THE REVISED MINIMUM STANDARD MODEL EXTENDED (RMSM-X)

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Summary

The World Bank has used macroeconomic models to forecast the development path of developing countries. During the 1970s and 1980s, the Revised Minimum Standard Model (RMSM) was used for this purpose. The popularity of the RMSM was undoubtedly due to its simplicity, but that simplicity has also limited its usefulness.

Introducing multiple economic agents in a consistent flow-of-funds framework allows the exploration of more policy options while preserving the useful features of the RMSM. This flow-of-funds version of the RMSM is known as the Revised Minimum Standard Model eXtended (RMSM-X). Although conceived as a working tool for country economists to facilitate their analysis of economic policy packages, the basic version of the RMSM-X generates all of the projections required for three activities within the World Bank.

1. Introduction

The game SimEarth was first conceived by Wil Wright while he was reading James Lovelock's Gaia Hypothesis. That theory proposes that the living matter of a world modifies its planetary environment to suit its own needs. Wil began working on a planet simulator trying to incorporate all major aspects of environmental science into a single model. Fred Haslam joined the project for the final year of development, helping out with the geologic, biologic, and sapient models.

The target machine for the game was the Macintosh 512k. At the time, this was the pinnacle of personal computers. The project constantly ran into memory limitations. Between large maps, window displays, and code segments, the developers had to make choices that frequently limited data representation. The final map had a total of ten bytes of information per tile. At the time this seemed lavish. Most of the values were a subsection of a byte and as a consequence have binary ranges such as 0–7 or 0–31.

Another limitation on the simulation was the desire to make the resulting application into a game. The developers had to consider what would be interesting for a player, and then had to give players the power and incentive to change the environment. From this perspective, the project results were in part a failure. Players could frequently complete a scenario without ever touching a key.

The attempt to mold the simulation into a game worked best with the models of Mars and Venus. Without player intervention, life could never form in these environments. Therefore, in these scenarios, player intervention was vital to success.

The goal of the project was to create an interactive environment that would provide insight into the global environmental systems that govern our world. The developers wanted to take what they had learned about the world and present the information in an accessible fashion, something that could lead players to learn more or at least think more about our world. This goal, at the very least, was met and achieved (see *SimEarth: A Great Toy*).

2. Purpose, Structure, and Function of the RMSM-X Model

For more than thirty years the World Bank has used macroeconomic models to forecast the development path of developing countries. During the seventies and eighties the Revised Minimum Standard Model (RMSM) was used for this purpose. The RMSM model calculated the need for additional foreign savings to close the so-called Savings Gap, or the model was used to calculate the extra foreign exchange requirements for purchasing those imports that were critically needed in the production process. The popularity of the RMSM was undoubtedly due to its simplicity, but that simplicity has also limited its usefulness. Introducing multiple economic agents in a consistent flow-of-funds framework allows the exploration of more policy options while preserving the useful features of the RMSM. This flow-of-funds version of the RMSM is known as the Revised Minimum Standard Model eXtended (RMSM-X). Although conceived as a working tool for country economists to facilitate their analysis of economic policy packages, the basic version of the RMSM-X generates all of the projections required for three activities within the World Bank. These are: the Country Assistant Strategy document, the country creditworthiness analysis or portfolio review, and the structural adjustment operations. In all these activities, the tool is used to evaluate the feasibility of the proposed policy adjustment and its sustainability, both external and internal.

3. Basic and Extended Versions of the Revised Minimum Standard Model

3.1. RMSM-X: The World Bank's Main Vehicle for Macroeconomic Projections

The RMSM-X model consists of two modules: the flow-of-funds module (popularly referred to as the RMSM-X), and a foreign debt module. The basic version of the RMSM-X contains four economic agents or sectors: Public, Private, Financial, and Foreign. The Public Sector is defined as the Central Government and the Financial Sector is defined as the Monetary System, consisting of the Central Bank and Deposit Money Banks. This means that the Private Sector (the so-called Private Sector should be interpreted as a residual sector, i.e. whatever sector the user does not specify separately will be in this Private Sector), or more appropriately labeled Rest of the Economy Sector, contains in addition to households and private firms, noncentral government agencies, parastatal enterprises, and nonmonetary financial institutions. The Foreign Sector is simply the balance of payments viewed from outside the country, which means that credits and debits are reversed from the normal Balance of Payments' view.

The RMSM-X, like the RMSM, relies on the fundamental accounting identity of standard national income accounts,

$$Y = C + I + X - M \qquad (1)$$

where *Y*, *C*, *I*, *X*, and *M* stand for gross domestic product at market prices, total consumption, gross domestic investment, export of goods and services, and imports of goods and services, respectively.

Gross domestic product (at market prices) must be equal, *ex post facto*, to expenditures

on consumption, investment, exports, and imports. The basic RMSM-X model requires a more detailed version of this equation, namely, dividing consumption and investment into government and private components:

$$Y = C_g + C_p + I_g + I_p + X - M \tag{2}$$

where *g* and *p* denote government and private, respectively.

If one knows the value of *Y*, *I*, *X*, and *M*, the value of *C* can be deduced. Similarly, if one knows the value of *C* and one of its components, or the value of I and one of its components, the other component can be deduced. The model relies heavily on such simple relations. In addition to the GDP identity, RMSM-X incorporates budget constraints for each of the four sectors which require not only that the total sources (revenues) for each sector equal its total uses (expenditures), but also that a use in one sector must be a source in another sector. These relationships ensure consistency with the flow-of-funds accounting methodology. Behavioral constraints of the model are embodied in four financial asset market-clearing relationships for money demand, foreign assets, government borrowing from the private sector, and domestic monetary credit. These relationships yield a system of nine equations, of which eight are independent and one is determined by Walras' law. Therefore the model can be solved for eight unknown variables—the endogenous or residually estimated values of the model.

