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# The World Bank Revised Minimum Standard Model: Concepts and limitations

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**Abstract**

The Revised Minimum Standard Model (RMSM) became an important analytical tool for the World Bank's financing projects in the 1970s. Since that time, the model and its sequential extensions (the RMSM-X and the RMSM-XX) have been used to forecast economic growth and development in developing countries, despite their numerous limitations.

The RMSM model can be solved in the positive mode and in the programming mode without or with limits on foreign flows. The model estimates the levels of investment and foreign financing that are needed to achieve a target for economic growth if it is solved in the positive mode or in the programming mode without constrains on foreign financing. If the RMSM model is solved in the programming mode with constrains on foreign financing then it gives us a feasible level of output growth for available levels of investment and foreign financing.

The extended Bank's models incorporate more complex economic structure. The RMSM-XX model more completely specifies the behavioural links among economic variables.

## Introduction

The World Bank was created at the Bretton Woods Conference in 1944. Initially, the Bank assisted with rebuilding of industrial countries after World War II. Nowadays the main goal of this development institution is promotion of the economic development in poor countries and its financing. The Bank assists developing countries through long-term financing of development projects and programmes.

In order to ascertain the resources needs of developing economies the Bank used various models. The Harrod-Domar growth model provided the analytical foundations for the Bank's operations in the 1950s. Next, the two-gap model designed by Chenery and Strout (1966) was used as the theoretical basis for the


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Bank's aid programmes. In the 1970s and 1980s, the Revised Minimum Standard Model (hereinafter: RMSM) became an important analytical tool for the Bank's financing projects. The RMSM model has evolved over time. Nowadays the World Bank uses the RMSM-X (the Revised Minimum Standard Model-Extended) and RMSM-XX models as the general model framework.

The RMSM model and its extended versions have many limitations but they have been used for decades to forecast economic growth and development in developing countries.

The aim of this article is to show the main modifications of the RMSM model, their implications for the World Bank macroeconomic policies and shortcomings.

In the article the structure of the standard RMSM model is presented in detail, whereas only main characteristics of the extended versions of the Bank model, due to their complexity, are shown.

## 1. The standard RMSM model

The RMSM model concentrates on the supply side of economy and real macroeconomic variables. The model is based on the Harrod-Domar growth model. It allows to determine medium-term growth. The output depends on the capacity of production. It means that the model ignores the demand effects on output. Economic growth is driven by capital accumulation or investment.

In the RMSM model the relationship between real[1] output and investment is given by

$$(1) \quad I_t = \sigma \cdot \Delta y_t \qquad \sigma > 1$$

where $I_t$ means total investment in time $t$, σ is the incremental capital-output ratio and

$$(2) \quad \Delta y_t = y_t - y_{t-1}$$

is the change in real output.

The incremental capital-output ratio is defined as the ratio of units of investment needed to produce one unit of output. In the model σ is assumed to be constant.[2] In consequence, parameter σ is associated with simple production function, where factor substitution is not possible. There are no possibilities for substituting capital with labour or labour with capital.

The incremental capital-output ratio is technologically given or is known from estimation using historical data. According to Khan, Montiel and Haque (1986, p. 27), reasonable values of the incremental capital-output ratio are in the

[1] The standard RMSM model takes prices as given.

[2] Constancy of the incremental capital-output ratio is not supported by empirical research (Kraev, Akolgo, 2005, p. 304).


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range of 4–7. Kenny and Williams (2001, p. 5) argue that this coefficient usually varies between 2 and 5.

Relationship (1) allows one to obtain the required level of investment consistent with a target level of growth rate of real output.

Equation (1) is often presented in the form

$$(3) \quad \Delta y_t = \varphi \cdot \Delta K_t,$$

where $\varphi$=1/σ is the inverse of incremental capital-output ratio and change in capital is equal to investment ($\Delta K_t = I_t$). Equation (3) allows one to obtain the change in real output for an available level of investment. The change in real output is a linear function of the level of investment.

