The World Bank Revised Minimum Standard Model

Concepts and Issues

Doug Addison

The Revised Minimum Standard Model was originally created in 1973 to ensure a consistent approach to World Bank projections. Its primary purpose, like the original two-gap models, is to show the user what levels of investment, imports, and external borrowing will be required to reach targeted real GDP and export growth rates. But the RMSM cannot provide guidance about the policies or prices that would be needed to reach those levels.
The Revised Minimum Standard Model (RMSM) was originally created in 1973 as a means of ensuring a consistent approach to World Bank projections and thus facilitate intercountry comparisons. Those objectives are met through the provision of a standard list of variables and a minimum set of economic relationships. The decision to minimize the number of linkages recognizes two facts: the quality of data for econometric analysis is generally poor, and users undoubtedly want to modify the model to meet their country-specific needs.

The RMSM is a thinking and planning tool. Its primary purpose, like the original two-gap models, is to show the user what levels of investment, imports, and external borrowing will be required for a targeted real GDP growth rate. The planner's choice of a real growth rate will determine what level of investment will be necessary. If the RMSM is run as a trade-gap model, the level of imports needed to sustain this rate of growth is driven by GDP, investment, and consumption — which is, in turn, residual. If the RMSM is run as a two-gap model and the savings constraint is binding, imports rather than consumption are residual. Real export growth is exogenous in both cases. The difference between exports and imports determines the need for external borrowing. This reflects the Bank's "needs" or "requirements" approach, and contrasts with the "constraints" or "availabilities" approach, which determines the real rate of GDP growth given available foreign capital.

The RMSM cannot, however, provide guidance about the policies or prices needed to reach the indicated levels. At first glance it would seem that the model has a rather limited scope. This is not so. The usefulness of any model is determined by the questions asked of it. One can easily and quickly discover whether or not a targeted growth rate is acceptable in terms of its impact upon per-capita consumption and external financing needs. It is also easy to manipulate the models' parameters to find out how the economy might be restructured to make a target growth rate practical. This sort of experimentation can lead to some very useful observations about the path a country should take in the future.

This paper was prepared in the Africa Country Department IV with the advice and support of the Country Economics Department staff. Copies are available free from the World Bank, 1818 H Street NW, Washington DC 20433. Please contact Josie Onwuemene-Kocha, room N11-032, extension 61750.
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INTRODUCTION

1. The Revised Minimum Standard Model was originally created in 1973 as a means of ensuring a consistent approach to World Bank projections and thus facilitate inter-country comparisons. These objectives are met through the provision of a standardized list of variables and a minimum set of economic relationships. The decision to minimize the number of linkages was made in recognition of two facts: the quality of data available for econometric analysis is generally poor and, secondly, users will undoubtedly want to modify the model to meet their country-specific needs. The number of variables, unfortunately, is not at all limited: there are about 430 variables in the model today. Happily there is a subset of core variables which form the backbone of the model. The remainder can be left blank or can be filled in according to the availability of information. It is the core variables and equations that are described here in this paper.

2. The RMSM is a thinking and planning tool. Its primary purpose, like the original two-gap models, is to show the user what levels of investment, imports, and external borrowing will be required for a targeted real GDP growth rate. The planner's choice of a real growth rate will determine what level of investment will be necessary. If the RMSM is run as a trade-gap model, then the level of imports needed to sustain this rate of growth is driven by GDP, investment, and consumption which is, in turn, residual. If the RMSM is run as a two-gap model and the savings constraint is binding, then imports rather than consumption are residual. Real export growth is exogenous in both cases. The difference between exports and imports determines the need for external borrowing. This is reflective of the Bank's "needs" or "requirements" approach and stands in contrast to the "constraints" or "availabilities" approach which determines the real rate of GDP growth given available foreign capital.

3. On the other hand, the RMSM cannot provide any guidance as to the sorts of policies or prices that would be needed in order to reach the indicated levels. At first glance it would seem that the model has a rather limited scope. This is not so. The usefulness of any model is determined by the questions asked of it. One can easily and quickly discover whether or not a targeted growth rate is acceptable in terms of its impact upon per-capita consumption and external financing needs. It is also easy to manipulate the models' parameters in order to find out how the economy might be restructured in order to make a targeted growth rate practical. This sort of experimentation can lead to some very useful observations about the path a country should take in the future.

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2. See, for example, Chenery and Bruno (1962) or Chenery and Strout (1966).

3. The original, discontinued, mainframe version of the model was able to accommodate either method. The "availabilities" approach is not, to this author's knowledge, currently an option.
THE NATIONAL ACCOUNTS

Accounting Identities

4. The RMSM uses a two-gap accounting framework. It ensures consistency between projections of the Balance of Payments and the National Accounts via the resource gap which both accounts share in common. The accounting identities are:

\[ GDP = C + I + X - M \] 

1)

\[ GDP = C + S \] 

2)

\[ I - S = M - X \] 

3)

These identities are expressed in real terms where gross domestic product (GDP) is the sum of consumption (C), investment (I) and exports (X) less imports (M). Alternatively, GDP is the sum of consumption plus saving (S).

Identity 3 states that the two gaps between investment and savings and between imports and exports are the same. If the level of savings is inadequate to finance a targeted level of investment, then investment must be financed from abroad in the form of net imports. As shown in Section III below, this will necessitate external borrowing.

Exogenous Variables

5. In the RMSM, real GDP growth is exogenous and must be targeted by the user. There are two common strategies. The first is to choose a rate which will ensure a constant or increasing GDP per capita growth rate in order to find out what sort of investment and external borrowing will be needed. The second is to choose a level of growth that results in levels of investment and borrowing that are consistent with one's expectations of ability and availability. This latter approach is a parallel to the "availabilities" method and usually ends up as an iterative process as growth rates are adjusted to produce the expected feasible levels of borrowing and investment.