3.2. Behavioral Structure of the Model

A number of simple behavioral relations supplement the accounting framework of the RMSM-X model. Among these are the demand for money function, the investment/output relation, the private consumption function, the import demand functions, and the export demand functions for manufacturing goods relevant to a country. Annex 3 describes for each variable identified in the basic RMSM-X how it is projected.

The money demand function specified is relatively simple and is based on the Fisher equation:

$$M = P \cdot Y \,/\, v \tag{3}$$

where *M* = Broad money; *P* = price level; *Y* = a scale variable (usually real GDP at market prices) and *v* = velocity of money. While the endogenous variable of this equation is dependent on the solution method popularly referred to as the closure rule (the standard solution methods or the so-called closure rules of the RMSM-X will be discussed in detail in the next section), the equation itself is not altered in character. For example, in private and public closures, the dependent variable is the demand for money (*M*), while in the policy closure, the endogenous variable is the price level (and consequently, the resulting inflation rate).

The *ICOR* is at the heart of the investment/output relation of the model, which is specified as:

$$I(t) = ICOR(t+1) \times [Y(t+1) - Y(t)] \quad (4)$$

where I = gross domestic or gross fixed investment; *ICOR* = incremental capital-output ratio; y is real GDP at market prices. In the private and public closures, this relation is used to generate the required investment for the assumed growth rate of real GDP at market prices and the given ICOR parameter value. In the policy closure, the same relation is utilized to obtain the growth in output, given the ICOR and the investment level for the previous year.

Private consumption is specified as a ratio of disposable income of the private sector. Private disposable income includes net factor and net transfer payments from abroad.

$$C_p = \beta \times (Y - T + NCTR + NFY) \quad (5)$$

where β = propensity to consume, *NCTR* = net current transfers in real terms received by the rest of the economy sector from the other sectors (if a component specific deflator of net current transfers is not available the deflator used to deflate the specific item in net current transfers is the domestic absorption deflator), *NFY* = net factor income in real terms from the other sectors (if a component specific deflator of net factor income is not available, the deflator used to deflate the specific item in net factor income is the domestic absorption deflator), Y = real GDP at market prices, and T is the sum of direct and indirect taxes paid by the rest of the economy sector. (An example of transfers that contribute to a person's net disposable income is worker's remittances from abroad and pension payments by the government.)

The simple import functions recognize two important determinants of demand:

$$IMi = f(Y, RERi) \quad (6)$$

where *IMi* = demand for *i*th import category (the import components identified in the RMSM-X are: food, consumer goods, intermediate raw materials, intermediate manufactured, capital goods, and fuel and other petroleum based products); Y = real GDP at market prices or a domestic absorption component (imports of capital goods are a function of gross domestic investment in the private and public closure, and in many models imports of consumer goods is made a function of total consumption); *RER* = real exchange rate of the *i*th import category. In the linear form of the specific functions used, the user has to specify the elasticities of demand with respect to Y and *RER*.

Export of goods is a combination of exports of primary goods, i.e. commodities and manufactured goods and products. The export functions specified for the primary goods are that their exports in year t+1 are dependent on a user specified growth rate g over the level of exports achieved in year t. Hence, the exports of primary goods are supply driven and the exporter can be seen as a (world) price taker. In the case of manufacturing exports, however, a demand function is specified that incorporates trends in real income of its trading partners and its real exchange rate. This translates into the following export-of-manufacturing-goods equation:

$$Xm = f(Yf, RERm) \qquad (7)$$

where *Xm* = exports of manufacturing goods; *Yf* = trading partners income; *RERm* = the real exchange rate of manufacturing goods. The advantages of this specification of both import and export demand functions is that it enables the exploration of various income and real exchange rates on the trade balance and the current account in the balance of payments.

3.3. Behavioral Extensions

Country teams are urged to adjust their RMSM-x models to a country's specific conditions. This customization is not limited to adjusting for country specific variables, but often includes extending the model with country specific sectors and/or adjustment to projections rules of critical variables in the model and hence to the behavioral structure of the model. Many behavioral extensions have been implemented by country teams. The model has been turned into an open IS-LM framework, incorporated a Philips curve to analyze the tradeoff between inflation and employment, to incorporate an important sector on the supply side of the economy such as the oil sector in Nigeria and the copper sector in Chile. Other (nondocumented) examples of extending the behavioral structure are the replacement of the ICOR rule by a production function that does allow for substitution between labor and capital, and the estimation of a private investment function and a private consumption function. Many of the above-mentioned extensions of the behavioral structure of the basic RMSM-X model are desirable and should be undertaken to increase its usefulness for policy analysis.

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Biographical Sketch

Jos Verbeek is employed at the World Bank, Washington, DC, US, as a Country Economist for Latvia and Lithuania in the Poverty Reduction & Economic Management Unit in Europe and Central Asia (1999–present). He was an Economist with the Development Data Group (1992–1998), Co-chairperson of the thematic group on macro modeling, i.e. Tools for Economic Analysis, and Operational work; (FY97–FY98): Introduced RMSM-X to the creditworthiness department of the Japanese Export Import bank, Trained staff of the Asian Development Bank in macro modeling using the RMSM-X framework, Provided technical assistance to the National Planning Commission of Namibia and the Economic Policy department of the Ministry of Finance of Mongolia, Lecturer in the EDI course Macroeconomic management: New methods and current policy issues, Tinbergen Institute, University of Amsterdam, The Netherlands; Research Assistant (1988–1992), involved in conducting research on growth theory and teaching introductory mathematical economics
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Dr. Verbeek is married to Vildan Demiraydin and is the proud father of two sons: Jens Eren and Erkin Emiel.