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NEPAL MACROECONOMETRIC MODEL

Sungsup Ra and Chang Yong Rhee

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Opinions and materials in this publication do not necessarily reflect the official views of ADB.

In this publication, $ refers to US dollars, and NRs refers to Nepalese rupees.

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FOREWORD

The Asian Development Bank's Nepal Resident Mission (NRM) is launching a Working Paper Series with this report to highlight its ongoing research activities. In preparing the working papers, NRM hopes to contribute to the public policy discussion and thereby deepen understanding of important economic and development issues in Nepal.

The NRM Working Paper Series draws on ongoing and recently completed research and policy studies undertaken by NRM and its policy analysis network. The papers represent rudimentary work meant to stimulate discussion and elicit feedback. Papers published under this series could subsequently be revised based on feedback of commentators and published as articles in professional journals or chapters in books.

The study on Nepal Macroeconometric Model is the first paper in the series and was undertaken by Sungsup Ra, Head, Macroeconomics, Finance, Governance, Regional, and External Relations, and Senior Country Programs Specialist , NRM, and Chang Yong Rhee, Professor of Economics at Seoul National University. I thank Ehung G. Baek, Professor of Economics at the Sangmyung University for his contributions during the modeling exercise. Sishir Bhattarai, Economics Consultant has provided economic editorial assistance. Thanks are due to Kavita Sherchan, External Relations and Civil Society Liaison Officer, NRM and Arun S. Rana, Publication Consultant for finalizing the report.

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Kunio Senga
Director General
South Asia Department

ABBREVIATIONS

ADB	Asian Development Bank
BOP	balance of payments
CPI	consumer price index
FY	fiscal year
GDP	gross domestic product
KDI	Korea Development Institute
LGS	low growth scenario
M2	money supply
MOF	Ministry of Finance
NGS	normal growth scenario
NMM	Nepal Macroeconometric Model
NRB	Nepal Rastra Bank
NRM	Nepal Resident Mission
PDL	polynomial distributed lag
RMSPE	root mean square percentage error

CONTENTS

ABSTRACT

This paper describes a medium-sized Keynesian income-expenditure model of the Nepalese economy. The model consists of five building blocks: final demand, prices, credit and money, government, and the balance of payments. The model is useful for policy simulations, economic planning and debt sustainability analysis. The forecasting performance of the model, both within-sample and out-of-sample, is evaluated and found satisfactory. A baseline scenario and two additional scenarios consistent with the Tenth Plan are examined.

I. INTRODUCTION

This paper presents a macroeconometric model of the Nepalese economy. Macroeconometric models of national economies are widely used for both policy analysis and forecasting. Countries have developed macroeconometric models to design long-term development plans and to assess the effects of economic policies. A macroeconometric model is particularly useful in the early stage of economic development. The model facilitates conducting in-depth policy analysis as well as to forecast the future course of the economy. Systematic analyses on the impacts of Government's policies are an integral part of economic planning in developing countries.

There are several existing macroeconometric models of the Nepalese economy. The existing models such as Sharma (1989) and Alamgir and Ra (2001) treat gross domestic product (GDP) as an exogenous variable. These models usually stipulate different growth paths and then examine the necessary policy changes to achieve the pre-specified target growth rates. Nepal's Tenth Plan, the 5-year development plan, covering fiscal year (FY) 2003–FY2007 is established by this approach as it specifies normal and low growth paths in advance and then compares corresponding policy scenarios.

As the Nepalese economy is becoming increasingly market-driven, most of the equations used in the model are demand oriented. The Nepal Macroeconometric Model (NMM) takes the Keynesian income-expenditure approach where GDP is determined endogenously. Among a number of exogenous variables, five variables are defined as policy variables: taxes, regular expenditures, development expenditures, foreign borrowing, and the exchange rate. Considering that economic growth is influenced by policy changes, the newly developed NMM is better suited for alternative policy analysis. The NMM provides answers to the effects of conducting in-depth scenario analysis for alternative policy options.

Beyond the general purpose of macroeconometric modeling, the NMM has two specific and practical objectives. First, the NMM can be used to conduct debt sustainability analysis. Public borrowing, both internal and external, is crucial to maintain sustainable growth in Nepal. Therefore, managing public debt within a sustainable level has become one of the most important policy tasks. Second, the NMM provides policymakers or local experts an opportunity to increase their modeling knowledge and thus better understand the structure of the Nepalese economy. Efforts have been taken to make sure that the model is easily accessible without need for professional or technical support. Armed with a user-friendly version of the model, policymakers, who may not be familiar with statistical analysis, can conduct policy scenario analysis through menu-driven options.

The rest of the paper is organized as follows. Section II presents a brief overview of the existing models, and Section III explains the data source and the variable definitions used in the NMM. Section IV discusses the main characteristics and the structure of the model, in particular, the specifications of the behavioral equations. Section V develops the baseline policy scenarios and two alternative scenarios consistent with the Tenth Plan (FY2003–FY2007), the current guide for economic policy in Nepal. Section VI compares the forecasting results of the NMM under three policy scenarios with those of the Tenth Plan. The final section concludes.

II. REVIEW OF PREVIOUS MODELS

A brief summary of the history of economic modeling exercises in Nepal including Sharma (1989) and Alamgir and Ra (2001) is presented below. In the early 1980's, individual researchers first attempted to use statistical models for economic analysis in Nepal. In 1987, the Water and Energy Commission developed a macro model for forecasting energy demand. A multi-sector, economy-wide model was first introduced in 1985 by Khanal, Thapa and Elbers (1987).