The main objective of the RMSM model is finding the sources for financing economic growth (sources for financing investment) over the short to medium term. Investment is financed by savings, either by domestic private or public sector or external sector. Private sector savings $S^P_t$ are equal to output $y_t$ less total amount of direct taxes paid by private sector to the government $T_t$ and private consumption $C_t$. Public sector savings depend on the level of taxes, net foreign inflows (net foreign borrowings) $F_t$ and government spending $G_t$. The external sector receives income from imports of goods and services $M_t$ and makes expenditure on exports of goods and services $X_t$. From external sector's point of view the net foreign inflows represent expenditure. The relationship between investment and savings is presented in Figure 1.

Foreign sector savings are equal (up to the sign) to the change in foreign currency reserves:

$$(4) \quad \Delta R_t = X_t - M_t + F_t.$$

The change in foreign currency reserves is determined by net inflow of foreign exchange which stems from international trade and capital flows. Equation (4) is called the balance-of-payments identity.

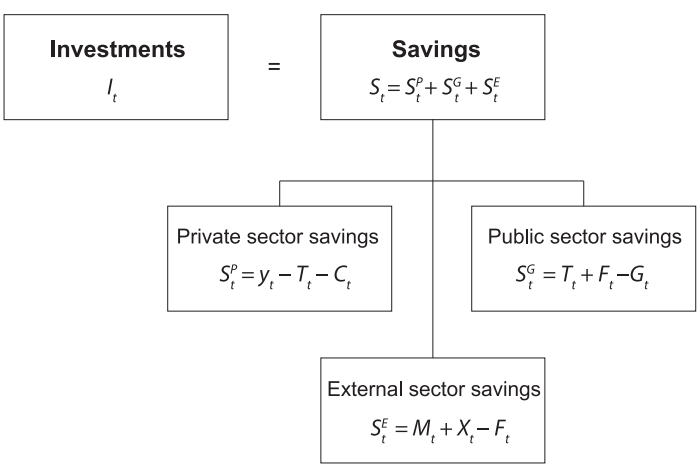


**Figure 1.** Relationship between investment and savings


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Domestic investment is a sum of private and public sector savings and the inflow of external savings

$$(5) \quad I_t = S_t^P + S_t^G + S_t^E$$

Foreign savings supplement domestic savings.

Equation (5) can be written in the form of the national income accounting identity

$$(6) \quad y_t = C_t + I_t + G_t + X_t - M_t ,$$

where all variables remain as before.

In the RMSM model the consumption function of the private sector is specified as

$$(7) \quad C_t = (1-s)(y_t - T_t), \qquad s \in (0,1),$$

where $s$ denotes a stable, historically given savings rate. Private consumption is proportional to real disposable income, which is defined as real output minus taxes.

The model assumes a linear relationship between imports and output. Real import demand function depends on the level of a country's real income

$$(8) \quad M_t = m \cdot y_t, \qquad m \in (0,1),$$

where $m$ is the constant marginal propensity to import.

The RMSM model is based on five relationships. The first relationship relates investment and the change in real output (1). The second one is the balance-of-payments identity (4). The third relationship is the national income identity (6). The remaining two are relationships (7) and (8) respectively. The model is relatively simple but it can be adjusted to specific conditions of a given country. Addison (1989, p. 1) argues that in the 1980s the number of different variables used in the RMSM model was about 430.

The RMSM model can be solved in various modes. The main ones are the positive (policy) mode and the programming mode[3] (Agénor, 2004, p. 374). The most important approaches to the RMSM model are presented in Figure 2.

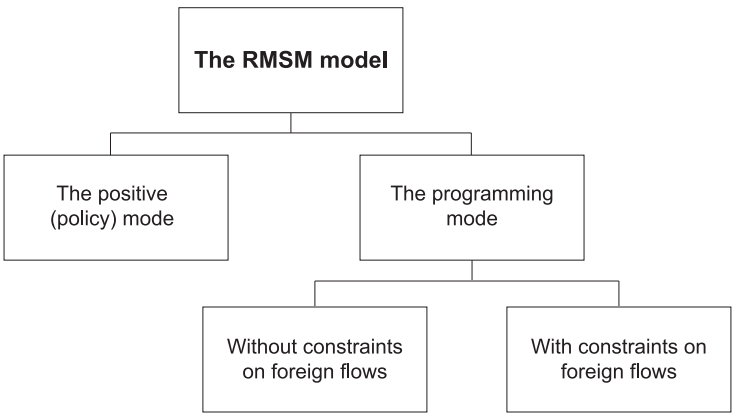


**Figure 2.** Modes of solving the RMSM model

[3] The positive mode shows what the outcomes for a given set of macroeconomic policies are. The programming mode shows what macroeconomic policies are required to achieve a given set of outcomes.


