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MACROECONOMIC PROJECTIONS OF THE GOVERNMENT HEALTH SECTOR IN DEVELOPING COUNTRIES: EXPERIENCES WITH SIMULATION MODELLING

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1. INTRODUCTION

The health sector does not operate in isolation from the rest of the economy. The economic plight of many developing countries, especially over the past 15 years, has affected the government sector and therefore the level of government health expenditure. This has reminded health policy makers that the health sector is linked to the economy. Countries have realised that the improvements they wish to see are constrained by the growth of the economy. In order to better plan the government health sector, health policy makers have to understand how it works as an integral part of the economy. This calls, among others, for a macroeconomic approach, that will show how the economy functions and what the interlinkages are with the health sector.

In this paper, we address first the issue of capacity building in basic macroeconomics, and discuss how a simulation model can be a useful tool for policy makers and their advisers at Ministries of Health. The purpose of this simulation model is (i) to improve the analysis of government options with respect to the evolution of health expenditure; (ii) to better undertstand and assess the possible impact of macroeconomic changes on the total government budget and, subsequently, on the government health budget; (iii) to gain a better grasp of the future roles in health financing of other economic agents, such as private households, enterprises and donors.

In the third section, we present the basic structure of the simulation model. In addition, we discuss which data users need to input and how they can use the model's output. We also present a sample of questions related to government health budget policy. A selected country application, that of Bangladesh, is presented in section 4. We conclude in section 5.

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2. CAPACITY BUILDING IN BASIC MACROECONOMICS AT MINISTRIES OF HEALTH

In the late eighties and the early nineties, Ministers of Health in many developing countries, especially in low-income regions, voiced a need for more capacity in economics among their staff. Economic growth in many countries had slowed down significantly, even to the point of turning negative. Structural adjustment programmes were also being implemented. This demand to better understand the linkages between the economy and the health sector could not be met by Ministry of Health (MOH) staff itself that generally acknowledged a weakness in economic analysis. Even until now, MOH staff with medical or public health background often occupy positions that involve financial planning and budgeting. The entry in Ministries of Health of economists, health economists or public health staff with basic short-term training in economics is only a recent phenomenon.

Given this particular environment, it can be understood better why the issue arose of capacity building in economics. Two questions needed to be addressed at the outset. First, why should staff's knowledge in economics be enhanced, and especially in macroeconomics? *Secondly,* which type of tool could be appropriate?

2.1 Why macro-economics?

Ministries of Health have to make their case with Ministers of Finance, sometimes more so than other ministries, that the health budgets or policy guidelines they propose are reasonable and financially sound. This puts Ministers of Health at a particular risk. Perhaps they have miscalculated budgets or badly judged the financial feasibility of certain policies. They are in fact less well informed than Ministries of Finance about the state of the economy and its evolution. In other words they may lack general macro-economic information.

If Ministries of Health enhance understanding about the basic building blocks of the macro-economy and how the health sector fits in, the quality of decision-making is likely to improve. For instance, by being informed about a serious trade deficit, they will better understand and accept a Ministry of Finance's request to seriously review the drug budget proposal. Another example is where general economic growth has fuelled higher tax revenues and therefore enables a rise in the total government budget. Understanding this linkage will alert them to claim a fair share of these additional government resources. Note also that most MOH are designing and/or implementing health plans. Again, improved knowledge of the future macro-economic environment will enhance the financial feasibility of such plans.

But, paying attention exclusively to the MOH's place in the macro-economy is not sufficient. It is also necessary to gain a better grasp of the potential role of other government agencies involved in health care, donors and the private sector (households, enterprises, non-governmental organisations, health insurance.

plans etc.). In this way, one obtains a macro-view of the country's budgetary possibilities for health care. For instance, it is good for a Minister of Health to know to what extent the Ministry of Education or Defence is also spending on health care, as this could be a way to bring the need for efficiency improvements in the government health sector on the Government cabinet table. Or, a more precise knowledge of what enterprises and households are currently spending on health care, might stimulate governments to initiate certain forms of government-regulated health financing such as social health insurance, thereby pooling contributions from government, households and enterprises.

Surely, a Ministry of Health's concern should in principle not be limited to macro-economic issues, dealing exclusively with budget levels and budgetary possibilities. Micro-economic analysis of economic agents within the health sector, such as health personnel and hospital managers, is equally important, as it would shed light on how government regulations or decisions impact on them and how they would adjust their behaviour. Still, from the point of view of capacity building and considering the urgency of certain macro-level issues, we judged that it was a priority to build a tool for macro-economic analysis, as that already would be filling an important gap.

2.2 Which type of tool?

Over the course of the past decade, PCs and networks have made their entry into Ministries in Health, even in low-income developing countries. We considered therefore that there would be no longer an impediment to construct a user-friendly computer-based model. But, which kind of model? An important criterion for the choice of the type of model has been the usefulness to help users, usually health policy makers, in their understanding of the linkages between the relevant macro-economic variables. We thereby echo the advice by Stokey and Zeckhauser, namely that `improved decision making is the goal of model building. The ultimate justification for models must rest on their usefulness in aiding decisions'[2].

It was decided therefore to build a simulation model that would enable users at Ministries of Health to understand and use the data from the national accounts and government finance, including the government health sector budget. It was also judged that this simulation model would not have to produce ready-made answers to policy questions. The model would therefore not 'replace' the decision-makers. Rather, by having a better grasp of the macro-economy and how the government health sector fits in, users would already improve the quality of their decision-making. Hence, we chose to build a *descriptive model* that would contain the basic structure of the national accounts and government finance.

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[2] Stokey and Zeckhauser (I 978,p. 13).