A macro model was developed as part of the link model for the South Asian Association for Regional Cooperation countries to examine the implications of regional trade on its member economies.[1] A combined macro and input-output model was also introduced in the preparation of long-term industrial plans in 1989. The input/output model of 39 sectors was jointly developed and combined with the macro model to derive policy implications of alternative development strategies at the detailed industry level as well as at the national economy level.[2] The main objective of the model was to determine the optimum volume of investment under an acceptable rate of inflation, acceptable ratio of deficit, realistic level of foreign assistance, and a stipulated per capita consumption growth rate. A similar version of the macroeconomic model was also used in the formulation of the Eighth Plan.

A slightly different, yet closely related model in the framework of flow-of-funds accounting was developed for the National Planning Commission Secretariat Project. The flow-of-funds accounting—such as Revised Minimum Standard Model -extended (RMSM-X) commonly used in the World Bank and the International Monetary Fund, was integrated into a consistent accounting framework: the budget and other pubic sector account, the balance of payments (BOP) or the rest of the world account, the monetary sector account, the private sector account, and the relevant variables from the national accounts. Such an integrated set of accounts is believed to help conduct policy analysis, analyzing overall macroeconomic management performance, evaluating country creditworthiness, and providing macroeconomic frameworks for public sector investment programs and structural adjustment programs. In 1990, a simple macroeconomic accounting framework was employed to examine the possibility of policy coordination between exchange rate policy and fiscal policy for more effective management of the economy.[3]

While the Tenth Plan was being formulated, the integrated macro and input-output model was used to set the growth rates as well as to determine the investment levels at both the sectoral and aggregate level without disrupting macroeconomic stability. Special attention should be drawn to two macroeconomic models: Alamgir and Ra (2001) and Sharma (1989). A common feature of the two models is that GDP is predetermined or stipulated before estimating individual equations. These models implicitly assume that the supply side determines aggregate output, and they predict each endogenous variable in a way that is consistent with the given output level. This may be interpreted as a supply-side production approach, although the aggregate production function is

[1] Khanal, D. R. and G. N. Sharma. 1992. A *Macroeconometric Model of Nepal in SAARC Link.* Nagvi, S.N.H. and S.A. Samad, eds. New Delhi: Oxford and IBH Publishing Co. Pvt. Ltd.

[2] Development Study Consultants. 1990. *Policy Planning Models for the Nepalese Economy with Special Reference to the Industrial Sector.* Mimeo. Kathmandu: DSC/MOI/UNIDO.

[3] Cruikshank, E.D. and R.H. Nord. 1990. *The Role of Exchange Rate Policy: The Case of Nepal*. Mimeo. Kathmandu.

not specified. Since GDP is driven by exogenous variables only, the previous models are not a system of simultaneous equations per se. The procedure for the macroeconomic projections in the Alamgir and Ra (2001) model starts with the projection of GDP growth by major economic sectors based on the growth elasticity derived from historical data adjusted for structural changes.

III. DATA

In contrast to the previous macroeconomic models, GDP is determined on the demand side in the NMM. Before explaining the structure of the model, brief explanations of the variable definitions and the data source of the NMM is presented below.

A. Definition of the variables and the Sample Period

The NMM is a medium-sized annual macroeconometric model.[4] There are 59 variables and 37 equations and the number of endogenous variables is equal to the number of equations. Of these equations, 20 are behavioral equations and 17 are identities. Among the exogenous variables, five variables are policy variables: taxes, regular expenditures, development expenditures, foreign borrowing, and the exchange rate. Given the peg of the Nepalese rupee to the Indian Rupee, monetary variables are not considered as policy variables.

The currency unit of all variables in the model is the Nepalese rupee, including the variables in the BOP account. The variables denominated in US dollars are converted to Nepalese rupees by multiplying the period average or the end of the period exchange rate. The currency denomination is not a major issue in estimation and simulation. Nevertheless, denomination by domestic currency is preferred since it is more efficient when the values of the variables from different sources are compared. For instance, the exports of goods and non-factor services in the national income account can be easily compared with the merchandise exports in the BOP account once all the variables are denominated in domestic currency.

As for the sample period, data were available for the sample period from FY1975 to FY2004. There are concerns regarding the reliability of national income account data before FY1984 due to potential data inconsistency. However, the advantage of a relatively large number of observations in a time series for obtaining more robust and reliable estimates outweighed the risk. Nevertheless, to minimize potential data inconsistency, the model is solved from FY1985 to FY2004 in historical simulation.

B. Data Adjustments and Transformations

The sources of the data are the Government of Nepal, the Ministry of Finance (MOF), and Nepal Rastra Bank (NRB). The data for final demand, prices, and money were obtained from the Economic Survey of MOF and Quarterly Economic Bulletin, Current Economic Scenario, and

[4] The model is based on annual data from 1974/75 to 2001/2002. Sufficient data are not available to build a quarterly model.

Budget Speech of NRB.[5] Some of the presentation of the data, however, differ from the international standard and are not appropriate for policy analysis, especially for debt sustainability analysis. A modified data set has been used in the country analysis after adjusting the government data in line with the International Monetary Fund format. The reported government finance statistics and the BOP statistics are extensively adjusted as the raw data are recorded on cash payment basis.[6] The adjusted data is expected to make the forecast results more consistent with international standards.

As will be discussed in subsequent paragraphs, the difference between the two data systems makes it difficult to directly compare the forecasting results of the Tenth Plan with our simulation results. The Tenth Plan is based on the reported government statistics. Appropriate adjustment of the variables is required to compare the forecasts of the Tenth Plan with those of the NMM.

The fiscal year of the Government of Nepal ends on 15 July. In our report, a convention is used such that figures after 'FY' denote the year that the fiscal year ends. Under this system, FY2002 includes the time period from 16, July 2001 to 15, July 2002. The unique dating convention makes it necessary to adjust foreign variables in the model to maintain data coherence. The current and the previous calendar year consumer price indexes (CPIs) were averaged to construct the Indian CPI for each fiscal year: the Indian CPI for FY1975 is the average of the CPIs of 1974 and 1975.