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4. Please note that many variables have been aggregated for the purpose of this paper. The mnemonic rules for variable names have, however, been retained to make the transition to or from the actual model as painless as possible. Appendix B illustrates the translation in detail.

5. The national accounts can be expressed either in local currency or in US dollars. The assumption used here is that local currency will be used.

6. GDP is disaggregated into three categories: agriculture, industry and all other goods. Separate growth rates are applied to each.
6. Real export growth is also set by the user. This growth rate describes export sales rather than production. The user will have to reflect all his or her assumptions about trading partner demand, market shares and reactions to changes in prices and exchange rates into this growth path.

\[ GDP_t = GDP_{t-1} \times (1 + gdp\_gr_t) \]

\[ X_t = X_{t-1} \times (1 + x\_gr_t) \]

There is no linkage of exports to GDP. Note that the growth of real export sales can be temporarily higher than GDP growth only if there are substantial stocks to draw down - or if the planner is willing to sacrifice consumption and/or investment growth.

**Investment**

7. The RMSM investment function is a function of desired GDP growth. There are two methods of providing this linkage: a marginal propensity to invest (MPI) or an incremental capital-to-output ratio (ICOR). Equation 6, below, can accommodate both.

\[ I_t = k_t + A_{1t} \times GDP_t + A_{2t} \times (GDP_t - GDP_{t-1}) \]

Parameter \( k \) represents autonomous investment. Parameter \( A_1 \) represents the marginal propensity to invest (MPI) when parameter \( A_2 \) equals zero. Parameter \( A_2 \) represents an incremental capital-to-output ratio (ICOR) when parameter \( A_1 \) equals zero.

8. This simple formulation leaves out many important variables. Capacity utilization and the application of labor are but two examples. Although it is true that past performance is not always an accurate predictor of the future, the modeler should endeavor to estimate these parameters on the basis of historical performance before making any judgments about what they could become in the future.

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7. The user can specify up to nine different export categories.

8. This can also include the recovery of goods which pass through the system of parallel markets.

9. The user can disaggregate GDP into three sectors: agriculture, industry, and all other goods. The investment function can also be disaggregated in the same way when the ICOR formulation is chosen.

10. The author has made some rough estimates of ICORs for several Sub-Saharan African countries. The average was three plus or minus two for high growth periods. The large variation is undoubtedly reflective of the many economic forces left out of the investment equation. (Unpublished internal note, September 20, 1988, AF4CO)
9. The reader may detect an anomaly in the subscripts of the investment equation. The definition of an incremental-capital-output-ratio requires that the change in GDP for any given year be contrasted with the change in capital (investment) for the preceding year. This is also consistent with the fact that the RMSM is a planning model: future GDP growth should determine present investment. Equation 6, therefore, should actually read:

\[ I_t = k_t + A_{1t} \times \text{GDP}_t + A_{2t} \times (\text{GDP}_{t-1} - \text{GDP}_t) \]  

The fact that it does not was a deliberate mis-statement on the part of the designers of the current RMSM. This was done because they did not want the last year of the projections to be incomplete because of a lack of information. The original RMSM manual states that the difference in results is minimal. This is true with regard to general trends and magnitudes. It could be misleading, though, if one is concerned with the timing of investment relative to targeted growth. A simple solution would be to specify the growth target for one year beyond the last year for which investment is to be projected.

Import Functions

10. The demand for imports is assumed to be driven by the need for consumption, intermediate and investment goods. The demand functions are expressed using growth rates computed as the rate of change in each of the aggregates multiplied by import elasticities of demand. Note that these are not price or income elasticities of demand. They are nothing more than simple linkages to the aggregate supply and use of goods. They are sometimes referred to as "composite" elasticities because their value must reflect the combined effects of prices, income, quantitative restrictions and exchange rate constraints as well as other demand related factors. None of these variables enter explicitly into the model.

11. There are three separate equations: imports of intermediate goods \( (M_g) \) are tied to changes in GDP via elasticity \( mg_{el} \), imports of investment goods \( (M_i) \) are linked to changes in investment using elasticity \( mi_{el} \), and consumer imports \( (M_c) \) are coupled to consumption by means of elasticity \( mc_{el} \). \(^{11}\)

\[
M_{gt} = M_{gt-1} \times (1 + mg_{el_t} \times (\frac{\text{GDP}_t}{\text{GDP}_{t-1}} - 1)) \]

\[
M_{it} = M_{it-1} \times (1 + mi_{el_t} \times (\frac{I_t}{I_{t-1}} - 1)) \]

\(^{11}\). The RMSM actually includes several import categories. Intermediate goods, fuels, and non-factor services are assumed tied to GDP. Capital goods are tied to investment. Food and other imports are linked to personal consumption.
Although the growth rate analogy is a very intuitive way to think of import demand, one can gain greater insight by viewing the change in import demand as being regulated by share-weighted-import-elasticities. The phrase "share-weighted-import-elasticities" includes both the share of imports supplying a particular economic activity and the elasticity of demand for that type of imports. For example, how much investment is sustained by imported capital and how does the need change as investment changes? The import functions are rewritten below using this method.

\[ M_{g_t} = M_{g_{t-1}} * (1 - mg_{el_t}) + mg_{el_t} * \frac{M_{g_{t-1}}}{GDP_t} \]  

\[ M_{l_t} = M_{l_{t-1}} * (1 - ml_{el_t}) + ml_{el_t} * \frac{M_{l_{t-1}}}{I_t} \]  

\[ M_{c_t} = M_{c_{t-1}} * (1 - mc_{el_t}) + mc_{el_t} * \frac{M_{c_{t-1}}}{C_t} \]

The advantage of the weighted elasticities approach is that it allows one to learn something about the direction of change and the share of imports relative to the other aggregates. The shares approach is also useful because it encourages one to think of the need to import as an evolving structural feature. For example, one could create a situation where a growing economy obtains more of its own capital domestically by making the investment-imports elasticity less than one. The following set of rules, embodied in Table 1, will prove to be a useful guide. It is assumed that GDP growth is positive.

