
Row 3	Deval_EUR	Depreciation of MYK vs. EUR
Row 4	Deval_JPY	Depreciation of MYK vs. JPY

For example, a depreciation of the domestic currency against USD in period 3 is implemented by *dividing* the value of the exchange rate in the base scenario by $(1+Deval_USD)$. Since the exchange rates in the model are expressed in units of local currency, the exchange rate is divided by the devaluation factor.

Base Scenario

As mentioned earlier, the values for the rates in this scenario are the Base reference rates for the model.

Base Scenario

	A	B	C	D
1	Base Scenario			
2	DInt_USD		Deval_USD	
3	DInt_EUR		Deval_EUR	
4	DInt_JPY		Deval_JPY	
5	DInt_MYK			

Values for the change parameters are all zeroes.

FX_Up2Sd Scenario

In this scenario the interest rate in each market rate in each foreign currency is raised by a certain amount. This value entered in cell B2, B3, and B4 represents percentage points. Thus, if the user wants to construct standard deviations based on a historical period, then this needs to be calculated outside of the AT. There are no changes in domestic interest rates assumed and the exchange rates do not change compared to the base scenario. Consequently, the user should leave cells B5 and cells D2:D4 blank.

FX_Up2Sd Scenario

	A	B	C	D
1	Parallel Shift FX 2Sd			
2	DInt_USD	2	Deval_USD	
3	DInt_EUR	2	Deval_EUR	
4	DInt_JPY	2	Deval_JPY	
5	DInt_MYK			

Shows 2 percentage point shock to base rate

DX_Up2Sd Scenario

The principle is the same as described for the foreign interest rates. No changes are assumed in foreign interest rates and the exchange rates remain the same as in the base scenario.

DX_Up2Sd Scenario

	A	B	C	D
1	Parallel Shift DX 2Sd			
2	DInt_USD		Deval_USD	
3	DInt_EUR		Deval_EUR	
4	DInt_JPY		Deval_JPY	
5	DInt_MYK	2		

All_Deval30 Scenario

In this scenario there is a 30 percent depreciation of the domestic currency assumed against each foreign currency in period 3. There are no changes in any interest rate.

All_Deval30 Scenario (30 percent in period 3)

	A	B	C	D
1	Devalue FX 30%			
2	DInt_USD		Deval_USD	30%
3	DInt_EUR		Deval_EUR	30%
4	DInt_JPY		Deval_JPY	30%
5	DInt_MYK			

Different devaluation scenarios may be created by changing the amount of devaluation with respect to each foreign currency in the cells D2, D3 and D4. The value has to be entered with the % sign or as a decimal number (e.g. 0.3)

Up1Sd_Deval15 Scenario

In this scenario, the interest rate for each market rate increases by 1 percentage point. There is also a 15 percent depreciation of the domestic currency against each foreign currency in period 3.

Up1Sd_Deval15 Scenario

	A	B	C	D
1	Parallel Shift FX 1Sd, DX 1Sd, Deval FX 15%			
2	DInt_USD	1	Deval_USD	15%
3	DInt_EUR	1	Deval_EUR	15%
4	DInt_JPY	1	Deval_JPY	15%
5	DInt_MYK	1		

Additional Scenarios

Additional scenarios may be created by copying any of the alternate scenarios into a new worksheet and changing the values of the parameters for changes in interest and exchange rates. The names of the spreadsheets should be such that the first 6 characters provide a unique identification for the scenario.

The deterministic scenario analysis program in the ScenarioAnalysis.xls file uses the first 6 characters of each worksheet name as identification for the corresponding scenario. Scenario names starting with the same 6 characters will create duplicate names for the scenario analysis program and may lead to erroneous results.

An alternative way for creating a new scenario would be to copy any of the scenarios into a new worksheet, give it an appropriate name and then change the values of the rates to any desired specification.

IX. SCENARIO ANALYSIS (SCENARIOANALYSIS.XLS)

Having described all borrowing strategies (*StrategyFile.xls*) and different market scenarios (*ScenarioFile.xls*), the worksheet ScenarioAnalysis.xls would combine the information provided in both workbooks to assess the costs and risks associated with the different financing strategies.

The key purpose of this spreadsheet is to recalculate the cash flows in the simulation model for a given strategy under different alternative scenarios, save the summary output, and repeat these steps for all selected combinations of strategies and scenarios.