Having in mind the largely non-economist users at Ministries of Health, we refrained from building an econometric model or a computable general equilibrium model of the health sector within the macro-economy. Such models have definitely proven their use over the past decades[3]. However, the construction and above all the maintenance of such models, demands expertise that was beyond the reach of Ministries of Health in many developing countries, especially the low-income countries.

We therefore constructed a *simulation model*[4], consisting largely of the accounting equations that are implicit in the national accounts and government finance. A limited set of simple tax equations is added to the model, however. The first step in the use of the simulation model is to input data for a base year. Subsequently the user defines growth rates for most of the variables, giving him/her a coherent set of projections. Projections can be made either, for 5 or 10 years, after the baseline year.

Upon obtaining a set of projections for the variables of interest or target variables, a debate can then follow about the feasibility of certain assumptions, especially those regarding the future government health sector budget. For instance, the projections may show that the share of the government health sector budget in the total government budget increases from 10% to 20% over a five year period. The latter may be judged infeasible, requiring the user to formulate new assumptions. An alternative computer simulation can then be undertaken: new assumptions can be introduced easily in order to obtain a different set of projections very quickly. Given fixed baseline values and a new set of fixed growth rates, the projections will be uniquely determined. In this sense, the simulation runs can be qualified as *deterministic.*[5]

At this stage it is important to point at the useful information that that would result from the application of the National Health Accounts methodology[6]. This method is now used in a large number of developing countries, and basically allows for an in-depth flow of funds analysis. It analyses for a particular year 'who pays, how much and for what'[7] in the health sector. These data can then be used to establish among others the baseline data on health expenditure. The usefulness of National Health Accounts was highlighted by Rovira, Darba and Brugiatti (2000) in their simulation exercises for Panama.

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[3] See for instance lntriligator (1996) and Dixon and Parmenter (1996) on econometric models and general equilibrium modelling, respectively.
[4] See Harding (1996) for application of simulation methods to public policy issues.
[5] See Budnick, Moiena and Vollman (1977,p.476).
[6] See for instance Berman (1997) and PAHO (2000).
[7] Berman, op.cit., p.17.

3. THE SIMULATION MODEL[8]

3.1 Basic structure

An important characteristic of the model is it contains for the most part accounting identities and conversion equations. Most of the variables are also exogenous, with forecasts depending upon baseline values and growth rates introduced by the user. In other words, behavioural responses by economic actors to government policies are not considered.

Two sets of simple linear equations are part of the model, however. *One is the set of equations where consumption, investment and international trade are defined as ratios of Gross Domestic Product (GDP).* Given baseline values for GDP and its utilisation, the model will calculate these ratios for the base-year. Subsequently, the user is able to change these ratios. *The second set comprises simple linear tax equations*, with specific categories of tax revenues (as dependent variables) linked exclusively to their tax bases (as explanatory variables). For the base year of the simulation, the coefficients in those equations (that can be interpreted as tax ratios) are calibrated, using base year values for tax revenue and the tax base. Still, in alternative simulation scenarios, the user can modify those coefficients to accommodate future alternative tax policies. For a detailed overview of the equations in the simulation model, we refer to the Appendix.

Next, we briefly outline the structure of the model. There are six main equation blocks in the model: (i) the production block; (ii) international transactions and exchange rate; (iii) deflators; (iv) consolidated government finance; (v) government health expenditure; (vi) private health sector expenditure. Finally, population and population growth are added to the model, so as to be able to convert key variables, such as GDP and health expenditure, in per capita terms.

In the *production block*, value added of four sectors (agriculture, manufacturing, other industry and services) is determined, which will lead to the gross domestic product (GDP). Subsequently, the utilisation of GDP into consumption, investment and international trade, is analysed. The resulting utilisation values are further used as tax bases in the consolidated government finance block. In addition, international trade values are used to calculate the balance of trade deficit/surplus.

The second block contains *the international transactions and the exchange rate*. We distinguish net factor income, net transfers, and net capital flows among the international transactions. Together with the trade balance, these will determine the net foreign currency reserves of the nation. In addition, exchange rate values (against the US$ by default) are given by the user. The exchange rate is used to convert the requested government drug supplies,

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[8] This simulation model has been named SimFin (see also Carrin, Perrot et al., 1995). It has two sub-models, namely MacroFin and MicroFin. In this paper, we concentrate on the former submodel.

budgeted in dollars, into national currency. The exchange raise is also used to estimate external aid requirements in US$.

In the third equation block, rates of growth of various price indices (consumer price index, investment price index, GDP deflator and foreign price index) are given by the user. Subsequently, forecasted deflators are used to convert variables at constant prices into current prices.

The consolidated government finance block consists, *first*, of equations for the government revenues. The user determines the consumption tax rate, income tax rate and international trade tax rate, whereas he/she inputs growth rates for other government revenue (including other fiscal revenue, non-fiscal revenue and grants). After inputting these parameters, total government revenue will be calculated. Secondly, regarding government expenditure, we distinguish *current* and *capital* expenditure. Current expenditure is further broken down into expenditure items according to the *economic classification*.

Government health expenditure is modelled in the fifth equation block. It consists, first, of expenditure by the Ministry of Health (MOH). Again, we distinguish current and capital expenditure. The economic classification is used to further detail the structure of the current health budget. As for most variables in other equation blocks, the user inputs the growth rates for the various categories of expenditure, so that overall MOH health expenditure can be forecasted. *Secondly,* in several developing countries, ministries other than the MOH also provide health services. The Ministries of Defence, Education or Transport, for example, may have a network of clinics for their personnel and their dependants. The same procedure as for MOH expenditure is used to obtain forecasts.

Finally, the sixth equation block incorporates expenditure equations related to *private economic agents* such as households, enterprises, non-governmental organisations and private health insurance funds. The rates of growth of current and capital health expenditure by these various agents can also be defined. The aim, of course, is to obtain a forecast of the overall levels of health expenditure in the private sector.