Only the nominal values of the components of GDP are available for each fiscal year since the Government of Nepal does not publish the components of real GDP. Thus, real variables were calculated in two-steps. The first step was to obtain the GDP deflator, which is the ratio of nominal GDP to real GDP (GDP at constant price). In the second step, each component of nominal GDP was divided by the same GDP deflator to get the corresponding component of real GDP. The difference between the sum of real components and real GDP forms the real statistical discrepancy.

The monthly interest rates were averaged to construct the annual interest rate for each fiscal year and the lending rate of commercial loans was used as the representative market interest rate. However, as only the range of the lending rate was available, the median value of the range and their monthly averages were used as a proxy for the annual interest rate.

IV. THE STRUCTURE OF THE MODEL

A. Main Characteristics

The NMM is not a substitute but a complement to the previous models. Nevertheless, the

[5] Data not published in the documents were provided by local consultants.

[6] Ministry of Finance. 2003. *Economic Survey: Fiscal Year 2002/2003*. Kathmandu; and Nepal Rastra Bank. 2002. *Quarterly Economic Bulletin*. Mid-July. Kathmandu. Since the Financial Comptroller General's Office records actual disbursements and authorizes payments on loans, that office is the original source of foreign grants and foreign loans.

characteristic is that the NMM is a Keynesian income-expenditure model in which the demand side determines GDP. The supply side is not explicitly specified as the aggregate production function is not estimated.[7] Its basic features are drawn from the Korea Development Institute (KDI) macro model that had been used to design successive 5-year economic development plans in Korea.[8] Due to the lack of quarterly data the NMM is an annual model while the KDI used a quarterly macroeconometric model. The NMM is also a mid-sized model with 37 equations.[9] A medium-sized model has an advantage in policy analysis as it incorporates more detail of the structure of the economy.

Second, the NMM distinguishes policy variables from simple exogenous variables. For any structural model to work, some exogenous variables need to be specified externally. Among exogenous variables, there are some over which governments have a significant degree of control. These policy variables are different from simple exogenous variables that are determined by noneconomic forces or foreign sectors; grants and foreign borrowing are two important exogenous variables in the government account in the NMM. The NMM treats grants as a simple exogenous variable because the government is unlikely to determine its amount. On the other hand, foreign borrowing is treated as a policy variable. The Government of Nepal has influence on how much is to be borrowed, either domestically or abroad, to finance government expenditures. There are five policy variables in the current version of the NMM: taxes, regular expenditures, development expenditures, foreign borrowing, and the exchange rate. Selecting appropriate policy variables is an important step in conducting policy simulation analysis.

Third, the role of the price block in the NMM is not conventional. Prices usually connect the real and monetary sector in a macroeconometric model. A shock to the monetary sector affects the real sector through a price block. A shock arising from the real sector also changes the price variable indirectly via monetary variables. In the NMM, however, this monetary propagation mechanism does not hold; the Nepalese CPI is almost completely explained by the Indian CPI. No other domestic variables, nominal or real, have explanatory power once the Indian CPI is included in the Nepalese price equation. Moreover, the estimated coefficient on the Indian CPI is close to one, implying that the Nepalese price is unit elastic with respect to the Indian CPI. This is a very interesting finding in that price stability in Nepal crucially depends on the Indian economy. The dominant influence of the Indian price on the Nepalese price is due to the pegging of the Nepalese rupee to the Indian rupee. Consequently, the price variables are modeled not to reflect changes in domestic aggregate demand or supply in the NMM.

Fourth, as is the case for prices, the NMM attempts to incorporate Nepal's strong economic ties with India in international transactions. India has been Nepal's most important trading partner, although economic relationships with other countries are also becoming important. The proportion of Nepal's exports going to India was 84% in 1975; the corresponding figure declined to 61% in 2002. Similarly, the proportion of imports from India decreased from 81% in 1975

[7] The supply side is not modeled in the current version due to the lack of sufficient data on employment and capital stocks.

[8] Baek, E. 1994. *The Use of Economic Data and Models In Economic Planning.* KDI. Discusses the history of the development and the main characteristics of the KDI model.

[9] A medium-size model usually consists of more than 30 equations.

to 42% by 2002.[10] Bilateral trade volume was used as an independent explanatory variable in the export and import equations to reflect the close ties with India.

Another interesting characteristic in the BOP account is the role of the foreign exchange rate, which is defined as Nepalese rupee per US dollar. The foreign exchange rate is usually one of the most important variables in international trade. However, the impact of the exchange rate on trade in Nepal is quite limited since the Nepalese rupee is pegged to the Indian rupee and India is the major trading partner of Nepal. The exchange rate variables were incorporated in the trade equations since the changes in the exchange rate with respect to the US dollar can affect trade with the rest of world by changing the relative prices with other countries.

B. The Specifications and Estimation Results

As illustrated in Figure 1, the NMM consists of 5 building blocks: final demand, prices, credit and money, government, and the BOP. Given the estimated behavioral equations and accounting identities, an external or policy shock initially disturbs a specific relation and then affects the economy through the propagation mechanism across the five building blocks. All the variables go through a dynamic adjustment process until the economy finds a new equilibrium. The estimation results and a brief description of the behavioral equations in each block is presented below.

1. Final Demand Block

Final demand or real GDP is defined as the sum of private consumption, government consumption, private fixed investment, government fixed investment, increase in stock or inventory, exports of goods and services less imports of goods and services, and statistical discrepancies. Nominal GDP is the product of the real GDP and GDP deflator.