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In the positive mode the change in real output $\Delta y_t$ and the change in foreign currency reserves $\Delta R_t$ are calculated for given values of policy instruments (taxes $T_t$, government spending $G_t$, net foreign inflows $F_t$), exports of goods and services $X_t$, parameters (savings rate, the incremental capital-output ratio, the marginal propensity to import) and the predetermined variable $y_{t-1}$.

In the programming mode the change in output $\Delta y_t$ and the change in foreign currency reserves $\Delta R_t$ are target values. If there are no limits to foreign flows, then the level of foreign financing $F_t$ needed to achieve targets is determined. If foreign inflows are limited, then the investment and growth potentials cannot be realized in the RMSM model. In this case target values for output and foreign currency reserves must be adjusted to the limited level of foreign financing.

The RMSM model is used either to estimate the levels of investment and foreign financing that are needed to achieve a target for economic growth or to calculate the feasible level of output growth for available levels of investment and foreign financing.

## 1.1. The solution of the RMSM model in the positive mode

In the positive mode the economic growth and the corresponding level of foreign currency reserves which enables an economy to avoid balance of payments disequilibrium are determined.

Substituting equations (1), (7), (8) and (2) into (6) yields variable $\Delta y_t$ in the following form

$$\Delta y_t = \frac{1-s}{\sigma - m - s} T_t - \frac{1}{\sigma - m - s}\left(G_t + X_t\right) + \frac{s+m}{\sigma - m - s} y_{t-1} \quad , \tag{9}$$

$$\sigma - m - s > 0$$

Change in output is determined for the policy instruments, given values of exports and the predetermined variable $y_{t-1}$. For sustained economic growth the dominator $\sigma - m - s$ has to be positive. It means that the incremental capital-output ratio has to be greater than the sum of the marginal propensity to import and savings rate.

Change in output is positively correlated with taxes and negatively correlated with government spending. An increase in taxes raises public sector savings and reduces private sector savings. However, the effect of the reduction in private savings is smaller than the increase in public savings. Government savings increase by the full amount of the tax increase, while private sector savings increase by a fraction of the tax increase. A reduction in government spending increases public sector savings and therefore increases investment and output.


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The second variable $\Delta R_t$ can be expressed as

$$(10) \quad \Delta R_t = -m\cdot(\Delta y_t + y_{t-1}) + X_t + F_t$$

Equation (10) is obtained after substituting (2) and (8) into (4). The solution of the RMSM model in the positive mode can be illustrated in the $\Delta y_t$ _ $\Delta R_t$ space (Figure 3).

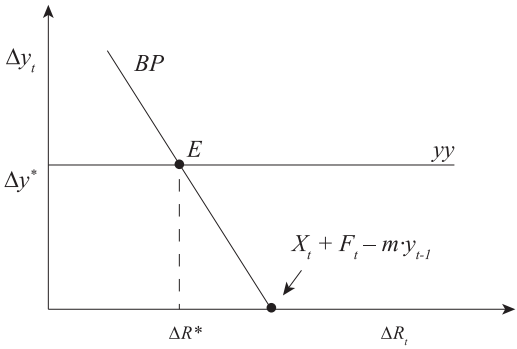


**Figure 3.** The RMSM model in the positive mode

Source: Agénor (2004, p. 375).

The horizontal line *yy* is given by equation (9) and the negative sloped line *BP* is described by

$$(11) \quad \Delta y_t = -\frac{1}{m}\Delta R_t - y_{t-1} + \frac{1}{m}\left(X_t + F_t\right)$$

Equation (11) is obtained from (10). The intersection of the lines *yy* and *BP* (at point *E*) defines equilibrium values of $\Delta y_t$ and $\Delta R_t$, for given values of the policy instruments and the exogenous variables.