A. Spreadsheet Structure

The spreadsheet contains 6 worksheets.

Table 2. Description of Spreadsheet

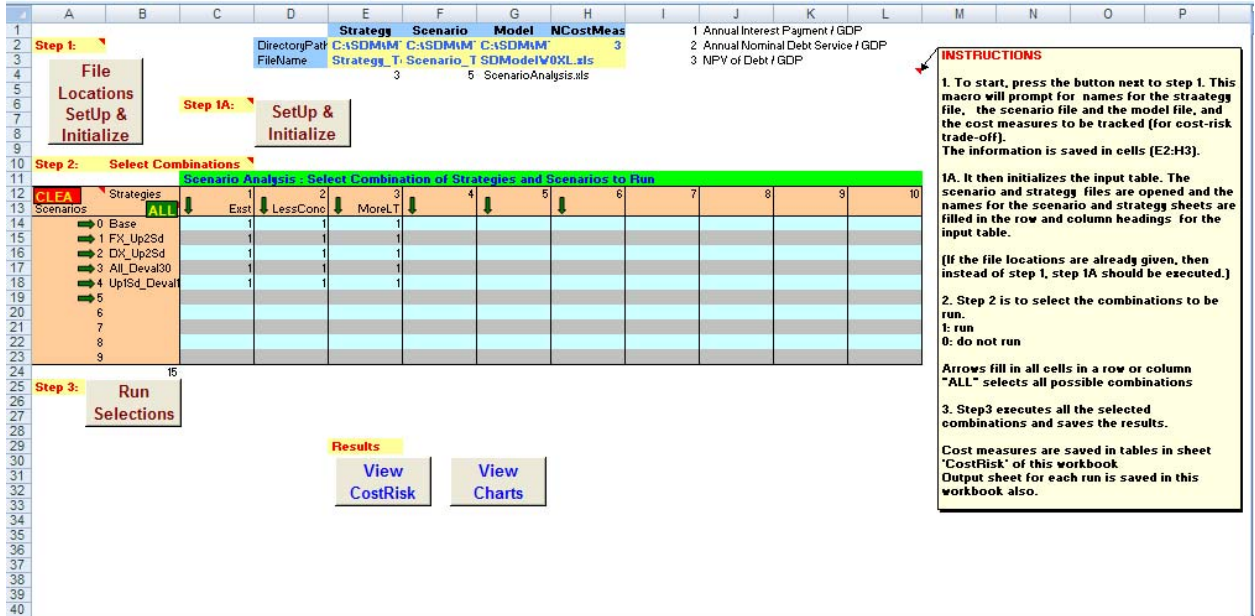
<i>Name</i>	Description
<i>Input</i>	User Interface with buttons and tables for providing input to specify the location of information and to define the scope of scenario analysis
<i>CostRisk</i>	Summary of cost/risk measures for different strategies
<i>SummaryOutput</i>	(to be specified)
<i>GraphList</i>	List of standard graphs for comparing output for different runs
<i>Compare</i>	Graphical Comparison of output for different scenarios
<i>OutputTemplate</i>	Template for Summary Output for each run (During scenario analysis this worksheet is renamed with a concatenation of strategy and scenario names for the first run. New worksheets with the same naming convention are created for each selected strategy-scenario combination)

ScenarioAnalysis.xls is a read-only file. After running the scenario analysis the file should be saved with a different name.

Steps for Running a Scenario Analysis

The inputs for running a scenario analysis have to be provided in the worksheet Input. Its layout is shown in Figure 17 below.

Figure 17. Layout of *Input Worksheet*



The worksheet contains several command buttons, which have been created to facilitate data entry and program execution (see Table 3).

Table 3: Command Buttons

Command Button	Function
File Locations Setup & Initialize	Collects information about Location of files Desired cost measures Sets up worksheet structure Initializes based on parameter values
Setup & Initialize	Assumes file location and cost measures have already been provided Sets up worksheet structure Initializes based on parameter values
Run Selections	Sets up the simulation model with each strategy-scenario combination selected for the analysis and saves results
View CostRisk	For viewing the cost-risk measures

Create Comparison Charts	For creation of graphs to show comparison between different scenarios of some selected statistics.
---	--

To run a scenario analysis the user has to proceed as follows:

Step 1 : File Specifications, Selection of Cost Measures, Initialization

The first step is to provide information about the location of files and the cost measures to be used for analysis. This is initiated by pressing the command button shown on the right.