3.2 Interpretation as a budgeting model

One can also interpret the simulation model as a MOH budgeting model. Indeed, budgeting of MOH plays a central role in the model. The model permits the simulation of alternative budget forecasts, so that they can be contrasted with the macro-economic environment and be analysed further on their acceptability in a wider government framework.

There are two steps in the budgeting of MOH health expenditure. First, an estimate is made of spending requirements at constant prices, or real expenditure. Secondly, to obtain expenditure at current prices, real expenditure is multiplied by an appropriate price index. Current and capital expenditure are obtained, using the consumer price index and investment price index, respectively. The advantage of this procedure is that the user is able to plan

real expenditure or *quantities* of goods and services first. If a budget plan were based directly on current prices, there would be a risk, especially in inflationary times, of obtaining quantities smaller than those that are really requested.

It should be noted that there is no explicit link between the MOH budget, on the one hand, and the structure or level of the *total* government budget, on the other. The two relevant equation blocks are independent from each other. In a first step, the total government budget should be interpreted as a hard budget constraint. In other words, given a total government budget, changes in MOH expenditure will only modify its share in the total budget. Surely, users may modify the assumptions related to the total government budget, usually in close consultation with the Ministry of Finance. A new simulation is then needed to study the new shares of MOH in the modified total government budget.

A special feature in the MOH sub-model is that the user can set the rate of growth of all budget items equal to the growth rate of real GDP, in an automatic fashion. In doing so, the resulting simulation will project a constant share of MOH expenditure in GDP. The latter is equivalent to adopting a unitary GDP elasticity of MOH expenditure. Often such a simulation is denoted by users as a 'minimum' budget scenario, claiming that the MOH budget should at the least track the growth of GDP

3.3 How to use the simulation model?

3.3.1 *The input into the simulation model and the role of the user*

We emphasise that the simulation model is not prescriptive. The results are neutral, and depend exclusively on the baseline values, growth rates and ratios introduced by the user. The user also selects whether he/she wants to obtain results for a five or a ten-year period after the baseline. All this may sound trivial, but again we have to bear in mind that the model is meant to familiarise users at MOH, who thus far are mainly non-economists, with the basic principles of macroeconomics, especially national accounting and public finance.

The important role of the user in data and parameter input is coherent with the objective of the model. Nevertheless, a concern thereby is that users should show a good dose of realism in the production of alternative but acceptable forecasts. One example to illustrate this concerns the size of the government sector. The economy of a developing country where government revenue (including grants) has traditionally represented 15% of GDP is not likely to suddenly switch to a ratio of 35%. Another example is that the share of health expenditure in the total government budget is projected to rise from 3% to 10% over two years, say. An increase in the latter ratios might well be possible, but usually needs a longer period of time.

In practical applications at country level, we have seen that MOH users may be uncertain about quite a number of hypotheses or may lack

information. In this case, establishing contact with appropriate staff from the Ministry of Finance or Planning and from the country's Statistics Bureau, in order to discuss data and hypotheses, has been an obvious solution. In fact, it is now recommended routinely to establish a governmental inter-agency team. Such a team may want to test a whole array of assumptions or introduce new data. The latter is feasible, as the simulation model is sufficiently flexible and can produce alternative forecasts in merely seconds.

3.3.2 *Sample questions on health system financing policy*

Below we list a number of selected questions related to health financing, whose analysis can be facilitated with the help of the simulation model. First, we list a sequence of questions about the *level of resources for health:*

(i) What is the trend in the percentage share of MOH expenditure in total Government expenditure? Are these shares adequate?

(ii) Can more resources for health be sought from the Government? What would be the implication for the future MOH budgets, if health expenditure growth were set equal to the GDP growth rate?

(iii) What is the current state of public finance, measured by the budget deficit as a percentage of GDP? Would it allow for an increase in the health budget?

Clearly, the model will not answer the question about adequate shares or levels of expenditure. What it will do, however, is produce alternative forecasts or scenarios that help users *judge themselves* about a set of feasible scenarios. The forecasts about the macro-economic environment will also enlighten them about growth of the economy and its impact on the financial possibilities in the government sector.

Secondly, we present a set of sample questions related to the *resource allocation in the health sector*:

(i) Is the MOH budget for drugs sufficient to satisfy the objectives of an essential drugs policy? Would the MOH be in a position to considerably increase the imports of essential drugs, if needed? Or would one anticipate objections from the Ministry of Finance in view of negative trade balances or reductions in net foreign reserves?

(ii) Are budgetary forecasts of current MOH expenditure on salaries and remuneration acceptable, when account is taken of other financial needs for the functioning of the government health sector?

(iii) Is the current policy for external financing of health expenditure sustainable? Is the share of external aid for health in total aid developing in a way that is acceptable to government and donors?

(iv) Should the current structure of health expenditure by agent (MOH, other ministries, private sector) be maintained? Or could'one redistribute resources between ministries for the sake of efficiency? Also, how large is the private sector? Would it be possible to tap those private resources for the

improverment of government health services, for instance via a social health insurance framework?

Again, the model itself will not advise the users. Rather, through the model, they will become aware of the major macroeconomic constraints and possibilities. This awareness will enable them to construct a set of alternative and feasible scenarios.

3.3.3 *Output tables*

The simulation results that can be inspected by the user relate to the macroeconomic environment and to the country's health expenditure. In the output tables on the *macroeconomic environment,* variables of particular interest are the GDP, trade balance, net foreign exchange reserves and the government budget deficit, as these are likely to influence levels of government health expenditure and its structure. In the same tables, the requested share of MOH and government health expenditure in total government expenditure is portrayed, as well as the requested share of total external aid for the government health sector.

The output tables related to *health expenditure* feature health expenditure by *agent* (MOH, other government health expenditure and private health expenditure), the *structure of MOH expenditure* according to the economic classification, and the *domestic and external financing* of health expenditure.