The change in foreign currency reserves $\Delta R_t$ in equilibrium is given by

$$(12) \quad \Delta R_t = -\frac{m\cdot\sigma}{\sigma - m - s} y_{t-1} - \frac{m\cdot(1-s)}{\sigma - m - s} T_t + \frac{m}{\sigma - m - s} G_t + \frac{\sigma - s}{\sigma - m - s} X_t + F_t$$

One obtains equation (12) after inserting (9) into (10). Change in foreign currency reserves increases if government spending, value of exports or net foreign borrowings are increasing. A reduction in taxes raises $\Delta R_t$, too.

## 1.2. The solution of the RMSM model in the programming mode

The programming mode shows what macroeconomic policies are required to achieve targets for economic growth and foreign currency reserves. In the programming mode without financing constraint net foreign inflows are treated as


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policy variable. In this approach it is assumed that the authorities have control over net capital inflows.

This mode is used to determine financing requirements for alternative target for changes in real income (or target rates of real output growth) and foreign currency reserves. Assuming the target values of output and foreign currency reserves, net foreign inflows are given by

$$(13) \quad F_t = \Delta R_t + m\cdot(\Delta y_t + y_{i-1}) - X_t.$$

Substituting $X_t$ calculated from (9) into (13) one obtains the net foreign inflows in the following form

$$(14) \quad F_t = (\sigma - s)\cdot\Delta y_t - s\cdot y_{t-1} - (1-s)\cdot T_t + G_t + \Delta R_t.$$

Net foreign inflows are an increasing function of the change in real output, government spending and foreign currency reserves.

The process of determining the values of policy instruments to achieve the desired values of the targeted variables consists of the following steps:

1. Specify values for the policy targets $\Delta y_t$ and $\Delta R_t$ .
2. Calculate the levels of investment (from equation (1)) and imports of goods and services (using equations (8) and (2)) for given values of parameters (the incremental capital-output ratio, the marginal propensity to import).
3. Specify value for the exogenous variable — exports of goods and services.
4. Determine the needed level of net foreign inflows from equation (13).
5. Calculate a feasible level of private consumption as the residual variable from equation (6) and compare it to the level of consumption derived from (7). If the two levels are different, then the targets and the instruments have to be adjusted to achieve a consistent level of consumption (Khan, Montiel and Haque, 1986, p. 33–34).

The programming mode with financing constraint allows to determine changes in real output for given alternative levels of foreign financing. This approach to the RMSM model is called the two-gap mode. Gaps occur when the level of investment is not sufficient to achieve a target for real output growth.

In the two-gap mode of the RMSM model there are two main constraints on the determination of changes in real output and foreign currency reserves, namely the trade constraint (trade gap or foreign exchange gap) and the savings constraint (savings gap). The trade gap mode focuses on the need for foreign currency to finance imports and the savings gap concentrates on the availability of savings to finance investment.

To derive the trade constraint one needs to write the balance-of-payments identity (4) in the following form:

$$(15) \quad M_t - X_t = F_t - \Delta R_t$$

For exogenous exports, equation (15) shows the level of imports consistent with a given value of net foreign inflows and the target level for foreign currency


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reserves. Substituting import demand function (8) and equations (1)-(2) into equation (15) one obtains investment as a function of foreign financing

$$(16) \qquad I_t^T = \frac{\sigma}{m} \cdot \left(X_t - \Delta R_t - m \cdot y_{t-1}\right) + \frac{\sigma}{m} \cdot F_t$$

According to equation (16), investment is a linear function of net foreign inflows for a target level for foreign currency reserves and a given level of exports and the predetermined value of $y_{t-1}$. A limit on foreign financing is a constraint for investment and hence economic growth. The trade constraint means that

$$(17) \quad I_t \leq I_t^T$$

In other words, demand for imports cannot be greater than the capacity to import. Trade constraint (16) is represented by the *TT*-line in Figure 4.