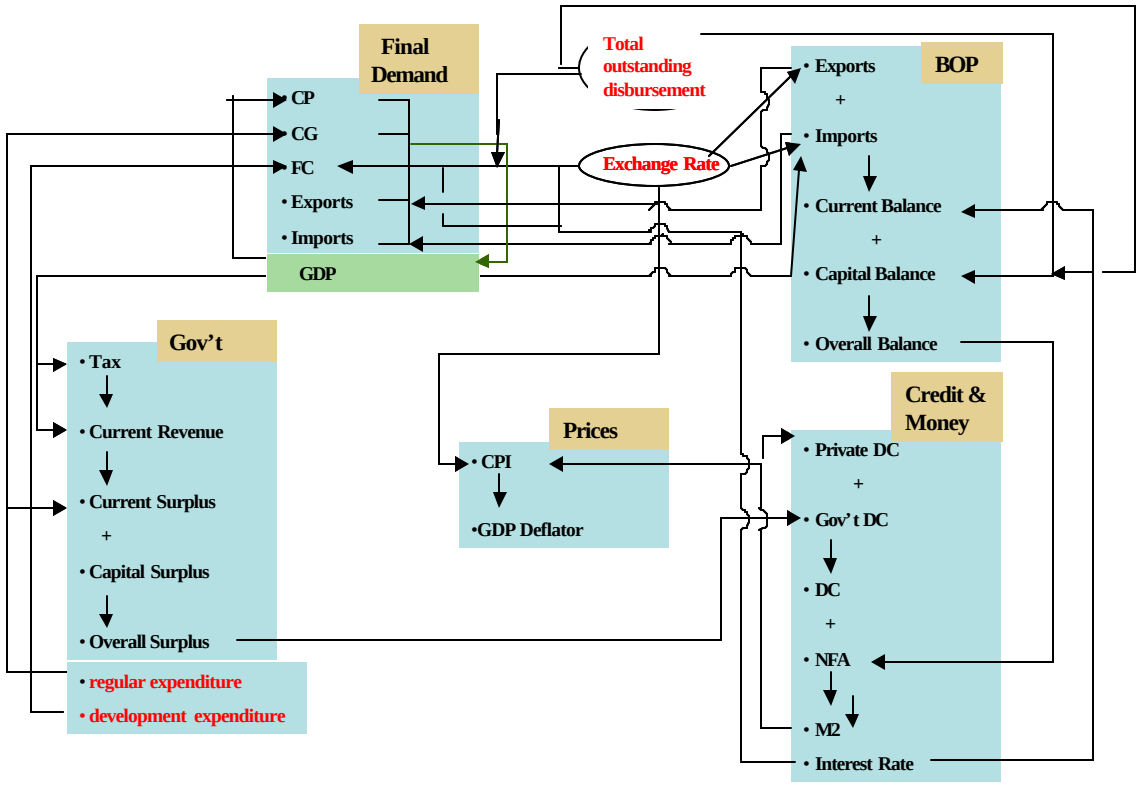
Private Consumption

Private consumption is specified as a function of the distributed lags of disposable income.[11] A polynomial distributed lag (PDL) specification is employed to avoid a potential multi-collinearity problem induced by the lagged income terms. Private consumption fits a first degree polynomial to the coefficients of six lags of order, constraining the far end to be zero.The restriction means that past income does not affect current consumption after 6 years. Without the restriction, the number of PDL parameters estimated should be two. With the far end restriction in place, it is reduced by one to account for the restriction. The original seven parameters of current and past incomes can be easily recovered from the PDL estimate even though they are reported here. This specification turns out to be the best one among the different combinations of degrees of polynomials, lag orders, and constraints. A PDL specification leads the estimated private consumption to be sufficiently smooth, consistent with actual private consumption. Real interest rate is not included as an explanatory variable in the consumption function since the estimated coefficient is not

[10] The export ratio declined to 9.4% in 1993, and the import ratio fell to 26.5% in 1997. They have been increasing since 1994 and 1998, respectively.

[11] The figures in parenthesis are t-statistics. Notations of variables are explained in the appendix.

Figure 1: Flow Chart of the NMM



significant. It is thereby implied that the real interest rate plays no role in the inter-temporal consumption decisions. The commercial loan rate, one of the market interest rates, was fixed at 12.5% from 1975 to 1986 and has been adjusted infrequently since 1986. The real balance, money supply 2 (M2) divided by CPI is also not significant in explaining private consumption behavior.

Log(*CP*)= 0.34 + 0.14*PDL(Log(*GDP-TAX/PGDP*100),6), sum of lags = 0.97 *(Equation 1)*
(1.2) (39.1) (39.1)

The sum of the estimated coefficients on the distributed lags is 0.97, indicating that the long-run elasticity of private consumption with respect to disposable income is close to one. The estimation result suggests that, in the long-run, private consumption varies one for one along with disposable income.

Government Consumption

Government consumption in the final demand block is a part of two types of government expenditures, regular and development, which are exogenous variables in the NMM. Government consumption is modeled as an endogenous variable and as a function of regular expenditures

and development expenditures in the government block, divided by the GDP deflator. The specification is based on a simple relationship between the government account and national income account. Since regular and development expenditures are policy variables, government consumption is also a policy variable in the NMM.

The estimation result shows that government consumption is more sensitive to regular expenditures than development expenditures. A 1% increase in regular expenditures and development expenditures leads to 0.62% and 0.17% increases in government consumption, respectively. It is not surprising that regular expenditures are more closely related to government consumption. Development expenditures are more likely related to government investment than government consumption. Other variables such as the real interest rate do not help explain government consumption.