**File
Locations
SetUp &
Initialize**

This brings up the following dialog box soliciting information about the location of different files.

The dialog box is titled "Deterministic Scenario Analysis - Set Up". It contains a section for "File Location" with three columns: "Strategy File", "Scenario File", and "Model File". Each column has a "Directory Name" text box and a "File Name" text box. A "Continue" button is located at the bottom right of this section. On the right side of the main dialog, there are "OK" and "Cancel" buttons.

Clicking any text box would prompt the user to browse and identify the appropriate file.

The dialog box is titled "Microsoft Excel" and contains the text "Browse for Files?". It has two buttons: "Yes" and "No".

If the user does not want to browse, pressing 'No' would remove the dialog box and the user may enter the information in the text boxes. Selecting 'Yes' would open the file explorer and the user can navigate the explorer to select the proper file.

Once all the information about file locations is completed the user should press 'Continue' twice. When the 'Continue' button is pressed, the program saves the information about the file locations in the area E2:G3, and opens the workbook SDModelV1.xls, unless it is already open. It will also display a dialog box to collect information about cost measures.

Clicking the box for the number of cost measures brings up the following query.

The user should select 'Yes' and the list of available cost measures will be shown.

After selecting the boxes for the desired cost measures, 'OK' should be pressed. The number of cost measures and the numeric codes for these measures will be displayed in the dialog box for cost measures.

Deterministic Scenario Analysis - Set Up

File Location

	Strategy File	Scenario File	Model File
Directory Name	C:\SDM\MTDS\V1\	C:\SDM\MTDS\V1\	C:\SDM\MTDS\V1\
File Name	StrategyFile.xls	ScenarioFile.xls	SDModelV1.xls

Cost Measures

Number of Cost Measures: 3

Selected Cost Measures: 01 02 03

Buttons: OK, Cancel, Continue

At this point all the information needed for this procedure have been provided and the user should press 'OK' to close the dialog box.

After closing the dialog box the program completes the set up and performs initialization.

- opens the strategy and scenario files, unless they are already open
- reads the worksheet names for the strategy and scenario files and saves them as strategy and scenario names (the files should have a maximum of 10 worksheets).
- fills in the column headings (cells C13:L13) of the selection matrix with the strategy names
- fills in the row names (cells B14:B23) of the selection matrix with the scenario names
- blanks out the selection matrix
- initializes the *CostRisk* worksheet
- erases all information in the *Compare* worksheet

Step 2 : Selecting Strategy-Scenario Combinations to Run

The next step is to select the Strategy-Scenario combinations which will be run for the analysis.

For each Strategy-Scenario combination to be run, the user should put a value of 1 in the cell representing the strategy-scenario combination.

Scenario Analysis : Select Combination of Strategies and Scenarios to Run											
CLEAR	Strategies	1	2	3	4	5	6	7	8	9	10
Scenarios	ALL	↓ Exst	↓ LessConc	↓ MoreLT	↓	↓	↓	↓	↓	↓	↓
→ 0 Base		1	1	1							
→ 1 FX_Up2Sd		1	1	1							
→ 2 DX_Up2Sd		1	1	1							
→ 3 All_Deval30		1	1	1							
→ 4 Up1Sd_Deval1		1	1	1							
→ 5											
→ 6											
→ 7											
→ 8											
→ 9											

Several arrows and buttons are placed in the worksheet to help the user select the combinations.

↓ Selects Column, All scenarios for the strategy represented in the column

→ Selects Row, All strategies for the scenario represented in the row

ALL Selects All possible combinations

CLEAR Clears All selections

Step 3 Run Selections

Run
Selections

Pressing the button starts the execution of the scenario analysis.

For each strategy-scenario combination selected to run the program executes the following tasks:

- Identifies the worksheet for the selected strategy in the *StrategyFile* spreadsheet, copies the strategy specification from this worksheet to the appropriate cells in the *Inp_Strg* worksheet in the model file.
- Identifies the worksheet for the selected scenario in the *ScenarioFile* spreadsheet, copies the scenario specification from this worksheet to the appropriate cells in the *Inp_Scen* worksheet in the model file.
- Recalculates the model file to regenerate the cash flows, computes summary statistics including debt ratios, risk indicators and cost measures.
- Copies the values of the selected cost measures in the appropriate areas of the *CostRisk* worksheet
- After running the first combination of strategy and scenario, it copies the results from the *OutPut_Annual* worksheet of the model file to the *OutputTemplate* worksheet; changes the name of the *OutputTemplate* worksheet to a name created by joining the first 6 characters of the strategy name and the first 6 characters of the scenario name.