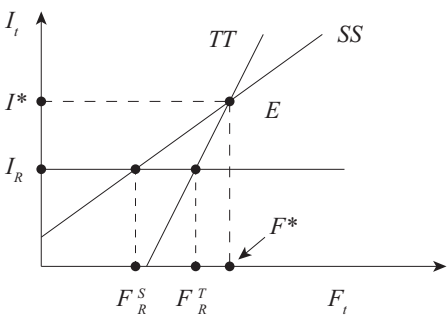


**Figure 4.** The two-gap mode of the RMSM model

Line *TT* with the slope greater than 1 is plotted under the assumption that $\Delta R_t + m \cdot y_{t-1} > X_t$. Horizontal shifts in line *TT* are mainly due to a revised target level for foreign currency reserves, because the value of exports is exogenous and real output in previous period is predetermined. Below line *TT* inequality (17) is satisfied. Above the line the trade constraint is binding.

For a target level for change in real output $\Delta y_t$, required level of investment is

$$(18) \quad I_R = \sigma \cdot \Delta y_t,$$

and the appropriate level of foreign financing that satisfies the balance-of-payments identity is given by

$$(19) \quad F_R^T = \Delta R_t + m \cdot (\Delta y_t + y_{t-1}) - X_t.$$

Equations (19) and (13) are the same. It means that trade-gap mode of the RMSM model and the programming mode without financing constraint yield the same level of net foreign flows.

Investment is also constrained by total savings. It means that investment cannot be greater than the sum of domestic and foreign savings. To derive the savings


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constraint one needs to insert equations (2) and (7) into the income accounting identity (6). After short calculations one receives

$$(20) \quad I_t^S = s\cdot(\Delta y_t + y_{t-1}) + (1-s)\cdot T_t - G_t - \Delta R_t + F_t.$$

Investment is a linear function of net foreign flows for target levels of the change in real output and foreign currency reserves. Equation (20) is represented by the *SS*-line in Figure 4. Line *SS* is plotted under the assumption that $s\cdot(\Delta y_t + y_{t-1}) + (1-s)\cdot T_t - G_t - \Delta R_t > 0$. Shifts in line *SS* are implied by changes in policy instruments and policy targets.

According to the savings constraint

$$(21) \quad I_t \leq I_t^S$$

Inequality (21) is satisfied below line *SS*. Above the line the savings constraint is binding. For the level of investment $I_R$, which corresponds to the target change in real output $\Delta y_t$, the level of foreign financing is given by

$$(22) \quad F_R^S = (\sigma - s)\cdot\Delta y_t - s\cdot y_{t-1} - (1-s)\cdot T_t + G_t + \Delta R_t\,.$$

Lines *TT* and *SS* intersect at point *E* with coordinates ($F^*$, $I^*$). To the left of $F^*$ investment is limited by the trade constraint, to the right of F* investment is limited by the savings constraint. In other words, at a low level of investment the trade gap is binding restriction to output growth. At a level of investment greater than $I^*$ the savings gap is binding. At point *E* there is no gap.

In the programming mode of the RMSM model with financing constraint the values of investment, changes in output, imports and changes in foreign currency reserves are determined through an iterative process. For example, when the trade constraint is binding this procedure consists of the following steps:

1. Specify values for the policy targets ($\Delta y_t$, $\Delta R_t$ ) and net foreign flows $F_t$.
2. Determine the required level of investment (18).
3. If $I_t^T < I_R$ , then reduce the desired change in foreign currency reserves until the constraint is relaxed.[4] If the required level of investment is achieved, then determine an appropriate level of imports from equations (8) and (2).
4. Calculate the change in foreign currency reserves from (4) and compare to the target value. If both values are identical, then estimate the level of private consumption (7). If compared values of foreign currency reserves are not identical, then resolve model for the new revised target for foreign currency reserves. The procedure is finished when the levels of foreign currency reserves obtained between iterations *n* and (*n-1*) are very close (Agénor, 2004, pp. 378–380).

The RMSM model has some serious shortcomings. It takes prices as exogenous. Inflation and changes in monetary aggregates do not have direct effect on

[4] When the desired level of investment is not achieved, the targeted change in output must be lowered to $\Delta y_t = I_t^T/\sigma$ .


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growth. The model ignores the monetary side of the economy. The supply side of the economy is not modelled either.