4. PRACTICAL USE OF THE SIMULATION MODEL

4.1 Introduction

Over the course of the past eight years, the simulation model has been applied in several countries, including Cuba, Mongolia, Nepal, Nicaragua, Guinea, Myanmar, Panama and Bangladesh[9]. In Cuba, Mongolia, Myanmar and Nepal, one was interested especially in the linkage between the economic growth and the future health budget. The model has been recently[10] applied in Nicaragua, in order to analyse what could be the impact of possible international debt relief operations on the size of the health budget. In Guinea, the model was used to contribute to the preliminary financial analysis of its new national health plan. The question addressed in Panama by Rovira, Darba and Brugiatti (2000) was the financial impact on the MOH budget of alternative growth paths for health personnel salaries.

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[9] Training activities were also organised for government staff of Guinea-Bissau and Sierra Leone, as well as for staff from 7 Latin American and Caribbean countries within the context of a WHO/PAHO Workshop on Health Care Financing in the Process of Health Sector Reform (30/10 to 3/11/1995).

[10] December 1999.

In 1997, the model was used in Bangladesh for a financial assessment of the fifth Health and Population Project (HAPP5). One of the central questions was, to which extent the Government of Bangladesh (GOB) could devote domestic resources to the health sector over the course of this Project, namely 1998-2003. This modelling experience has been well documented, and we therefore choose to present it in this paper.

4.2 Estimating the government's resource envelope in Bangladesh[11]

4.2.1 *Macro-economic context*

At the time of the analysis in 1997, health policies were being reassessed in the framework of the HAPP5 project. It was agreed that the preparatory work by the Ministry of Health and Family Welfare (MOHFW) for this project would require an assessment of the feasibility of any new plans and strategies, within the context of the macro-economy and the resources that would be available for the health sector. We now discuss the main features of that macro-economic context:

(i) *The population* of Bangladesh (120 million in 1995) had been growing at 2% per year. Population control and family planning is one of the priorities of government policy. In the simulations, therefore, it was assumed that the fertility rate would decline and that the population growth would be lowered to 1.3% by the year 2003.

(ii) The GDP has continued to expand: in fiscal year 1995/96, real *GDP growth* reached an estimated 4.7%, whereas the growth estimate for 1996/97 was 5.7%. The Government's medium-term growth target was 7% per year, hoping to achieve thereby effective results in poverty reduction. Investments needed to achieve this growth target, seemed to be insufficient. Accordingly, the simulation scenarios contain growth rates of GDP below the target: they increase gradually from 4.7% in the first year of the simulation to 6% in 2002/2003.

(iii) Since 1990, Government has had a record of controlling inflation. Average annual consumer price inflation was 3.4% in the period 1991/95. In 1995-97, inflation pressure increased, however, reaching an inflation rate of 7.3% in 1996/97. In the simulations, it is assumed that all inflation rates (except foreign inflation) will decline to 6% in 1999/2003.

(iv) As far as the exchange rate is concerned , there have been .a number of small depreciations of the Bangladesh currency, the Taka, since mid-1995. It has been assumed that these depreciations will continue until 2000, year in which a stable exchange rate of 50 Taka to 1 US$ would be reached.

(v) Since 1992, public finance has been recovering through expenditure reduction and tax revenue expansion. The Government also improved the

[11] This section relies heavily on Kawnine et al. (1997).

administration of the tax system and revenue collection. As a result, domestic financing of development projects increased: domestic resources financed 40% of the Annual Development Plan in 1996/97, coming from 10% in 1990/91. This basic trend is introduced in the simulations as well.

4.2.2 *Simulation scenarios*

As most of the economic and financial data had been updated in 1994/95, the latter year was selected as the baseline year of the simulations. First, a baseline scenario is analysed. It incorporates the major macroeconomic trends as discussed above. It is assumed further that the target of a budget deficit below 6% of GDP will be adhered to. The latter is ensured by assuming that annual real growth of both total government expenditure and MOHFW expenditure would be restricted to 4%.

In a second scenario, called the *priority-to-health scenario*, we maintain the same hypotheses as in the baseline, except for the assumed growth of the health budget. In this scenario we assume that real MOHFW expenditure grows annually by 8% in the period 1996/97 to 2002/03. The total government budget in constant prices, as in the previous scenario, continues to grow by 4%.

A final analysis is done in the *salary-adjustment scenario*, where one studies the impact of a hypothetical upward adjustment of the pay scale for civil servants in 1997/1998. In that particular year, real increase in salaries and remuneration would be 20% both in the total government budget and the MOHFW budget. From 1998/99 on, the real increase in the total government and MOHFW budget is the same as the previous scenario, namely 4% and 8%, respectively.

4.2.3 *Simulation results*

Selected results of the three scenarios are presented in Table 1. Each time, the baseline value is presented as well as the projections for the period 1998 to 2003.

In the *baseline scenario,* we see that the share of government resources allocated to health remains at 8% between 1995-2003. Health expenditure as a percentage of GDP also remains stable at 1.5%. These are the implications of keeping real health expenditure growth constant at 4%, annually. Also note that by 2003, MOHFW expenditure (current prices) is about 33.6 billion Taka, of which 24.4 billion is financed by domestic resources.

Given the assumptions in the *priority-to-health scenario,* the share of MOHFW expenditure in the total government budget rises from 8.0% in the base year to 10.4% in 2002/03. And MOHFW expenditure as a proportion of GDP rises from 1.4%a to 1.6% by the end of the simulation period. MOHFW budgeted expenditure (current prices) rises to 43.8 billion Taka in 2002/03, with domestic financing of this amount equal to 31.6 billion Taka. Notice that

health expenditure per capita basically doubles from 3.23 US$ in the base year to 6.43 US$ in 2002/03.