Log(*CG*) = 5.86 + 0.62*Log(*REGEXP/PGDP*) + 0.17*Log(*DEVEXP/PGDP*) *(Equation 2)*
(31.7) (16.2) (2.7)

Private Fixed Investment

Total investment consists of private fixed investment, government fixed investment, and increases in stock or inventory. Increases in stock may well be an important component in the business cycle. However, it is not correlated with excess demand pressure in Nepal.[12] Rather, the increase in stock is heavily influenced by the fluctuations in agricultural production that, in turn, are greatly affected by exogenous factors such as climate. Hence, the increase in stock is assumed to be exogenous.

Private fixed investment is usually one of the most difficult parts to estimate since it is extremely sensitive to business cycles and depends on investors' future expectations. In the private fixed investment equation, the real interest rate and development expenditures are used as independent variables. Other variables such as output and credit availability do not have sufficient explanatory power. As in the private consumption equation, a PDL specification for development expenditure is used in order to reflect a lag structure between expenditures and investment. Private fixed investment fits a first-degree polynomial to the coefficients of six lags of order, constraining the far end to be zero. The estimated long-run elasticity of private fixed investment is around 1.60, implying that private fixed investment is highly sensitive to the government's development expenditures. One possible explanation for this is that private investors are likely to extract information about future business conditions from the government development expenditures or the government investment may have multiplier effects on the private sector. The coefficient on regular expenditures, on the other hand, is not significant.

Log(*FCP*) = –4.07 – 0.59*Log(*INT1-PCHY(CPI)*) + 0.23*PDL01(Log(*DEVEXP/PGDP**100),6) *(Equation 3)*
(-3.8) (-3.6) (14.5)
sum of lags = 1.60, *PCHY(CPI)* denotes inflation rate.
(14.5)

[12] Excess demand pressure is measured as the gap between GDP and Hodrick-Prescott filtered GDP.

Consistent with theoretical prediction, private fixed investment is negatively correlated with the real interest rate. The estimated elasticity of private fixed investment with respect to the real interest rate is 0.59, suggesting that a higher interest rate discourages private investment. The presence of the real interest rate in the private investment equation represents a channel through which monetary shocks are transmitted to the real sector.

Government Fixed Investment

As in the case of government consumption, government fixed investment is correlated with regular expenditures and development expenditures. Foreign borrowing is also considered since a substantial amount of government investment is likely to be financed by borrowing from abroad. In addition, the real interest rate is expected to affect government investment through a transmission channel from the monetary sector to the real sector. In contrast to government consumption, government fixed investment is more strongly influenced by development expenditures than regular expenditures. The estimated coefficient on development expenditures is almost twice as large as the estimated coefficient on regular expenditures. The negative coefficient estimate on the real interest rate implies that a rise in the real interest rate reduces government fixed investment. However, government investment is less sensitive to the real interest rate than private investment. Although foreign borrowing is an important source of financing for government investment, the estimated coefficient is not statistically significant. However, if development expenditure is excluded, foreign borrowing becomes a significant factor. This is understandable given that development expenditures are mostly financed through foreign borrowing. To emphasize the importance of foreign financing in domestic investment, foreign borrowing is included in the government investment equation together with development expenditure.

$$\begin{aligned}\text{Log}(FCG) = \; & -1.13 + 0.85 * \text{Log}(DEVEXP/PGDP*100) + 0.32 * \text{Log}(REGEXP/PGDP*100) \\ & \quad (-1.3) \qquad\qquad (5.2) \qquad\qquad\qquad\qquad (4.6) \\ & - 0.32*\text{Log}(INT - PCHY(CPI)) + 0.02*\text{Log}(FBORR/PGDP) \\ & \qquad\qquad (-2.6) \qquad\qquad\quad (0.3)\end{aligned} \qquad \textit{(Equation 4)}$$

Exports and Imports of Goods and Non-factor Services

Two bridge equations are estimated to link exports and imports in the BOP account to the exports and imports in the national income account. Exports and imports in the national income account were regressed on the merchandise exports and imports in the balance of payments account. Notably, exports and imports in the national income account include non-factor services as well as goods exports and imports while those of the balance of payments account include only merchandise exports and imports.[14] A dummy variable, DUM9498, is constructed to improve the fitness of the export estimation.

[14] Non-factor services include shipping, passenger, and other transport services, and travel, as well as current account transactions not separately reported (e.g., not classified as merchandise, non-factor services, or transfers). These include transactions with nonresidents by government agencies and their personnel abroad, and also transactions by private residents with foreign governments and government personnel stationed in the reporting country.

The estimation results of the two bridge equations confirm the close ties between the national income account and BOP account. The long-run sensitivity of exports is 0.45, and the sensitivity of imports is 0.99. The two estimated coefficients are close to, but not equal to 1.00 primarily because of the inclusion of non-factor services in the national income account. The dummy variable in the exports equation, DUM9498, is estimated to be significant.

Log(*XX*) = 3.37 + 0.45*Log(*XRUP/PGDP*) + 0.27**DUM9498* + 0.45*Log(*XX(-1)*) *(Equation 5)*
(6.2) (5.7) (4.3) (5.1)

Log(*MM*) = 4.85 + 0.99*Log(*MRUP/PGDP*) + [*AR(1)* = 0.71] *(Equation 6)*
(27.9) (34.3) (3.6)

2. Price Block

Consumer Price Index

The price block consists of the CPI and the GDP deflator. An interesting finding is that most of the fluctuations in the CPI in Nepal can b e explained by the fluctuations in the CPI in India. The serial correlation adjusted coefficient on the Indian CPI is 1.03, suggesting that there is nearly a one-for-one relation between the two countries' CPIs. Other than the Indian CPI, no variable is found to be significant, although M2 is included in the price equation in the NMM to link the monetary sector to the real sector. An attempt was made to estimate the effect of the excess demand pressure on the price, but the coefficient was found to be insignificant.