The Bank model does not provid an explicit relationship between policy variables and economic growth. For example, policy makers do not obtain any information about the quantitative impact of their policy actions on the allocation of economic resources in an economy.

A more useful analytical tool for policy makers is the RMSM-X model developed in the late 1980s.

## 2. Extensions of the RMSM model

The RMSM-X model, in addition to the standard RMSM, includes the financial programming approach of the International Monetary Fund (IMF). The IMF's approach is based on the Polak model, which integrates monetary, income and balance of payments analysis. The standard Polak model contains two behavioural relationships: the demand for money function and the function of the demand for imports and two identities: for the money supply and for the balance of payments (Nowak, 2012, p. 29).

Typically, the RMSM-X model consists of four economic sectors: public, monetary, foreign and private. The public sector comprises the central government. The monetary sector includes the central bank and money deposit banks. The foreign sector represents the balance of payments viewed from outside of the country. The private sector is a residual one. It comprises these sectors of the economy that are not separately specified in the model. Hence the private sector contains households, private firms, non-monetary financial institutions or non-central government agencies.

In practice, each basic sector can be further disaggregated. For example, the monetary sector can be divided into the central bank and the domestic banking system. A sector of state economic enterprises can be distinguished beside the central government sector. Each sector is characterized by its budget constraint. Additionally, national accounting identity is derived as the aggregation of all sectors. In the basic version of the model there are two types of financial assets (money and foreign assets). Some models include central bank credit and domestic bonds.

The accounting framework of the model is supplemented by the demand for money function, the investment-output relation, the private consumption function, the import demand function and also the export demand function for commodities. The targets are set for changes in potential output and in foreign currency reserves, and additionally — for the rate of inflation, real exchange rate and real interest rate.[5]

[5] Detailed structure of the RMSM-X model can be found in Everaet, Garcia-Pinto and Ventura (1990), Serven (1990) or Agénor (2004).


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The RMSM-XX model is a further extension of the RMSM-X. In this model consumption, investment and import demand functions are econometrically estimated. Moreover, the model specifies additional relations. For example, the real wage is a function of the level of employment. The supply side of economy is analysed in more detail. The model includes a richer specification of the links among economic variables. It requires a simultaneous solution procedure (Mills, Nallari, 1992, p. 114).

## 3. Advantages and disadvantages of the Bank models

The RMSM model has a simple and transparent structure. It requires a set of statistics that is available in each developing country. The model needs as inputs national income, balance of payments, government finance and monetary data. Simplicity is one of the main advantages of the model. However, it limits its usefulness.

The Bank models are criticized from different points of view. First of all, the RMSM model represents an investment approach to economic growth. Investment is the only determinant of output growth. Hence the shortage of capital stock is the main limiting factor for economic growth and development. Other important economic growth factors, such as technical progress, human capital or social capital, are not explicitly included in the model.[6]

The RMSM model assumes that there is a one-to-one relation between foreign financing (foreign aid) and investment. In other words, all aid is invested by a recipient country. In reality not all aid is used in productive manner. In a recipient country part of it is very often used for consumption or to finance borrowing from domestic sources. Generally, the positive impact of aid on economic growth is not confirmed by empirical research.[7]

Another important shortcoming of the RMSM model is the assumption about the constant average and marginal productivity of capital and a lack of factor substitution. The extended versions of the RMSM model are mainly criticized because of their inadequate financial structure, mechanical behavioural rules and a basic supply side.

Despite these limitations the Bank models are used to monitor the effects of stabilization packages (structural adjustment lending, development packages) and to quantify decisions of policy makers, and evaluate trade-offs between different policy packages (Mechler, 2004, p. 123).

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[6] In the RMSM model the impact of technical progress and human capital can be incorporated into the incremental capital-output ratio (Yotzov, 2001, p. 15).

[7] A survey of studies on foreign aid and economic growth can be found in Hansen and Tarp (2001), Mallick and Moore (2005, pp. 369–370), Xiaoyong and Gong (2008, p. 1270) or Doucouliagos and Paldam (2008).


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According to Easterly (1999, p. 423), the RMSM model is a "ghost" model, because it is based on the growth model that died out of the academic literature long ago. However, it is so ingrained in the World Bank that no one wants to change it.

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