The main difference between the *salary-adjustment scenario* and the previous one is the additional increase in expenditure due to the presumed salary scale adjustment in 1997/1998. MOHFW expenditure in current prices rises to 45.1 billion Taka by the end of the simulation period; .32.4 billion of this amount is domestically financed. Health expenditure per capita rises to 6.63 US$ by 2002/03, whereas the share of health expenditure in GDP climbs to 1.7%.

It should be noted that the simulation results were seen by the Bangladesh team as preliminary. It was expressed that the baseline data as well as the assumptions needed to be verified and discussed further with the Ministry of Finance and Planning Commission. The team clearly accepted the model, but not as an exclusive planning tool. We agree with this assessment, as there are limits to what the simulation model at hand can do. The model is also built as a generic model for application in any developing country. Some specific country problems and issues may become so preponderant that they may warrant a special additional tool or model.

5. CONCLUDING REMARKS

In general, the experience of exposing government staff in several developing countries to the basic macroeconomics of health sector expenditure while using the simulation model has been positive. Still, there is scope for some immediate improvement in the structure of the simulation model. A first important feature to be included would be the analysis of *trade-offs:* for instance, when a proposal is simulated to increase the MOH budget level, the model should be able to present the financial consequences of this proposal on the *total* government budget. In addition, the model could help to analyse the financial weight of the health sector next to the other sectors; the latter calls for introducing the functional classification of total government expenditure into the model[12].

Suppose now that the model would be endowed with this feature. What then if we hypothesise the existence of a *soft budget* constraint for the *total* government budget? In this particular case, the total government budget would merely be adjusted with the proposed increase in the MOH budget. However, in the case of a *hard budget* constraint, other ministries would have to decrease their expenditure. The model could compute, for instance, what the percentage decrease would have to be of, say, the Ministry of Defence or different other ministries in order to ensure the financial feasibility of the MOH plans. As a

[12] In this way, we would be able to study the share of human development oriented government budgets in the total government budget. On the concept of human development, see Ramirez, Ranis and Stewart (1998).

more concrete example, one would be able to analyse the savings to be made in non-health government departments in order to finance a MOH plan to provide a basic package of health care to the poorest. In this way the MOH would be made aware of the implied trade-offs, and could be better prepared to defend its position.

A second improvement would be to include the budget of quasi-autonomous governmental agencies, such as a social security and health insurance, that are crucial to the health sector. It would make the simulation model more relevant to those developing countries that have or are developing a social health insurance system.

Thirdly, one might consider to build a link between the simulation model and relevant econometric analysis on the determinants of health. One possibility indeed would be to use the results of econometric work whereby health indicators are explained via economic indicators such as GDP, health expenditure and other social expenditure. Health indicator forecasts could now be obtained after linking the available econometric coefficient estimates to the forecasted values of the explanatory variables produced by the simulation model.

Finally, other improvements in the simulation model may be suggested, including the introduction of behavioural responses of households, enterprises and donors. In this case other modelling techniques, including econometric model building, would need to be used. How feasible this would be, depends on the improvement of capacity in economics and quantitative techniques at Ministries of Health. To be coherent with the objective of modelling proposed earlier, we suggest that any choice of modelling technique should be made, having in mind the needs of the users at Ministries of Health for better-informed decision-making.

Health expenditure indicators	Year	Baseline scenario	Priority-to-health scenario	Salary adjustments scenario
MOHFW expenditure (current prices, in million Taka)	1994/95	15,617	15,617	15,617
	1998/99	23,639	26,472	27,301
	1999/00	25,817	30,024	30,964
	2000/01	28,186	34,040	35,106
	2001/02	30,772	38,593	39,801
	2002/03	33,596	43,755	45,126
Domestically financed MOHFW expenditure (current prices, in million Taka)	1994/95	10,934	10,934	10,934
	1998/99	16,868	18,880	19,247
	1999/00	18,509	21,509	21,927
	2000/01	20,309	24,505	24,980
	2001/02	22,284	27,917	28,458
	2002/03	24,451	31,804	32,421
MOHFW expenditure as a % of total government expenditure	1994/95	8.0 %	8.0 %	8.0 %
	1998/99	8.0 %	8.9 %	8.9 %
	1999/00	8.0 %	9.3 %	9.2 %
	2000/01	8.0 %	9.6 %	9.6 %
	2001/02	8.0 %	10.0 %	9.9 %
	2002/03	8.0 %	10.4 %	10.3 %
MOHFW expenditure as a % of GDP	1994/95	1.4 %	1.4 %	1.4 %
	1998/99	1.5 %	1.5 %	1.6 %
	1999/00	1.5 %	1.5 %	1.6 %
	2000/01	1.5 %	1.6 %	1.6 %
	2001/02	1.5 %	1.6 %	1.7 %
	2002/03	1.5 %	1.6 %	1.7 %
MOHFW expenditure per capita (constant prices of 1994/1995)	1994/95	130	130	130
	1998/99	142	159	164
	1999/00	145	169	174
	2000/01	149	180	186
	2001/02	153	192	198
	2002/03	157	205	211
MOHFW expenditure tier capita (current prices in US$)	1994/95	3.23	3.23	3.23
	1998/99	3.83	4.28	4.41
	1999/00	3.95	4.59	4.73
	2000/01	4.25	5.13	5.30
	2001/02	4.58	5.74	5.92
	2002/03	4.94	6.43	6.63

Table I. Simulation results: alternative scenarios for the MOHFW budget in Bangladesh.