<table>
<thead>
<tr>
<th>Elasticity</th>
<th>Real Import Growth</th>
<th>Import Shares</th>
</tr>
</thead>
<tbody>
<tr>
<td>m_el &gt; 1</td>
<td>positive</td>
<td>increasing</td>
</tr>
<tr>
<td>m_el = 1</td>
<td>positive</td>
<td>constant</td>
</tr>
<tr>
<td>0 &lt; m_el &lt; 1</td>
<td>positive</td>
<td>declining</td>
</tr>
<tr>
<td>m_el &lt; 0</td>
<td>negative</td>
<td>declining</td>
</tr>
</tbody>
</table>

At this point all but one variable has been described. That variable is consumption. The closure rule is:

\[ C_t = GDP_t - I_t - X_t + M_t \]
We will pay special attention to the effects of GDP and export growth, as well as the choice of parameters, on consumption. Real growth in consumption, per-capita consumption in particular, is perhaps the most important criteria in assessing the acceptability of the growth scenario being modeled. Growth which does not increase real per-capita consumption is rarely politically sustainable.

Income Effects and the Terms of Trade

14. Up to this point, the discussion has omitted the effects of the terms of trade. The present formulation of the accounting framework correctly implies that one must supplement domestic output with net imports \((M-X)\) insofar as expenditures exceed total domestic output \((GDP)\). It says nothing about the gains or losses resulting from changes in the terms of trade. In the social accounting framework used with the RMSM, however, we take these gains or losses into account by making a distinction between gross domestic income \((GDY)\) and gross domestic product \((GDP)\) -- the difference between the two being the income effects of changes in the terms of trade:

\[
GDY_t = GDP_t + TTADJ_t
\]

where \(TTADJ\) stands for the adjustment to GDP for changes in the terms of trade.

15. In calculating real \(GDY\), we value production for exports in accord with the resulting capacity to import. The capacity to import from exports is calculated by deflating export earnings \((exports \ at \ current\ prices)\) by the price of imports. In this way, we take into account price changes measured against the base year for both exports and imports. The capacity to import, in other words, is equal to exports adjusted for the terms of trade \((XTTADJ)\). It is the equivalent of looking upon exporting as an indirect way of "producing" imports.

\[
XTTADJ_t = \frac{(X_t \times XPI_t)}{MPI_t}
\]

Note that \(XPI\) and \(MPI\) are price indices expressed in local currency terms. These indices should share the same base year as the rest of the national accounts variables.

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12. The terms of trade adjustment is independent of exchange rate movements because the formula results are always denominated in the same currency as the national accounts.
16. The income effect of changes in the terms of trade (TTADJ) thus is the difference between the capacity to import and real exports as ordinarily calculated. It is written as:

\[ TTADJ_t = XTTADJ_t - X_t \]

\[ = (X_t \times XPI_t)/MPI_t - X_t \]  \hspace{1cm} (14)

The terms of trade adjustment is simply a way of taking into account the effects of changes in export and import prices upon potential real expenditures. If the export and import price indices are equal, the adjustment will be zero. In the base year, therefore, the terms of trade adjustment will always equal zero and GDP will equal GDY. If the terms of trade have improved (XPI > MPI) since the base year, then the adjustment will be positive (and vice versa).

17. Domestic saving must also be adjusted for the income effects of changes in the terms of trade. Domestic saving is properly defined as income less consumption rather than as production less consumption.

\[ GDS_t = GDY_t - C_t \]  \hspace{1cm} (15)

This is identical to investment less the resource gap (RG) where the resource gap is defined as exports adjusted for the terms of trade less imports.

\[ GDS_t = I_t - RG_t \]  \hspace{1cm} (15)

\[ RG_t = M_t - XTTADJ_t \]  \hspace{1cm} (16)

Note that consumption and investment are not affected by the introduction of the terms of trade adjustment. Equation 11, however, can be re-written as:

\[ C_t = GDY_t + RG_t - I_t \]  \hspace{1cm} (11)

**The Constrained Savings Case**

18. The RMSM is often run as a one-gap (trade gap) model. When this is done, the model is closed as indicated in paragraph 13 and equation 11: consumption is a residual. Savings is also a residual since it is defined as income less consumption. The RMSM, however, was originally intended to be, and can still be used as, a two-gap model in which either the trade or the savings gap may prove to be the binding constraint. Particularly where there are socio-political constraints on consumption and spending, it is desirable to specify a realistic maximum marginal savings rate. This is the same as choosing a minimum marginal propensity to consume. When the savings rate binds, net imports must exceed the level required to fill the trade gap because it is necessary to have sufficient resources available to meet both required investment and minimum consumption levels.

19. To see if the savings gap (rather than the trade gap) is binding, one must solve for the level of imports necessary to guarantee the
maximum marginal savings rate (MAXMSR) is not exceeded. This is done below:

$$\text{Target } M_t = I_t + \text{XTTADJ}_t - GDS_{t-1} - \text{MAXMSR}_t \times (GDP_t - GDP_{t-1})$$  \hspace{1cm} (17)$$

In order to reach this targeted level, one could calculate the difference between total imports ($M_g + M_i + M_c$) and the targeted level of imports. This difference could then be added to the total. In practice, however, it is assumed that the adjusting variable will be consumption-related imports. The motivation for making this adjustment was, after all, the desire for politically acceptable marginal savings and consumption rates. If total imports, including ($M_c$), produce an overly high savings rate then ($M_c$) will be re-calculated to produce a MSR at the maximum acceptable level.

$$M_{ct} = I_t + \text{XTTADJ}_t - M_{gt} - M_{it} - GDS_{t-1} - \text{MAXMSR}_t \times (GDP_t - GDP_{t-1})$$  \hspace{1cm} (18)$$

when a MAXMSR is specified and $M_{ct} > M_{ct}$ as defined in Equation 10

Keep in mind, when using the MAXMSR, that using imports to maintain consumption in the face of increased investment needs may not be sensible if it results in an overly high level of foreign borrowing. Financing constraints may render the maximum savings option moot. Keep in mind also that boosting imports to compensate increased exports is counter-productive when a nation needs to generate a trade surplus in order to pay off its foreign obligations. The system of equations in real terms is now complete and summarized in Table 2 below.