Log(*CPI*) = -0.41 + 1.03*Log(*INDP*) + 0.02*Log(*M2*) + [*AR(1)* = 0.82] *(Equation 7)*
(-1.2) (5.6) (0.2) (5.9)

GDP Deflator

A bridge equation is estimated for the GDP deflator. Since the GDP deflator in Nepal is constructed using the same data used in constructing the CPI, the GDP deflator and CPI exhibit almost identical fluctuations. The elasticity of the GDP deflator with respect to CPI is 0.92. The exchange rate displayed marginal explanatory power for the GDP deflator and was not included in the equation.

Log(*PGDP*) = 0.43 + 0.92*Log(*CPI*) + [*AR(1)* = 0.43] *(Equation 8)*
(11.2) (99.3) (2.5)

3. Money and Credit Block

M2 is the sum of net foreign assets and domestic credit. Domestic credit consists of private domestic credit, government domestic credit, and claims on government enterprises. Three behavioral equations were specified for net foreign asset, private domestic credit,

and government domestic credit.[15] Since the Nepalese rupee is pegged to the Indian rupee and the domestic currency is fully convertible for all current account transactions, the money supply is endogenously determined in the model. In principle, interest rates should also be included as an endogenous variable. However, it is difficult to find a variable that has significant explanatory power in the interest rate equation. Moreover, the interest rate has generally been fixed with infrequent adjustments in Nepal. Therefore, without theoretical justification, treating the interest rate as an exogenous variable cannot be avoided in the NMM. It has been more difficult to get good estimation results for variables in the money and credit block compared with variables in other blocks. Also, many variables in the money and credit block are stock variables. Therefore, where necessary, stock variables were transformed into flow variables (by taking their differences) before estimation.

Net Foreign Assets

Net foreign assets is one of the crucial variables in the NMM's propagation mechanism, but it is very difficult to find a good specification for net foreign assets. Net foreign assets affect the aggregate money supply, and M2 then influences the price level and real economic variables. A surplus in the overall balance in the BOP block leads to an increase in net foreign assets and vice versa. Following this linkage between accounts, changes in net foreign assets of the central bank are directly linked to the overall balance in the NMM.

$$\Delta(NFA) = \underset{(-2.2)}{-1548.60} + \underset{(6.3)}{0.96}*OB \qquad \textit{(Equation 9)}$$

Changes in net foreign assets are very closely correlated with the overall balance in BOP account; the coefficient estimate is around 0.96.

Private Domestic Credit

Domestic credit includes private domestic credit, government domestic credit, and claims on government enterprises. Private domestic credit further subdivides into household loans, corporate loans, and security holdings. Theoretically, these components are all very sensitive to the market interest rate and economic conditions. In addition, corporate loans are likely to be affected by future economic prospects as well as current economic conditions. Nominal GDP was used to represent current economic conditions. Given the serial correlation of nominal GDP, it was assumed that future business prospects are also incorporated in nominal GDP. As expected, changes in private domestic credit are positively correlated with nominal GDP. In contrast, the interest rate was excluded since the coefficient estimate on the market interest rate is not significant.

$$\Delta(DCP) = \underset{(-1.4)}{-993.71} + \underset{(13.2)}{0.04}*GDPN \qquad \textit{(Equation 10)}$$

[15] Claims on the Government are treated as exogenous. The variable name is DCO in the model.

Government Domestic Credit

Government domestic credit is closely related to the overall government budget deficit: a large portion of government domestic credit is the accumulated government budget deficit. Government domestic credit declines along with the government budget surplus and vice versa. Changes in government domestic credit was regressed on the budget surplus and a statistically significant relation was found. Lagged variables of government domestic credit and the budget surplus were also included. A dummy variable, DUM99, was included in the equation to improve the goodness of fit (DUM99 equals 1.00 for FY 1999 and zero otherwise).

$$\Delta(DCG) = \underset{(-0.4)}{-235.13} + \underset{(3.7)}{0.83}*\Delta(DCG(-1)) - \underset{(-5.1)}{0.86}*OVSUR + \underset{(4.2)}{0.88}*OVSUR(-1) + \underset{(1.0)}{1122.09}*DUM99 \quad \textit{(Equation 11)}$$

4. Government Block

There is only one behavioral equation in the government block: non-tax revenue. All other endogenous variables in the block are defined by simple accounting identities. The current revenue of the government is defined as the sum of tax and non-tax revenue. Government expenditures include regular expenditures and development expenditures. The overall balance of the government is defined by government current revenue and sales of fixed assets, which can also be calculated as capital revenue minus government expenditures and lending less repayment. Since the government can actively use taxes, regular expenditures, and development expenditures to exercise control over the economy, those three variables are considered as policy variables in the model. Excluding foreign grants, the government finances the overall budget deficit through foreign borrowing or domestic borrowing. The use of the cash balance is included in domestic borrowing in our model.

Non-tax Revenue

Non-tax revenue includes charges, fees, fines, forfeitures, receipts from sales of commodities, royalties and sales of fixed assets, principal and interest payments, etc. Since these components are likely to be influenced by nationwide economic activities, non-tax revenue is regressed on nominal GDP and the coefficient is found to be statistically significant.

$$\text{Log}(NTAX) = \underset{(-15.3)}{-5.77} + \underset{(35.3)}{1.15}*\text{Log}(GDPN) + [\underset{(1.6)}{AR(1)=0.29}] \quad (\textit{Equation 12})$$

5. Balance of Payments Block

Merchandise exports and imports, foreign loans, amortization, and official capital grants are specified in this block. Two bridge equations for foreign loans and official capital grants are specified to link them to foreign borrowing and foreign grants in the government block, respectively. Net services and net transfers are both exogenous variables in the NMM.[16] The current balance, capital balance, and overall balance are defined by accounting identities in the BOP.