APPENDIX

Equations of the simulation

3.1 Production

Gross domestic product

We start by defining[13] the value added of four sectors, i.e. agriculture, manufacturing industry, other industry and services. The value added in these sectors j-: 1,...,4) in time, is determined by making use of the value of the previous year (t-1) and the rate of growth (rva):

$$va_{t,j} = va\ t.i.i * (1 + rva_{t,j}) \qquad (1)$$

The gross domestic product at factor cost (gdpf) is then the sum of the added values from the four sectors:

$$gdpf_t = \Sigma_j va_{t,j} \qquad (2)$$

Gross domestic product in current prices is obtained by multiplying gdp by the gdp-deflator (PRGDP):

$$GDPF_t = gdpf_t * PRGDP_t \qquad (3)$$

Net indirect taxes (TXIN) are defined as a fraction of gross domestic product:

$$TXIN_t = a_{t,l} * GDPF_t \qquad (4)$$

so that gross domestic product at market prices (GPDM) can be written as

$$GDPM_t = GDPF_t + TXIN_t \qquad (5)$$

Utilisation of GDP

For the base year, the values of the different categories of utilisation of GDPM are given by the user: these are private consumption (PC), public consumption (GC), gross fixed capital formation (FC), imports of goods (MG) and of services (MS), as well as exports of goods (EG) and of services (ES). For the base year, the simulation model will then calculate the shares of these variables in GDPM. Those shares take the form of coefficients in the following equations:

$$PC\ t = a\ t, 2 * GDPM\ t \qquad (6)$$

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[13] Henceforth, symbols for variables in lower case refer to variables in constant prices. The same symbols in upper case refer to variables in current prices. In addition, all growth rates are represented by symbols beginning with "r". The subscript "t" denotes time (years).

$$GC\ t = b\ t, 2 * GDPM\ t \quad (7)$$

$$FC\ t = c\ t, 2 * GDPM\ t \quad (8)$$

$$EG\ t = d\ t, 2 * GDPM\ t \quad (9)$$

$$ES_t = e_{t,2} * GDPM_t \quad (10)$$

$$MG_t = f\ t, 2 * GDPM\ t \quad (11)$$

$$MS\ t = g_{t,2} * GDPM_t \quad (12).$$

The trade variables will serve to construct the balance of trade. The other variables, except FC, will be connected to the consolidated government finance block.

3.2 International transactions

Balance of trade

We now have all elements needed to calculate the balance of trade (BAL):

$$BALT_t = EG_t + ES_t - MG_t - MS_t \quad (13).$$

The other components of international transactions are net foreign income (NFI), net foreign transfers (NFT), and short- and long-term capital flows (CPF). The value of a trans action in year $_t$ is obtained by applying the rare of growth to the value in year $_{t,1}$:

$$NFI_t = NFI_{t-1} * (1 + rnfi_t) \quad (14)$$

$$NFT_t = NFT_{t-1} * (1 + rnft_t) \quad (15)$$

$$CPF_t = CPF_{t-1} * (1 + rcpf_t) \quad (16)$$

Net reserves in foreign currencies

The change of net reserves in foreign currencies (RES) is defined as follows:

$$RES_t = BALT_t + NFI_t + NFT_t + CPF_t \quad (17)$$

and in US$ as:

$$RES\$_t = RES_t / RXCH_t \quad (18)$$

where RXCH is the exchange rate (local currency per US$).

The balance of trade and the change in net foreign currency reserves are indicators of the international position of the economy. They also constitute important information for the government health policy makers. For example, a permanently negative balance of trade could explain a continuous drop in net reserves, which in turn might impact upon the propensity to import health-related goods such as drugs and equipment. Conversely, a positive balance of trade may help to increase reserves, and this could allow health-related imports to be stepped up.

Exchange rate

The user inputs the exchange rate observed for the base year. There are then two different ways of projecting the future rate of exchange. One is to put in one's own estimates, in which case it is advised to consult the Ministry of Finance or the Central Bank in order to input acceptable estimates.

The other option is to instruct the model to calculate the exchange rate following the theory of purchasing power parity (PPP). This theory maintains that in the long term, the rates of exchange between the US$ and the local currency should fully reflect the difference between the rate of domestic inflation and the foreign inflation rate. Such a PPP exchange rate would then guarantee the equivalence of the purchasing power of the two currencies.

The following equation determines the PPP rate of exchange[14]:

$$RXCH_t = RXCH_{t-1} * (1 + rprgdp_t)/(1 + rprf_t) \quad (19)$$

where rprgdp and rprf refer to the deflators for the domestic and foreign gross domestic product, respectively.

The exchange rate is used to convert values in foreign currency into values in local currency. We refer to the budgeting of Government health expenditure, where the exchange rate plays an important role. In that equation block, budget estimates for drug imports are first made in US$. Subsequently, the exchange rate is used for the conversion into local currency.

The exchange rate is also used to convert local currency values into US$, as for example in forecasting of international aid for health in US$. In the current version of the model, such aid is first of all formulated as the difference between the total requested budget (in local currency) and the amount financed by domestic resources. The requested international aid is then converted into US$ by using the exchange rate.

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[14] See Barro (1984, p.534).

3.3 Deflators

All price indices for the base year are fixed at 100. For the simulation period, the consumer price index (PRC), the investment price index (PRI) and the GDP deflator (PRGDP) are defined as follows:

$$PRC_t = PRC_{t-1} * (1 + rprc_t) \quad (20)$$

$$PRI_t = PRI_{t-1} * (1 + rpri_t) \quad (21)$$

$$PRGDP_t = PRGDP_{t-1} * (1 + rprgdp_t) \quad (22)$$

The consumer price index and investment price index are used to convert government current and capital expenditure at constant prices into expenditure at current prices, respectively.

There is also the foreign price index (PRF) which is defined as

$$PRF_t = PRF_{t-1} * (1 + rprf_t) \quad (23)$$

This index is used to convert government imports of drugs at constant US$ into government imports at prices in current US$.