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13. The actual RMSM formula ties imports of consumption goods to gross national rather than domestic income and savings. The difference between the two concepts is factor service income and private unrequited transfers.
Table 2

The Revised Minimum Standard Model: Condensed Form

Exogenous:

GDP:
\[ \text{GDP}_t = \text{GDP}_{t-1} \times (1 + \text{gdp}_{gr_t}) \] 4)

Exports:
\[ \text{X}_t = \text{X}_{t-1} \times (1 + \text{x}_{gr_t}) \] 5)

Endogenous:

Investment:
\[ \text{I}_t = \text{k}_t + (\text{A}_1 + \text{A}_2) \times \text{GDP}_t - \text{A}_2 \times \text{GDP}_{t-1} \] 6)

Imports

Intermediate:
\[ \text{Mg}_t = \text{Mg}_{t-1} \times (1 + \text{mg}_{el_t} \times (-\frac{\text{GDP}_t}{\text{GDP}_{t-1}} - 1)) \] 8)

Investment:
\[ \text{Mi}_t = \text{Mi}_{t-1} \times (1 + \text{mi}_{el_t} \times (-\frac{\text{I}_t}{\text{I}_{t-1}} - 1)) \] 9)

Consumption:
\[ \text{Mc}_t = \text{Mc}_{t-1} \times (1 + \text{mc}_{el_t} \times (-\frac{\text{C}_t}{\text{C}_{t-1}} - 1)) \] 10)

or...
\[ \text{Mc}_t = \text{I}_t + \text{XTTADJ}_t - \text{Mg}_t - \text{Mi}_t - \text{GDS}_t - \text{MAXMSR}_t \times (\text{GDP}_t - \text{GDP}_{t-1}) \] 18)

when a MAXMSR is specified and \( \text{Mc}_t > \text{Mc}_{t-1} \) as defined in Eq. 10

Terms of Trade Revaluations:

Terms of Trade:
\[ \text{TTADJ}_t = \frac{(\text{X}_t \times \text{XPI}_t)'}{\text{MPI}_t} - \text{X}_t \] 14)

GDY:
\[ \text{GDY}_t = \text{GDP}_t + \text{TTADJ}_t \] 12)

Exports:
\[ \text{XTTADJ}_t = \text{X}_t + \text{TTADJ}_t \] 13)

Resource Gap:
\[ \text{RG}_t = \text{M}_t - \text{XTTADJ}_t \] 16)

Savings:
\[ \text{GDS}_t = \text{I}_t - \text{RG}_t \] 15)

Closure

Consumption:
\[ \text{C}_t = \text{GDP}_t - \text{I}_t - \text{X}_t + \text{Mg}_t + \text{Mi}_t + \text{Mc}_t \] 11)
\[ = \text{GDY}_t + \text{RG}_t - \text{I}_t \]
21. In this section of the paper we will investigate the effects of changes in real GDP and export growth on each of the variables. For illustrative purposes, it will be assumed that we are working with an economy that has very inefficient capital and high import elasticities of demand. If you are mathematically inclined, you may want to refer to Appendix A which contains the equations upon which this discussion is based. Please note that the results shown in the following figures are extreme cases chosen for expository purposes: the modeler would not, under ordinary circumstances, expect to see such exaggerated results.

22. We will start the analysis with investment. It was explained earlier that the modeler has two ways of linking investment to GDP: an marginal propensity to invest (A1) or an ICOR (A2). Examples of both can be seen in Figures 1 and 2 below. If the MPI (A1) is used, then the trend in investment merely mimics the trend in GDP. If an ICOR (A2) is used, then investment increases both with the absolute level of GDP and with the rate of growth in GDP. That is why the effect is so much more volatile in Figure 2. (See Appendix A.1)

23. Imports will move in the same direction as, and parallel to the trends of, the variables they are linked to so long as the elasticities of demand are positive. The share of these imports in economic activity, however, will change unless the elasticities are set equal to one. (See Table One.) Figures 3 and 4 are examples of intermediate and capital goods imports during a short burst of GDP growth when the respective elasticities of demand are larger than one and investment is linked to GDP via an ICOR. These will be the standard assumptions in the examples that follow. (See Appendix A.2 and A.3)

24. Consumption and consumption-related imports (Mc) are interdependent. They are also the only aggregates which are linked to the level of exports as well as GDP. Consider consumption first. Positive changes in GDP or imports will add to consumption; increases in investment or exports will take away from it. The total effect of GDP growth is therefore mixed. The final result will be determined by the efficiency of investment, the strength of the import elasticities and the starting import shares. The overall effect, however, will almost always produce a marginal propensity to consume greater than zero and less than one - thus producing the traditional positive relationship between income and consumption. (See Appendix A.4.)
Figure 1: Investment and GDP
\[ I = A1 \times GDP \]

Figure 2: Investment and GDP
\[ I = A2 \times \Delta GDP \]