- For additional combinations that are selected to be run, the program saves the output information in the *OutPut_Annual* worksheet of the model file in a new worksheet in the *ScenarioAnalysis* spreadsheet, and sets the worksheet name to a concatenation of the first 6 characters of the strategy name and the first 6 characters of the scenario name.

It is important to ensure that each strategy and scenario is uniquely identified by the first six characters. Otherwise, there may be problems due to duplicate worksheet names.

IX.4. CostRisk Worksheet

This worksheet is used to save the selected cost measures for each run.

There is a matrix for each cost measure, each column represents a strategy and the rows represent scenarios. These matrices appear in rows 3 through 14 of the worksheet. When the run is executed, the program fills out the matrices with the actual values of the respective cost measure.

	A	B	C	D	E	F	G	H	I	J	K	L	
1													
2	Absolute Measures			1 Annual Interest Payment / GDP									
3		Strategies	1	2	3	4	5	6	7	8	9	10	
4	Scenarios		Exst	LessConc	MoreLT								
5		Base	3.0%	3.3%	2.9%								
6		1 FX_Up2Sd	3.0%	3.4%	2.9%								
7		2 DX_Up2Sd	3.1%	3.5%	3.0%								
8		3 All_Deval30	3.0%	3.4%	2.9%								
9		4 Up1Sd_Deval	3.1%	3.5%	3.0%								
10		5											
11		6											
12		7											
13		8											
14		9											

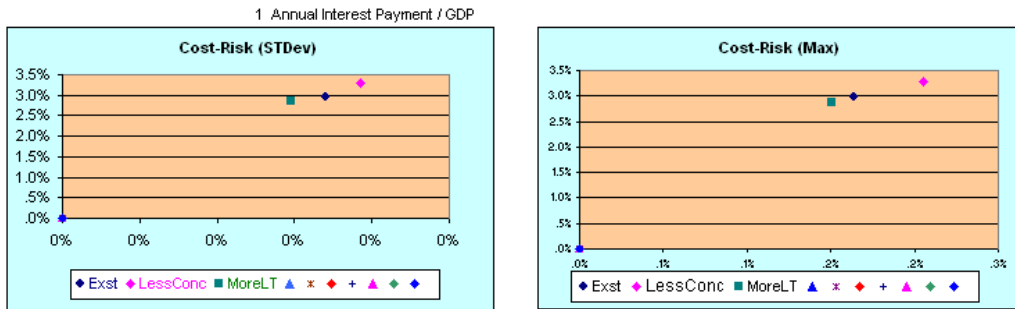
For each strategy, the difference of the cost measure for each scenario from its value in the base scenario is calculated. This represents the change in the cost measure for the risk scenario. These calculations are shown in a matrix for each cost measure in rows 21 through 32.

	A	B	C	D	E	F	G	H	I	J	K	L
19												
20	Differences from the Base Scenario											
21		Strategies	1	2	3	4	5	6	7	8	9	10
22	Scenarios		Exst	LessConc	MoreLT							
23		Base										
24		1 FX_Up2Sd	.0%	.1%	.1%							
25		2 DX_Up2Sd	.2%	.2%	.1%							
26		3 All_Deval30	.1%	.1%	.1%							
27		4 Up1Sd_Deval	.1%	.2%	.2%							
28		5										
29		6										
30		7										
31		8										
32		9										

It is assumed that the cost measure for the base scenario for each strategy represents the cost measure for the strategy. The risk measure for the strategy is calculated from the volatility of the cost measure for the same strategy under different risk scenarios. 3 volatility measures are estimated based on the maximum deviation, average deviation and standard deviation.

	A	B	C	D	E	F	G	H	I	J	K	L
34												
35	Cost and Risk Measures											
36	Strategies	1	2	3	4	5	6	7	8	9	10	
37	4	Exst	LessConc	MoreLT								
38	Cost	Base	3.0%	3.3%	2.9%							
39	Volatility	Max	.2%	.2%	.2%							
40		Average	.1%	.1%	.1%							
41		StDev	0%	0%	0%							

Finally two cost-risk graphs are plotted – one with the standard deviation measure of risk, and one with maximum deviation as risk - showing the cost-risk trade-off possibilities for the selected strategies.