[16] Net services of the BOP block include non-factor and factor services.

Merchandise Exports

Motivated by close economic ties with India, exports to India are included in the equation along with the exchange rate. Since the dependence of exports on India is directly taken into account, this may not be a desirable approach. However, exports to a foreign country primarily depends on foreign income. Since Nepal's major trading partner is India, exports to India may be used as a proxy for the Indian income variable. A dummy variable, DUM97, is included in the specification to improve the fit.[17] Other potentially important variables such as world trade volume and the relative price of Nepal with respect to other trading partner countries are found to be insignificant.

It is expected that a depreciation of the currency increases exports and merchandise exports in Nepal are indeed positively correlated with the exchange rate before FY1997. However, exchange rate and merchandise exports move in opposite directions since FY1997, which is inconsistent with economic theory. The unusual finding could be explained by a structural change that affects exports around FY1997, and that the normal economic relationship between exports and the exchange rate is expected to resume soon. The interaction term of exports to India and the dummy variable is included for the time being as the variable for exports to India before 1997 is not found to be significant in the export equation.

$$\text{Log}(XRUP) = \underset{(14.6)}{2.30} + \underset{(37.6)}{1.91}*\text{Log}(ERA) - \underset{(-1.7)}{2.89}*(DUM97*\text{Log}(ERA)) + \underset{(2.3)}{0.65}*(DUM97*\text{Log}(XIND)) + \underset{(1.3)}{6.13}*DUM97 \qquad \textit{(Equation 13)}$$

Merchandise Imports

Merchandise imports are specified as a function of real GDP, the exchange rate, and imports from India along with the dummy variable, DUM97. Replacing real GDP with nominal GDP adversely affects the simulation results substantially, suggesting that price changes do not play a role in import demand. The estimated short-run income elasticity of merchandise imports is 0.61. The exchange rate is negatively correlated with imports (estimated coefficient of -0.13). Imports from India also plays an important role to explain merchandise imports. While the estimated coefficient on DUM97 is not significant, the interaction terms of the dummy variable with GDP or the exchange rate are highly significant.[18]

$$\text{Log}(MRUP) = \underset{(-2.0)}{-6.02} + \underset{(8.5)}{0.78}*\text{Log}(MRUP(-1)) + \underset{(1.9)}{0.61}*\text{Log}(GDP) + \underset{(2.3)}{0.17}*\text{Log}(MIND) - \underset{(-0.8)}{0.13}*\text{Log}(ERA) + \underset{(3.5)}{0.47}*(DUM97*\text{Log}(GDP)) - \underset{(-3.6)}{1.44}*(DUM97*\text{Log}(ERA)) \qquad \textit{(Equation 14)}$$

[17] DUM97 is 1.00 for the years since 1997.

[18] Import demand responds more strongly to gross domestic product and the exchange rate since FY1997, possibly due to structural changes.

Foreign Loans and Official Capital Grants

Foreign loans and official capital grants in the BOP account are linked to foreign borrowing and foreign grants in the government block by two bridge equations. Foreign loans and official capital grants are regressed on foreign borrowing and foreign grants in the government block, respectively. As expected, the long-run elasticity of foreign loans of BOP block with respect to foreign borrowing in the government block is 1.00 whereas the short-run elasticity is only 0.37. Official capital grants is not directly regressed on foreign grants. A simple bridge equation may adversely affect the simulation results due to the strong persistence of official capital grants. Changes in official capital grants was regressed on a 4-year moving average of foreign grants to reduce the problem of persistence. Such a specification improves the estimation result and simulation performance.

Log(*FLOANS*) = 0.28 + 0.62*Log(*FLOANS(-1)*) + 0.37*Log(*FBORR*) *(Equation 15)*
(1.3) (10.1) (5.0)

Δ(*OCGRANTS*) = -159.20 + 1.24*Δ(MOVAV(*FGRT*,4)) + [*AR(1)*=0.62]
(-0.3) (2.8) (3.0)

Amortization

Amortization is the repayment of debt in small, regular installments. Nominal GDP was considered as an explanatory variable since amortization usually depends on the borrower's ability to service and pay down the debt. The dummy variable, DUM97, was included to make adjustments to the slope of nominal GDP and constant term. The coefficient estimate on the interaction term of dummy variable and nominal GDP is negative, suggesting that amortization has become less dependent on income since 1997.

Log(-*AMORT*) = -17.47 + 2.06*Log(*GDPN*) - 0.93*(*DUM97**Log(*GDPN*)) + 11.34**DUM97* *(Equation 16)*
(-33.1) (42.8) (-2.4) (2.3)

Foreign Aid Disbursements

When a foreign loan contract is signed, the amount is not directly paid to the borrower. Instead, a loan account is opened in the creditor's books under the name of the borrower, and the loan amount is credited to that account. Withdrawal from the account is approved only after fulfillment of the requirements attached to the loan contracts. Foreign grants are paid in a similar way when a foreign grant contract is signed. Two equations are designed in the model for the purpose of relating foreign aid disbursement (the sum of foreign loans and foreign grants) to foreign borrowings and foreign grants in the government block. There should be a one-for-one long run relationship between the two foreign loans and two foreign grants, respectively. As expected, the short-run elasticity of foreign loans (foreign aid disbursements) with respect to foreign borrowing in the government block is 0.37, but its long-run elasticity is close to 1.00.

Log(*LOAN*)= 0.28 + 0.37*Log(*FBORR*) + 0.62*Log(*LOAN(-1)*) *(Equation 17)*
(1.3) (5.0) (10.1)

Log(*GRANT*)= -0.04 + 1.00*Log(*FGRT*) *(Equation 18)*
(-0.4) (69.3)

6. Block Linkages

Once the coefficients in each behavioral equation are estimated, a simulation can be conducted to solve for each endogenous variable. Given certain initial values, interactions among variables across blocks are repeated until the system finds the equilibrium for the economy. Therefore, it is important to understand how the variables or blocks are linked to each other in the system.