Figure 3: Intermediate Imports

Figure 4: Capital Imports
\[ I = A2 \times \Delta GDP \]
Consumption can be made to fall, even though GDP is growing, under two conditions. The first, and most obvious, of these would be a large increase in exports. The second case would occur when consumption is sacrificed for investment. This could be induced by an acceleration in GDP growth combined with a large inefficient ICOR and an elasticity of less than one for imports of investment goods. The effect of the low import elasticity is that imports will fail to increase rapidly enough to compensate for the large expansion in investment spending needed to support the increased GDP growth: consumption must therefore fall. Figure 5 illustrates this case. Imports of consumption goods, as shown in Figure 6, will mirror the trend in consumption. (Appendix A.5)
Figure 7 shows what would happen to the resource gap, without any terms of trade adjustments, in the inefficient ICOR scenario used in figures 2-4 above. An increase in GDP growth will require more capital goods which, in turn, will necessitate more capital goods imports since, in this example, the capital imports elasticity is greater than one. The resource gap can be reduced by increasing the growth of exports, by using lower import elasticities, or by increasing the price of exports relative to the price of imports. (See Appendix A.6) Whether any of these changes would in fact be reasonable in a particular case is, of course, a matter of judgement.
27. Up until this point we have examined what happens when the savings and consumption functions are unconstrained. If the user has decided to use the maximum marginal savings rate (MAXMSR), then the above equations will hold until the marginal maximum savings rate is reached. At that time, the following equations will take effect:

\[ C_t = C_{t-1} + (1 - MSR) \times (GDP_t - GDP_{t-1}) \]  
19)

\[ M_t = I_t + XTTADJ_t - GDS_{t-1} - MAXMSR_t \times (GDP_t - GDP_{t-1}) \]  
17)

\[ RG_t = I_t - GDS_{t-1} - MAXMSR_t \times (GDP_t - GDP_{t-1}) \]  
20)

\[ \frac{\Delta GDS_t}{\Delta GDP_t} = MAXMSR_t \]  
21)

\[ \frac{\Delta C_t}{\Delta GDP_t} = 1 - MAXMSR_t \]  
22)

\[ \frac{\Delta M_t}{\Delta GDP_t} = \frac{\Delta I_t}{\Delta GDP_t} + \frac{\Delta XTTADJ_t}{\Delta GDP_t} - MAXMSR_t \]  
23)

\[ \frac{\Delta RG_t}{\Delta GDP_t} = \frac{\Delta I_t}{\Delta GDP_t} - MAXMSR_t \]  
24)

GDP growth, under this constraint, will require more external borrowing as long as the marginal savings rate is less than the marginal propensity to invest. Observe that export performance does not enter into the resource gap equation at all. The reason, as expressed in equation 17, is that exports are prevented from competing with consumption through the provision of more imports. Put another way, the marginal savings rate is a binding constraint on the savings and consumption functions. Changes in investment or exports will, therefore, be compensated by the level of imports. Figure 8 below shows the effects of increased GDP growth with the high ICOR and import elasticity scenario used above. Figure 9 illustrates the effects of boosting export growth.

28. Note that it may be unrealistic to produce a situation where an increase in exports automatically increases imports: such a result would be viewed as counter-productive when a trade surplus is needed in order to pay off foreign obligations. It would be a better policy to maintain consumption by reducing inefficient investment flows and replacing them with more productive additions to the stock of capital.
Figure 8: Constrained Savings with GDP Growth

Figure 9: Constrained Savings with Export Growth
29. The standard practice in balance of payments presentations is to show the current account (CURBAL) balanced by the capital account (NETCAP) plus the change in reserves (CHGRES). Each of the accounts are expressed in net nominal US dollars. If, for example, there are more dollars flowing out of the capital account than in, then NETCAP will be negative and the sum of the current and reserve accounts will positive.

\[ \text{CURBAL} + \text{NETCAP} + \text{CHGRES} = 0 \]

The current account includes the resource balance (RESBAL), net factor services (NETFSY) and net current transfers (NETCTR). The word "current," with respect to transfers, is meant to distinguish these transfers from official transfers which are recorded in the capital account and used for investment purposes.

\[ \text{CURBAL} = \text{RESBAL} + \text{NETFSY} + \text{NETCTR} \]

The resource balance (RESBAL) is defined as exports (EXP) less imports (IMP) of goods and non-factor services. As will be shown below, it is the resource balance that provides the linkage between the national accounts and the balance of payments.

\[ \text{RESBAL} = \text{EXP} - \text{IMP} \]

30. A short digression is now necessary. Both the current and the capital account contain distinctions between foreign exchange flows set into motion by events prior to the projection period and those flows generated during the projection period. The former are referred to here as "pipeline" flows. The latter flows can be grouped into two types: expected new flows and additional unidentified flows needed to balance the accounts. These last are referred to as GAPFIL flows. These distinctions are important because they place emphasis on the question of how much more money a country will have to borrow given existing pipeline and expected new flows.

31. Factor service income (NETFSY) will be defined here as interest accrued on GAPFIL borrowing (INTGAP) plus all other factor services (OTHFSY). This last item includes pipeline and expected interest flows,net payments on direct foreign investment and net income from property and labor.

\[ \text{NETFSY} = \text{INTGAP} + \text{OTHFSY} \]

32. The capital account contains net GAPFIL flows (NETGAP), net expected and pipeline long-term flows (LTCAPF) and other capital flows (OTHCAP). Net flows here are defined as disbursements and other credits less repayments and other debits.
Net long-term capital flows (LTCAPF) include net direct foreign investment (NETDFI), official capital transfers or grants (DBTGRT), net long-term borrowing (NETLT) and other long-term flows (OTHLT). Other capital flows (OTHCAP) include net short-term capital (SHTERM), capital not elsewhere included (CAPNEI) plus errors and omissions (ERROMS).