3.4 Consolidated Government finance

Government revenue

First, two types of indirect tax are defined: indirect taxation of private and public consumption (TXCO) and taxation of foreign trade (TXFT). The levels of these tax amounts are given for the base year. Estimates are then made for the simulation period using the following equations:

$$TXCO_t = a_{t,3} * (PC_t + GC_t) \quad (24)$$

$$TXFT_t = b_{t,3} * (EG_t + ES_t + MG_t + MS_t) \quad (25)$$

For the base year, the coefficients in (24) and (25) are calculated by the model. They can be interpreted as taxation rates. The user may then enter his/her own hypotheses about those rates for the simulation period.

Secondly, direct taxation on household income and corporate profits (TXIP) are identified. The same approach is taken as for indirect taxation. Direct taxation is linked to the gross domestic product:

$$TXIP_t = c_{t,3} * GPDF_t \quad (26)$$

The coefficient in this equation can be interpreted as the income and profits tax rate.

Thirdly, other government revenue (ogr) is identified such as non-fiscal revenue, other types of fiscal revenue as well as grants. Once again, the value

for the base year is given. Values in constant prices are obtained for the simulation period, using an appropriate growth rate:

$$ogr_t = ogr_{t-1} * (1 + rogr_t) \quad (27)$$

Other government revenue in current prices is then

$$OGR_t = ogr_t * PRGDP_t \quad (28)$$

Finally, total government revenue can be obtained as follows:

$$GRV_t = TXCO_t + TXFT_t + TXIP_t + OGR_t \quad (29)$$

Government expenditure

Here we distinguish current and capital expenditure. There are four types of *current* expenditure: 1. salaries and remuneration; 2. purchase of goods .and services; 3. subsidies and transfers; 4. interest on debt. The user inputs the budget figures for the base year. Budgeted current expenditure (j = 1,...,4) for the simulation period is then calculated with the following equations:

$$gre_{t,j} = gre_{t-j-1} * (1 + rgre_{t-j}) \quad (30)$$

and in current prices:

$$GRE_{t,j} = gre_{t,j} * PRC_t \quad (31)$$

Budgeted *capital* expenditure in constant prices is as follows:

$$gce_t = gce_{t-1} * (1 + rgre_t) \quad (32)$$

and in current prices:

$$GCE_t = gce_t * PRI_t \quad (33)$$

Total budgeted government expenditure is then defined as:

$$GE_t = GRE_t + GCE_t \quad (34)$$

We also define *domestically financed* current (gred) and capital (gced) expenditure in constant prices as follows:

$$gred_t = gred_{t-1} * (1 + rgred_t) \quad (35)$$

$$gced_t = gced_{t-1} * (1 + rgced_t) \quad (36)$$

The latter expenditure, in current prices, is then as follows:

$$GRED_t = gred_t * PRC_t \quad (37)$$

and

$$GCED_t = gced_t * PRI_t \quad (38)$$

External financing of total government expenditure

The requested external financing of total government expenditure, or international aid, is calculated as the difference between total government expenditure and domestically financed government expenditure:

$$GEX_t = GE_t - GRED_t - GCED_t \quad (39)$$

The latter can be converted in US$ as follows:

$$GEX\$_t = GE_t / RXCH_t \quad (40)$$

Government budget deficit

The government budget deficit is defined as follows:

$$GBD_t = GRV_t - GE_t \quad (41)$$

and as a percentage of GDP at factor cost:

$$PGBD_t = GBD_t / GDPF_t \quad (42)$$

The latter indicator will appear in the output tables of the model. How can it be used? As an example, suppose that in a developing country, a fiscal adjustment programme aims to reduce government deficits. An adjustment programme may include, say, a gradual reduction of a deficit of 10% of GDP to 4%, over a period of 5 to 10 years. If the country cannot enjoy a strong economic growth and/or a considerable increase in government revenues, the government is forced to curtail its expenditure in order to achieve the new deficit targets. A number of expenditure growth rates may become negative. The user is then likely to be confronted with the constraints on total government expenditure. He/she will understand better why the Ministry of Finance would want to put health spending under a stricter control. Such a situation also gives the user a strong hint that the budget of some health programmes may need to be reviewed.

3.5 Government health expenditure

Ministry of Health expenditure

(i) Expenditure at constant prices

We adopted the economic classification for the *current* health expenditure, distinguishing the following categories: l. salaries and remuneration; 2. training; 3. equipment and supplies; 4. medical supplies (other than drugs and vaccines); 5. drug imports (in millions of US$), 6. drug purchases (on the domestic market); 7. maintenance of equipment and infrastructure; 8. utilisation of equipment and infrastructure; 9. social mobilization; 10. miscellaneous.

The values of the base year are given by the user. For the simulation period, the current expenditure of the MOH ($hre_{t,mi,j}$) of category j (j=1,...,10) in year t is the result of multiplying the value of year t, by the growth rate ($rhre_{t,mi,j}$):

$$hre_{t,mi,j} = hre_{t,mi,j} * (1 + rhre_{t,mi,j}) \quad (43)$$

Total current expenditure is therefore equal to:

$$hre_{t,mi} = \Sigma_j hre_{t,mi,j} \quad (44)$$

Domestic financing of total current expenditure is defined as:

$$hred_{t,mi} = hred_{t-1,mi} * (1 + rhred_{t,mi}) \quad (45)$$

Capital expenditure (hce) and capital expenditure financed by domestic resources (hced) are determined, respectively, as follows:

$$hce_{t,mi} = hce_{t-1,mi} * (1 + rhce_{t,mi}) \quad (46)$$

and, $$hced_{t,mi} = hced_{t-1,mi} * (1 + rhced_{t,mi}) \quad (47)$$

Total expenditure (he) and total domestically financed expenditure (hed) are calculated, respectively, as follows:

$$he_{t,mi} = hre_{t,mi} + hce_{t,mi} \quad (48)$$

and, $$hed_{t,mi} = hred_{t,mi} + hced_{t,mi}) \quad (49)$$

(ii) Expenditure at current prices

To obtain *current expenditure* at current prices, we multiply expenditure at constant prices by an appropriate price index. To calculate the value of imports at current prices in national currency ($HRE_{t,mi;5}$), we proceed as follows: we multiply imports at constant prices, and in US$, by the external price index, and then multiply further by the exchange rate. The latter is expressed in the following equation:

$$HRE_{t,mi;5} = hre_{t,mi;5} * PRF_t * RXCH_t \quad (50)$$

For the other categories of current expenditure and domestically financed current expenditure, the consumer price index is used to calculate expenditure at current prices:

$$HRE_{t,mi;j} = hre_{t,mi;j} * PRC_t \text{ for } j=1,\ldots,4 \text{ and } j=6,\ldots,10 \quad (51)$$

and, $$HRE_{t,mi} = hred_{t,mi} * PRC_t \quad (52)$$

Total current expenditure is then defined as:

$$HRE_{t,mi} = \Sigma_j HRE_{t,mi,j} \quad (53)$$

Capital expenditure at current prices (HCE) and domestically financed capital expenditure ;it current prices (HCED) are obtained using the investment price index. This leads to the following equations:

$$HCE_{t,mi} = hce_{t,mi} * PRI_{t} \quad (54)$$

and, $$HCED_{t,mi} = hced_{t,mi} * PRI_{t} \quad (55)$$

Total MOH expenditure is now simply defined as the sum of current and capital expenditure:

$$HE_{t,mi} = HRE_{t,mi} + HCE_{t,mi} \quad (56)$$

(iii) External financing of MOH expenditure

The request for external donor financing (HEX) is *calculated* as the difference between total health expenditure and domestically financed health expenditure:

$$HEX_{mi} = HE_{t,mi} - HRED_{t,mi} - HCED_{t,mi} \quad (57)$$

Using the exchange rate, budgeted external aid for health in US$ can now be defined as follows:

$$HEX\$_{t,mi} = HEX_{t,mi} / RXCH_{t} \quad (58)$$

It is then easy to express external aid for health as a proportion of total external aid:

$$PHEX_{t,mi} = HEX\$_{t,mi} / GEX\$_{t} \quad (59)$$

The latter of course is an indicator that enables the MOH to monitor the importance that is assigned to health within the total external aid budget.

Health expenditure by other Ministries

The MOH is often not the only one to incur health expenses. The following set of equations can be used in analysing (i) the respective roles of the ministries in financing health services; (ii) how government interventions could be better coordinated with a view to increasing the effectiveness of government funding.

(i) Health expenditure at constant prices

We have four categories: 1. Ministry of Defence; 2. Ministry of Labour; 3. Ministry of Education; 4. Other ministries.

Current expenditure (hre) and capital expenditure (hce) are defined, respectively, as follows:

$$hre_{t,oth,j} = hre_{t-1,oth,j} * (1 + rhre_{t,oth,j}) \quad (60)$$

and, $$hce_{t,oth,j} = hce_{t-1,oth,j} * (1 + rhce_{t,oth,j}) \quad (61)$$

where j (j=1,...,4) refers to the category of ministry.

Total current and capital expenditure are therefore defined, respectively, as:

$$hre_{t,oth} = \Sigma_j\, hre_{t,oth,j} \quad (62)$$

and, $$hce_{t,oth} = \Sigma_j\, hce_{t,oth,j} \quad (63)$$

Total health expenditure is:

$$he_{t,oth} = hre_{t,oth} + hce_{t,oth} \quad (64)$$

(ii) Health expenditure at current prices

For current expenditure at current prices (HRE) and capital expenditure at current prices (HCE), we have the following equations:

$$HRE_{t,oth} = hre_{t,oth} * PRC_t \quad (65)$$

$$HCE_{t,oth} = hce_{t,oth} * PRI_t \quad (66)$$

Total expenditure of all the other ministries therefore equals:

$$HE_{t,oth} = HRE_{t,oth} + HCE_{t,oth} \quad (67)$$

Private health expenditure

In this module, the user is called upon to specify the expected private sector expenditure for health. How can this information be used? Obviously, each country selects its appropriate health system, including optimal sharing of financial responsibilities between the government and private sectors. This module will help the user to reflect on the future capacity to pay of the different sectors. The baseline values already will give substantial information to the user. In recent applications, the baseline data generally reveal a far greater role of the private sector than anticipated.

(i) Expenditure at constant prices

We have selected four categories of expenditures, namely those of 1. households (direct payments for health care); 2. private health insurance plans; 3. non-governmental organizations: 4. enterprises.

Current expenditure (hre) and capital expenditure (hce) are defined as:

$$hre_{t,pr,j} = hre_{t-1,pr,j} * (1 + rhre_{t,pr,j} \quad (68)$$

and, $$hce_{t,pr,j} = hce_{t-1,pr,j} * (1 + rhce_{t,pr,j} \quad (69)$$

where j(j=1,…,4) referse to the source of private expenditure.

Total private expenditure is defined as follows:

$$hre_{t,pr} = \Sigma_j\, hre_{t,pr,j} + \Sigma_j\, hce_{t,pr,j} \quad (70)$$

(ii) Expenditure at current prices

Current expenditure at current prices (HRE) and capital expenditure at current prices (HCE) are defined as follows:

$$hre_{t,pr,j} = hre_{t-1,pr,j} * (1 + rhre_{t,pr,j} \quad (68)$$

and, $$hce_{t,pr,j} = hce_{t-1,pr,j} * (1 + rhce_{t,pr,j} \quad (69)$$

Total private expenditure is then simply:

$$HE_{t,pr} = HRE_{t,pr} + HCE_{t,pr} \quad (68)$$

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