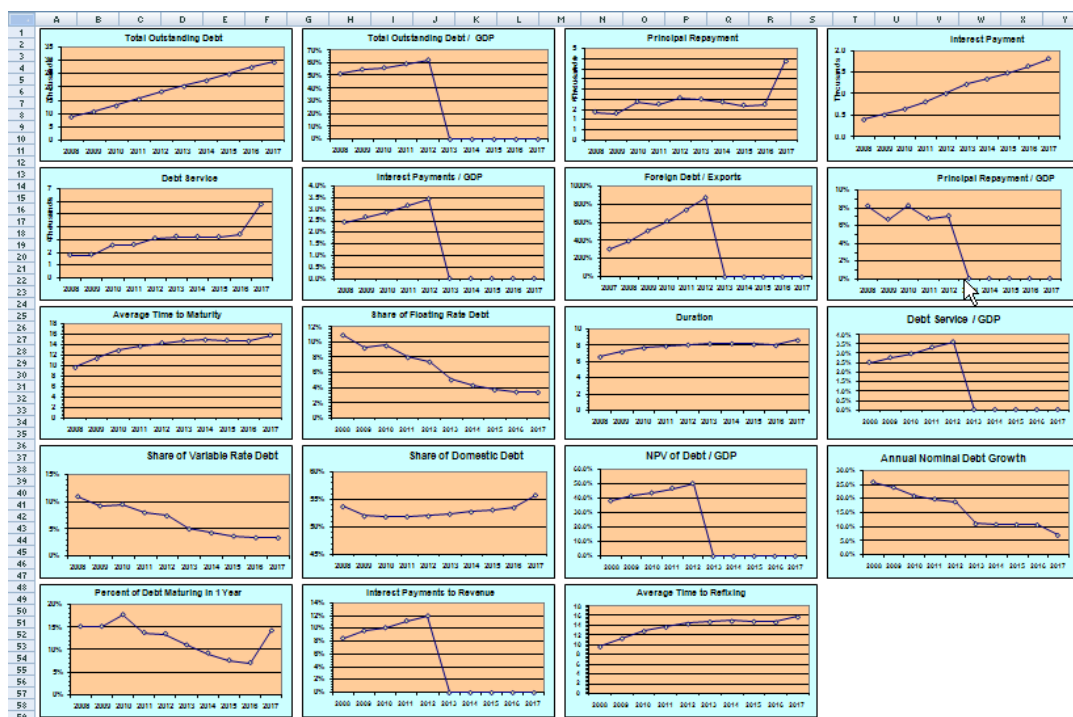
The computations are repeated for each selected cost measure.

B. Summary Output Worksheet

This worksheet is a placeholder for future development.

IX.6. GraphList Worksheet

A set of standard graph templates, representing time series of selected debt characteristics, have been created and saved in this spreadsheet.



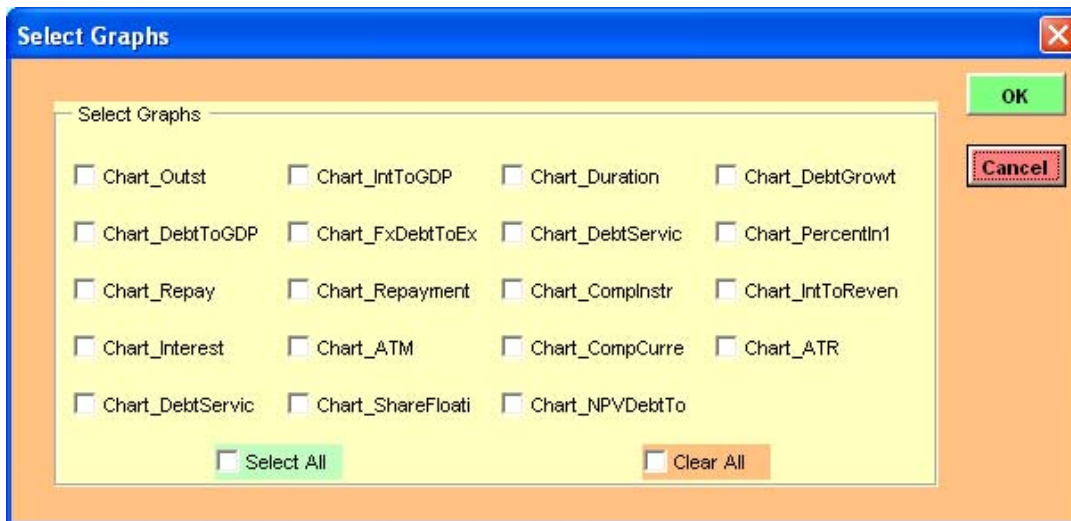
The variable plotted in these graphs are listed in the following table.