**Exogenous Variables**

33. The following items are determined exogenously: other factor services (OTHFSY), net current transfers (NETCTR), net long-term flows (LTCAPF) and net other capital flows (OTHCAP). Note that net long-term borrowing (NETLT) is made up of both expected and pipeline flows. Pipeline flows are usually calculated by the World Bank’s Debtor Reporting System from information about existing loans. Expected flows are computed exogenously in a separate debt module based on the modelers assumptions about new loan commitments and terms. All other factor service and net capital items as well as net current transfers are projected by means of exogenous growth rates. These growth rates are expressed in nominal terms and so must include both value and volume effects.

**The Resource Balance**

34. Exports (EXP) are equal to real exports in local currency (X) multiplied by an exogenous export price index (XPI) and exchange rate (E). The same relationship holds true for imports.

\[
\text{RESBAL} = \text{EXP} - \text{IMP} \quad 27)
\]

\[
\text{EXP} = X \times XPI \times E \quad 31)
\]

\[
\text{IMP} = M \times MPI \times E \quad 32)
\]

Although the exchange rate and price indices affect the valuation of the resource balance, they do not induce any changes in real trade volumes. The overall trends are all determined on the real side of the model. It is there that the modeler must impute reactions to prices and exchange rates by manipulating the real export growth rate and the import elasticities.

---

14. Many modelers choose to use the World Bank’s *Half Yearly Commodity Price Forecast* for the export and import price indices. These are based on global supply and demand projections which include assumptions about large producers and consumers for certain commodities and countries. The modeler may treat each country as a "price taker" when these indices are used.
The Change in Reserves

35. The assumption made by the RMSM authors was that policy makers should try to maintain a level of reserves adequate to finance two months of imports. Each incremental change to the level of imports will therefore require an additional one sixth that amount to be set aside as reserves -- assuming the stock of reserves is already adequate at the beginning of the projection period.\(^{15}\)

\[
\text{CHGRES} = (\text{IMP}_t - \text{IMP}_{t-1}) \times (1,33)
\]

If the starting level of reserves is insufficient, the modeler may want to modify the formula to calculate how much more should be added to the stock of reserves over the first several years of the projection period. Keep in mind also that governments with fixed exchange rate systems are likely to be more concerned with the level of reserves than those with market systems.

External Borrowing

36. The need for "additional unidentified borrowing (GAPFIL) is a residual. It is determined in part by the size of the resource balance. This pressure is further amplified by the change in reserves (CHGRES), which is directly linked to imports, and by the need to repay previous debts (AMTGAP) plus interest (INTGAP) on the stock of outstanding debt (DODGAP). Exogenous forces are represented by other factor service income (OTHFSY), net current transfers (NETCTR) and net pipeline borrowing (NET).

\[
\text{GAPFIL} = - \text{RESBAL} - \text{INTGAP} - \text{OTHFSY} - \text{NETCTR} + \ldots
\]

\[
- \text{AMTGAP} - \text{LTCAPF} - \text{OTHCAP} - \text{CHGRES}
\]

\[
= - \text{CURBAL} - \text{AMTGAP} - \text{LTCAPF} - \text{OTHCAP} - \text{CHGRES}
\]

It is assumed that borrowing in one period will generate a repayment stream in the future: there is no provision for building up arrears as so often happens in real life.\(^{16}\) For the purpose of this discussion it is assumed that all

\(^{15}\) The RMSM also assumes that there will be interest earned on foreign exchange reserve holdings abroad. These earnings are included as part of OTHFSY. They were not made explicit because their inclusion does not significantly change the dynamics of the model.
loans are repaid in the period following disbursement.

\[ AMTGAP_t = GAPFIL_{t-1} \]  

Next, assume that interest (INTGAP) is charged and paid on the stock of outstanding debt (DODGAP). Note that GAPFIL borrowing in each period increases interest charges in the next period which further increases the need for GAPFIL financing.

\[ DODGAP_t = DODGAP_{t-1} + GAPFIL_t - AMTGAP_t \]  
\[ INTGAP_t = DODGAP_{t-1} \times i_t \]

37. GAPFIL borrowing is normally assumed to be made on commercial bank terms for non-IDA countries. Because of this, the modeler should seek to ensure that the level of this costly borrowing is not unreasonable. A useful gauge of what is and is not acceptable for total borrowing is the debt service ratio. A debt service to exports ratio of less than 20 or 25 percent is generally considered reasonable although this may be temporarily exceeded from time to time. If there is too much GAPFIL borrowing, the RMSM user should review his or her assumptions about the terms and amounts of the other flows in the model. Perhaps more borrowing could be shifted into concessional sources. If there is not sufficient flexibility there, then it is possible that the targets for real GDP and export growth will have to be revised.

38. Note also that the RMSM will generate a negative GAPFIL when there is a surplus of funding. This will also produce negative interest (meaning the interest is earned rather than owed) which will feed back into the GAPFIL equation in the next period. Assuming that no mistakes were made with regard to other variables, the user must then make some decisions about how the earnings are to be allocated. One use would be to increase reserves - although this will require a modification to the formula for CHGRES. One could also eliminate the excess by importing more or borrowing less.
39. All BOP variables have now been defined. The complete system of equations is shown in Table 3. The behavior of the balance of payments system, as a whole, is uncomplicated. Most of what happens is already predetermined by the relationships in the national accounts. The only tricky part is the feedback loop between interest charges and the size of the GAPFIL.  

There is an additional feedback loop between the balance of payments and the national accounts which ought to be discussed. An earlier footnote indicated that imports of consumption goods, when under the maximum marginal savings constraint, are actually linked to gross national savings rather than gross domestic savings. The latter do not include factor service income or transfers. This is an important omission because factor service income includes interest payments which expand or contract with the amount borrowed. If the MAXMSR is used, then the effects of a real resource gap (M > X) will be exacerbated by the interest charged on the resulting external borrowing.
### Table 3

The RMSM Balance of Payments: Condensed Form (Nominal USS)

**Exogenous:**

- Export Price Index: $XPI_t$
- Import Price Index: $MPI_t$
- Exchange Rate: $E_t$
- Other Factor Services: $OTHFSY_t$
- Net Private Transfers: $NETCTR_t$
- Long-term and Other Capital: $LTCAPF_t$ and $OTHCAP_t$

**Endogenous:**

- Resource Balance: $RESBAL_t = EXP_t - IMP_t$  \(27)\)
- Exports, Goods and NFS: $EXP_t = X_t \times XPI_t \times E_t$  \(31)\)
- Imports, Goods and NFS: $IMP_t = M_t \times MPI_t \times E_t$  \(32)\)
- Net Factor Services: $NETFSY_t = INTGAP_t + OTHFSY_t$  \(28)\)
- Interest, New Borrowing: $INTGAP_t = DODGAP_{t-1} \times i_t$  \(37)\)
- Debt Outstanding (stock): $DODGAP_t = DODGAP_{t-1} + GAPFIL_t - AMTGAP_t$  \(36)\)
- Current Account Balance: $CURBAL_t = RESBAL_t + NETFSY_t + NETCTR_t$  \(26)\)
- Capital Account Balance: $NETCAP_t = NETGAP_t + LTCAPF_t + OTHCAP_t$  \(29)\)
- Amortization, New Borrowing: $AMTGAP_t = GAPFIL_{t-1}$  \(35)\)
- Change in Reserves: $CHGRES_t = (IMP_t - IMP_{t-1}) \times (1/6)$  \(33)\)

**Closure:**

- Unidentified: $GAPFIL_t = - CURBAL_t - AMTGAP_t + ...$
- New Borrowing: $LTCAPF_t - OTHCAP_t - CHGRES_t$  \(34)\)
THE CHOICE OF PARAMETERS

40. Having settled on a set of real growth rates for GDP and exports, the planner may wish to manipulate the RMSM parameters in order to obtain more realistic or acceptable results. It could be, for example, that a targeted increase in real growth rate of per capita consumption would result in an unsustainable level of external borrowing. If this were the case, then the planner might want to simulate the effects of a structural adjustment. Structural adjustment, in this case, implies changes in the efficiency of investment, the efficiency of import usage, the marginal savings rate or changes in the share of each national accounts aggregate in the general supply and use of goods.

The Efficiency of Investment

41. One way to ensure that adequate consumption is maintained and to decrease the need for external borrowing is to improve the efficiency of investment so that less capital can make a greater contribution to output. Less investment means, ceteris paribus, that more domestic output and imports can go towards consumption. If the share of imports in investment remains constant then the demand for capital imports will decline and so will the need for external finance. This could be done by increasing the capacity utilization of under-used factories, the application of a larger labor force to existing capital, better management of existing capital, or the purchase of more efficient capital. The modeler can reflect these improvements by using smaller investment parameters. This will be true no matter which functional form the modeler has chosen for the investment function. Note that these are all essentially planning options. The necessary incentives to make them successful cannot be modelled in the RMSM.

Import Elasticities

42. Another way to reduce borrowing requirements is to directly reduce the dependency upon imports. Note that a reduction in imports could also have a harmful effect by cutting into consumption if investment or exports are not reduced in compensation. The critical question is whether or not the average long-run elasticities are to produce expanding or shrinking import shares. For example, if the modeler wants to assume an economy which becomes progressively better at satisfying consumer or investment needs out of domestic production, then the elasticities should be less than one.\(^\text{18}\) (See Table 1 above.)

\(^{18}\) An empirical study by Lopez and Thomas finds that the long-term composite elasticity for total imports should range from about 1.1 to 1.4 with higher coefficients during high growth periods. They found very few countries with elasticities of less than one for sustained periods.
43. The RMSM user can also allocate the change in parameters over the three types of import functions: intermediate goods, capital goods and consumption goods. The relative effect of each is determined by the starting value of the respective import shares. Keep in mind, also, that the capital goods import function can be especially volatile if the investment function uses an ICOR rather than a MPI or a lagged function.

The Marginal Savings Rate

44. If the modeler has imposed the MAXMSR constraint on savings then he or she has ensured a protected level of consumption at the expense of the need to borrow. Once the maximum marginal savings rate has been reached the need for borrowing can only be reduced if the marginal propensity to invest can be brought below the MAXMSR as illustrated by equation 24.
SUMMARY AND CONCLUSIONS

45. The RMSM is primarily a planning tool and thinking aid. It calculates the amount of investment, imports, and external borrowing that will be needed in order to sustain a targeted real growth rate in GDP and exports. Except in the constrained savings case, consumption and savings are residual items which float up or down as a consequence of the relative changes in the other national accounts aggregates. If consumption declines or if external borrowing increases too quickly, this is a sign that the desired rate of growth is unacceptable - or that structural changes are needed before society can sustain that amount of growth without damage.

46. Structural change, defined as a shift in the composition of the supply and use of goods, is extremely easy to manipulate within the model. The amount of investment needed to fuel domestic output is controlled through a marginal propensity to invest or an ICOR. The level of imports needed to support investment, consumption or intermediate uses is controlled through a set of demand elasticities. Export performance is controlled directly by means of a real growth rate. If desired, marginal changes in consumption and savings rates can be constrained within politically acceptable boundaries.

47. The clarity of the model is its main strength but also a source of weakness. The simplicity of the linkages in the RMSM, the lack of prices and other key policy variables, and the number of exogenous variables presents the modeler with numerous challenges. The planner can describe the desired changes and trends but he or she cannot be sure that these will be consistent with the existing arrangement of price and other incentives in the economy. In consequence, the planner cannot indicate how prices and policies should be changed.19

19. This charge is not unique to the RMSM but holds for all similarly constructed two-gap models, including the original, as well as many other types of planning models. See for example the comments of Kindleberger and Herrick (1977).
APPENDIX A

This appendix contains a list of the real marginal changes in each of the endogenous variables of the national accounts per marginal change in GDP and exports.