	<u>Chart Name</u>	<u>Chart Variable</u>
1	Chart_Outst	Total Outstanding Debt
2	Chart_DebtToGDP	Total Outstanding Debt / GDP
3	Chart_Repay	Principal Repayment
4	Chart_Interest	Interest Payment
5	Chart_DebtService	Debt Service
6	Chart_IntToGDP	Interest Payments / GDP
7	Chart_FxDebtToExports	Foreign Debt / Exports
8	Chart_RepaymentToGDP	Principal Repayment / GDP
9	Chart_ATM	Average Time to Maturity
10	Chart_ShareFloating	Share of Floating Rate Debt
11	Chart_Duration	Duration
12	Chart_DebtServiceToGDP	Debt Service / GDP
13	Chart_CompInstr	Share of Variable Rate Debt
14	Chart_CompCurrency	Share of Domestic Debt
15	Chart_NPVDebtToGDP	NPV of Debt / GDP
16	Chart_DebtGrowth	Annual Nominal Debt Growth
17	Chart_PercentIn1Year	Percent of Debt Maturing in 1 Year
18	Chart_IntToRevenue	Interest Payments to Revenue
19	Chart_ATR	Average Time to Refixing

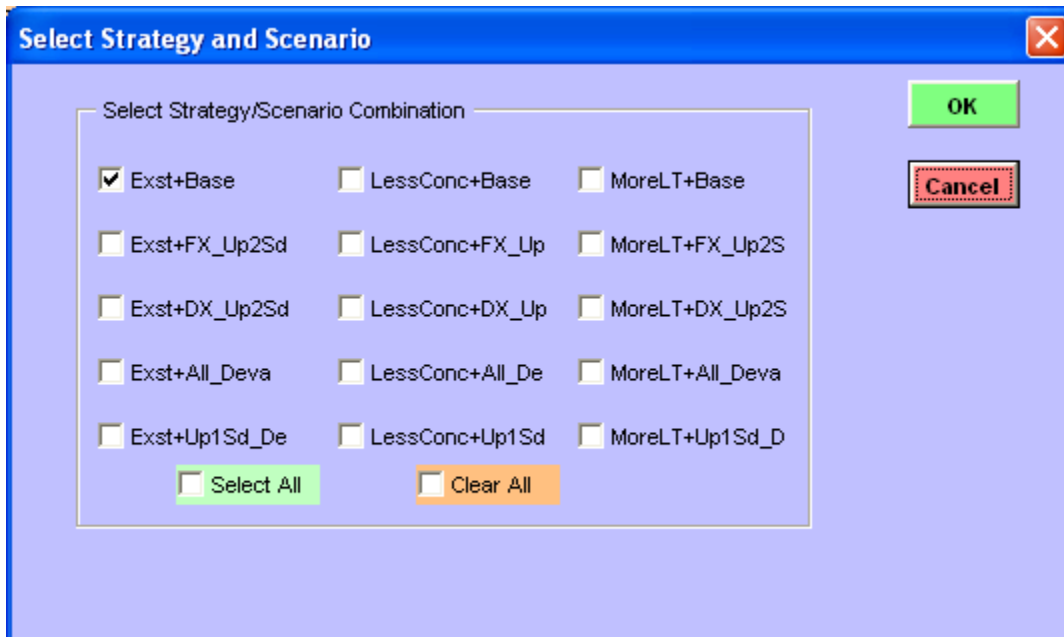
These templates may be used to display and compare graphs of the selected debt characteristics for different runs. Creation of these graphs is initiated by the command button

**Create
Comparison
Charts**

Pressing this button shows the list of available graph templates.



User should select the graphs to be created and then press 'OK'. The program then displays a list of scenarios, from which user should select the ones to be displayed in the graph.



After the selection user should press 'OK'. The program will then create and display the graphs in the worksheet *Compare*.