A.1. Investment

\[
\frac{\Delta I_t}{\Delta GDP_t} = \frac{\Delta k_t}{\Delta GDP_t} + \frac{\Delta A_t}{gdp_grt} + A_1t + A_2t - A_2t-1 * \left( \frac{1}{gdp_grt} - \frac{1}{gdp_grt*(1+gdp_grt-1)} \right)
\]

= A_1t + A_2t * g_t

when parameters A1 and A2 are constants, where:

\[
g_t = 1 - \frac{1}{gdp_grt} + \frac{1}{gdp_grt + gdp_grt * gdp_grt-1}
\]

For the sorts of growth rates normally experienced, the lagged GDP growth function (g) is only slightly smaller than GDP growth. Thus, one can think of the two as being essentially the same.

If the parameters are constants then the average propensity to invest will equal the marginal propensity to invest. If A2 equals zero then A1 will equal the average and marginal propensity to invest. If A1 equals zero then the real rate of GDP growth multiplied by the ICOR (A2) will equal the average and marginal propensities to invest.

A.2. Imports, Intermediate Goods

\[
\frac{\Delta M_{gt}}{\Delta GDP_t} = mg_{el}t * \frac{M_{gt-1}}{GDP_{t-1}}
\]

= sg_t

where sg_t represents the share-weighted elasticity for imports of intermediate goods.

A.3. Imports, Capital Goods

\[
\frac{\Delta M_{it}}{\Delta GDP_t} = mi_{el}t * \frac{M_{it-1}}{I_{t-1}} * \frac{\Delta I_t}{\Delta GDP_t}
\]

= si_t * \frac{\Delta I_t}{\Delta GDP_t}

where si represents the share-weighted elasticity for imports of capital goods.

Continued ...
A.4. Consumption

The marginal propensity to consume, within the RMSM, is expressed as:

\[
\frac{\Delta C_t}{\Delta GDP_t} = \frac{1}{1-sc_t} * \left((sg_t + 1) + (si_t - 1) * \frac{\Delta I_t}{\Delta GDP_t} - \frac{\Delta X_t}{\Delta GDP_t}\right)
\]

\[
\frac{\Delta C_t}{\Delta X_t} = -1
\]

The parameters \(sg\) and \(si\) are described above. Parameter \(sc\) is short-hand for the share-weighted elasticity for imports of consumption goods.

\[
sc_t = mc_{el_t} * \frac{Mc_{t-1}}{C_{t-1}}
\]

Note that it is possible, though highly improbable, that an economy could import nearly all of its consumption goods and do so with an elasticity with an absolute value greater than one. If this were the case, then the left-hand side of the product in the marginal propensity to consume would be negative. The overall marginal propensity to consume will, however, almost always be positive and less than one.

A.5. Imports, Consumption Goods

Imports of consumption goods, as illustrated below, will simply mirror the trend in consumption.

\[
\frac{\Delta Mc_t}{\Delta GDP_t} = \frac{sc_t}{1-sc_t} * \frac{\Delta C_t}{\Delta GDP_t}
\]

\[
\frac{\Delta Mc_t}{\Delta X_t} = -sc_{t-1}
\]

A.6. The Resource Gap

The resource gap will generally increase with GDP growth through the effects of the increased need for imports. If, however, elasticity \(sc\) outweighs elasticity \(si\) and if the product of the difference and the marginal propensity to invest outweigh elasticity \(sg\), then GDP growth could induce a reduction of the resource gap. This is most easily achieved when all three elasticities are negative. An increase in exports will also reduce the resource gap.

\[
\frac{\Delta RG_t}{\Delta GDP_t} = \frac{1}{1-sc_t} * (sg_t + sc_t + (si_t - sc_t) * \frac{\Delta I_t}{\Delta GDP_t} - \frac{\Delta XTTADJ_t}{\Delta GDP_t})
\]
APPENDIX B

Anyone who has already used the RMSM will want to know how the condensed model variables are related to those in the actual model. The condensed version of the RMSM can be translated to the actual model by using the rules below. For a complete description of these terms and of how they are calculated, see the User's Guide to the Revised Minimum Standard Model.

B.1. The National Accounts

\[ \text{GDP} = YAGR + YIND + YOTH + INDTAX \]
\[ X = XGNFS \]
\[ I = IFIXED + CHGSTK \]
\[ M_g = MINT + MFET + MNFS \]
\[ M_i = MCAP \]
\[ M_c = MFOOD + MOCG \]
\[ RG = MGNFS - XTTADJ \]
\[ \text{where MGNFS} = M_g + M_i + M_c \]

B.2. The Balance of Payments

\[ \text{RESBAL} = \text{EXP} - \text{IMP} \]
\[ \text{EXP} = \text{EXPCM1 through EXPCM6 + EXPMAN + XPNFS} \]
\[ \text{IMP} = \text{IMPOOD + IMPOCG + IMPPET + IMPCAP + IMPINT + IMPNFS} \]
\[ \text{NETFSY} = \text{INTCAP} + \text{OTHFSY} \]
\[ \text{OTHFSY} = \text{DIIP + INTRES + INTLT + INTSTP + IMFCHG + OTHFSR} - \text{OTHFSP} \]
\[ \text{NETCTR} = \text{WRKRM} - \text{WRKRP} + \text{OTHCTR} - \text{OTHCPT} \]
\[ \text{CURBAL} = \text{RESBAL} + \text{NETFSY} + \text{NETCTR} \]
\[ \text{NETCAP} = \text{GAPF1L} + \text{LTCAPF} + \text{OTHCAP} \]
\[ \text{CHGRES} = \text{NETIMF} + \text{OTHCHR} \]
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