Program restrictions

Names of the strategy worksheets	first 6 characters should be unique
Maximum number of strategies in the strategy file	10
Names of the scenario worksheets	first 6 characters should be unique
Maximum number of scenarios in the scenario file	10
Maximum number of cost measures to be tracked at one time	10
Maximum number of graphs to be created at one time	15

Appendix I. Running Model SetUp

The spreadsheet can be run as it is using the default parameters. However, formulas and table sizes are adjustable through an excel macro, which accommodates different data characteristics. These characteristics are specified in the Inp_Param worksheet and in the Inp_XData worksheet.

A. Inp_param

The yellow Model SetUp button (in the hidden worksheet MainMenu) should be activated to create the new structure after changes have taken place in the above parameters. More precisely, the procedure is as follows: (1) unhide worksheet 'MainMenu' (go to Format/Sheet/Unhide and click on MainMenu); (2) click 'Model SetUp' button; (3) this will display several screens in succession for inputting/changing model parameters. Current values for the parameters will be displayed; (4) change parameters; and (5) click yellow Model SetUp.

Once the changes are undertaken, the macro will create the structure appropriate for the new parameters. Consequently, the user will have to change/input values in the new templates (in each of the input sheets). For instance, if the number of currencies is expanded to 5 from 4, then the additional currency has to be specified.

Figure 18. Main Menu Worksheet to Change Model Parameters



C. Inp_XData

If the user wants to utilize the loan by loan option provided in Inp_XData without aggregating the data beforehand, then it is very likely that the default value of 32 rows will prove insufficient. Under such circumstances, the following steps should be applied: 1. insert new rows; 2. input loan by loan data; 3. open MainMenu worksheet; 4. click green Existing Debt button to change the structure; 5) hide worksheet MainMenu.

Appendix II. Table of all Worksheets in the Workbook Model.xls

Table 4. Worksheets in the Model

<u>WorkSheetName</u>	<u>Type</u>	<u>Description of the Contents</u>
MainMenu	Program (Hidden)	Menus for macros to perform various tasks for setting up the model
WorkArea	Internal (Hidden)	
Inp_Param	Input	This worksheet contains information about the model parameters <ul style="list-style-type: none"> • Frequency and Horizon • Currency Information • Borrowing Instruments • Composition of Currency Baskets • Miscellaneous Information
Inp_XData	Input	Input area for key characteristics of existing debt portfolio (Loan-by-loan, or Aggregated by currency and instrument type including projection for repayments and average interest rate/spread)
Inp_Macro	Input	<ul style="list-style-type: none"> • projection of macroeconomic indicators • selected market information (yield curve, credit risk premium, inflation rate)
Inp_Scen	Input	<ul style="list-style-type: none"> • market scenario – projection of <ul style="list-style-type: none"> – interest rates and – exchange rates • term structure calculation
Inp_Strg	Input	<ul style="list-style-type: none"> • details of financing strategy for new borrowing <ul style="list-style-type: none"> – product mix – currency mix for each product
XDebt	Computation	Details of cash flows from <i>existing debt</i> <ul style="list-style-type: none"> • debt service payments <ul style="list-style-type: none"> – principal repayments and interest payments • outstanding balance • computation of risk indicators for each instrument <ul style="list-style-type: none"> – present value, – duration, – average time to maturity and – average time to rate fixing
XDebt_Summ	Computation	Summary of cash flows from <i>existing debt</i> <ul style="list-style-type: none"> • by product type and by currency
NewBorr	Computation	<ul style="list-style-type: none"> • new borrowing needs • new debt issuance
Ndebt	Computation	Details of cash flows from <i>new debt</i>

<u>WorkSheetName</u>	<u>Type</u>	<u>Description of the Contents</u>
		<ul style="list-style-type: none"> • debt service payments <ul style="list-style-type: none"> – principal repayments and interest payments • outstanding balance • computation of risk indicators for each instrument <ul style="list-style-type: none"> – present value, – duration, – average time to maturity and – average time to rate fixing
<i>NDebt_Summ</i>	Computation	Summary of cash flows from <i>new debt</i> <ul style="list-style-type: none"> • by product type and by currency
<i>Debt_Summ</i>	Computation	Summary of cash flows from <i>all debt (existing and new)</i> <ul style="list-style-type: none"> • by product type and by currency
<i>Dur_XSumm</i>	Computation	Summary of cash flows from <i>existing debt</i> <ul style="list-style-type: none"> • by Fixed and Floating Summary of Risk Indicators <ul style="list-style-type: none"> • by Fixed and Floating <ul style="list-style-type: none"> – present value, – duration, – average time to maturity and – average time to rate fixing
<i>Dur_NSumm</i>	Computation	Summary of cash flows from <i>new debt</i> <ul style="list-style-type: none"> • by Fixed and Floating Summary of Risk Indicators <ul style="list-style-type: none"> • by Fixed and Floating <ul style="list-style-type: none"> – present value, – duration, – average time to maturity and – average time to rate fixing
<i>Duration</i>	Computation	Summary of cash flows from <i>both existing and new debt</i> <ul style="list-style-type: none"> • by Fixed and Floating Summary of Risk Indicators <ul style="list-style-type: none"> • by Fixed and Floating <ul style="list-style-type: none"> – present value, – duration, – average time to maturity and – average time to rate fixing
<i>Out_Period</i>	Output (Hidden)	Summary Output by Period Summary of debt service projections Present values of debt service Cost measures Debt ratios
<i>Out_Annual</i>	Output	Summary of debt service projections Present values of debt service Cost measures Debt ratios

<u>WorkSheetName</u>	<u>Type</u>	<u>Description of the Contents</u>
RpyPrfl	Output (Hidden)	Profile of repayments from <i>both existing and new debt</i>

Appendix III. Calculating the Domestic Yield Curve

Borrowing rates for external currencies

A. Estimation of forward rates

Yield curve for foreign currencies

For international currencies the current yield curve is easily available and this can be used to calculate forward rates in the same currency.

Step 1: Yield curve interpolation

Benchmark issues are not usually available for every maturity and the yield curve will have gaps. The values for the gaps will be estimated by using an interpolation algorithm (such as piecewise linear or cubic spline).

Step 2: Zero coupon curve estimation

The zero coupon curve will be estimated from the interpolated yield curve. (Since the differences between the zero curve and the yield curve are usually small relative to the uncertainties in the estimation of the yield curve sometimes it may not make significant difference if this step is skipped and the yield curve is assumed to be the same as the zero curve.)

Step 3: Forward zero curve estimation

No arbitrage forward rates may be calculated from the zero curve successively for consecutive years.

$$f_{m;t} = \frac{(1 + s_{t+m})^{\frac{t+m}{m}}}{(1 + s_t)^{\frac{t}{m}}}$$

where

s_t = spot rate for maturity t , and

$f_{m;t}$ = forward rate of maturity m at period t

1 year forward rates are calculated using the expression $m = 1, 2, 3, \dots$

$$f_{m;1} = \frac{(1 + s_{1+m})^{\frac{1+m}{m}}}{(1 + s_1)^{\frac{1}{m}}}$$

Since the highest maturity point in the zero curve is lost in the forward rate calculation this point can be captured with some assumption such as the difference from the next lower maturity point remains constant.

Step 4: Yield curve for future borrowing

From the zero forward curve the yield to maturity for a coupon bearing instrument at par can be calculated. If the step of calculating zero curve from the yield curve above was skipped then this step will be skipped as well.

B. Prorated country credit premium

For the country to borrow in foreign currencies a premium for the country credit risk may need to be added to the corresponding rate in the foreign currency.

From the observed points of the country's borrowing rates in foreign currency, estimates may be made for the credit risk premium for some maturities. The observed values may be interpolated or fitted by some algorithm to estimate risk premium for other maturities.

C. Interest rates for external borrowing

Adding the country premium and the borrowing rate for the external currency will give the borrowing rate for the country in that currency.

II. Borrowing rates for domestic currency**A. Estimation of forward rates****Yield curve for Domestic market**

If a stable yield curve is available for the domestic market then the process for the external currencies may be followed for the domestic currency to estimate future borrowing rates. But the domestic yield curve may be more difficult to get, especially in countries where the domestic market is non-existent or the domestic market activities are not very deep. In this case the domestic borrowing rates may be derived for a foreign currency rate by adjusting the foreign rates by the inflation differential and any term premium.

Step 1: Current Yield curve

If there is no yield curve for the domestic market then the domestic yield curve may be constructed from a foreign yield curve by adjusting for the inflation differential. The spreads are further adjusted to match any observed points in the current yield curve. These spreads are added to the current yield curve of the foreign currency to generate the current yield curve for the domestic currency.

Step 2: Forward rates

The same spreads are added to the forward curves of the foreign currency to generate the forward curves for the domestic currency.