The government block is crucial for determining final demand. In particular, private fixed investment as well as government consumption and government fixed investment are strongly affected by government expenditures. The interest rate, from the money and financial block, determines fixed investment. Real exports and imports of goods and non-factor services in the final demand block are directly linked to the BOP block through simple bridge equations. The price block also affects final demand by converting nominal variables to real variables.

The price block is almost exogenous in the sense that prices are primarily determined by exogenous variables. Prices do affect variables in other blocks, but not vice versa. Prices in Nepal is a function of the Indian price and exchange rate, both of which are determined exogenously. The effect of the M2 is relatively weak since under the fixed exchange rate regime, the monetary authority cannot control the monetary base while the price level is greatly affected by the exchange rate.

The money and credit block is linked to final demand, government, and BOP. The aggregate M2 is the sum of private and government domestic credits and net foreign assets. Nominal GDP from the final demand block determines the change in domestic private credit. In contrast, the change in domestic government credit is determined by the overall government deficit from the government block. The change in net foreign assets is determined by the overall balance from the BOP block.

The government block is directly linked only to the final demand block. Nominal GDP from the final demand block plays a role as a scale variable in the non-tax revenue equation. Other important variables in the government block are mainly policy variables, including tax revenue, development expenditures, regular expenditures, and foreign borrowing.

The BOP block is linked to the final demand block and the government block. Imports of goods and services are primarily determined by nominal GDP. Foreign loans and official capital grants are connected with the variables in the BOP block.

C. Evaluation of the In-sample Forecasting Performance

Well-specified individual behavioral equations are a prerequisite for a good macroeconometric model. From a statistical perspective, individual equation estimation should exhibit high goodness of fit, and the coefficient estimates should be statistically significant. However, good statistical properties in individual equations do not necessarily imply a good performance of the model as a whole. Rather, good forecasting performance of the model depends on how well the relations between behavioral equations are linked and if the coefficient estimates are economically reasonable. Tests need to be carried out to determine whether the predicted values from the system trace the actual history of the variables reasonably well to evaluate the forecasting performance of the model.

The model is evaluated for both within-sample and out of sample predictive performances. The evaluation of within-sample performance is mainly via conventional statistics such as the root mean square percentage error (RMSPE). Out-of-sample forecasting performance is evaluated using stochastic simulations. Out-of-sample forecasting performance is not discussed in this paper. Stochastic simulations of variables by adding random shocks were performed using the NMM and a more in-depth discussion is presented in the paper on debt sustainability.[19]

The RMSPE is one of the most widely used statistics for testing the performance of a model. Let $\hat{y}_t$ be the solution or the predicted value of a variable at period t, and y_t be the actual value. Given the observations on and for t=1,…,T, the RMSPE is defined by:

$$RMSPE = \sqrt{\frac{1}{T}\sum_{t=1}^{T}\left(\frac{\hat{y}_t - y_t}{y_t}\right)^2} \times 100$$

Table 1 summarizes RMSPE for key variables in the NMM. Solutions are obtained from FY1985 to FY2004 for all endogenous variables, so that the number of observations is 20. Simulation begins in FY1985 since there are some concerns about data consistency in using the national income data before FY1984. As can be seen from Table 1, the model is able to track the historical development of the Nepalese economy reasonably well. Figure 2 depicts the trajectories of the static and dynamic ex post simulations over the period 1975-2003 along with the actual values. RMSPE is less than 10% for most variables and most importantly, the performance of forecasting GDP is excellent: RMSPE is only 3.9%. As expected, among the components of GDP the forecasting errors for consumption and import are quite low, while those for investment and exports are relatively high. The model forecasts of the prices (CPI and PGDP) are also satisfactory; RMSPE for current account balance is relatively high and unsatisfactory. Since net foreign assets is directly linked to the BOP and as it is also a component of the aggregate money supply, RMSPE for net foreign assets and M2 are also high.

[19] ADB. 2004. *Nepal: Debt Sustainability Analysis.* Manila.

Table 1: Root Mean-squared Percent Errors of Key Variables

(%)

Variable	RMSPE	Variable	RMSPE	Variable	RMSPE	Variable	RMSPE
CP	6.1	MM	6.3	NTAX	13.5	M2	22.8
CG	5.3	GDP	3.9	CURREV	3.0	XRUP	10.7
FCP	13.2	GDPN	6.6	DBORR	15.8	MRUP	8.9
FCG	8.0	CPI	3.8	DC	7.6	CB	24.8
XX	13.3	PGDP	3.9	NFA	46.1	KB	10.1

V. POLICY SCENARIOS

The primary purpose of developing the NMM is to provide guidelines for macroeconomic planning and management by forecasting the future path of the economy. However, forecasting performance usually declines with the length of the forecasting horizon. In the case of Nepal, considering the rapidly changing economic structure, it is more likely to be so. Taking this into consideration, the forecasting horizon is set at 5 years.[20]

It follows that a set of assumptions are needed on the future values of exogenous variables including government policy variables. In particular, since policy variables have great influence on the course of the economy, it is important to set the future values of policy variables in a consistent way. The NMM has five policy variables: (i) tax revenue, (ii) development expenditures, (iii) regular expenditures, (iv) foreign borrowings, and (v) exchange rate. A point to be noted is that under a fixed exchange rate regime, exchange rate policy can be regarded as part of monetary policy. Consequently, the policy variables in the NMM are mostly fiscal policy variables and a variable for the exchange rate.[21]

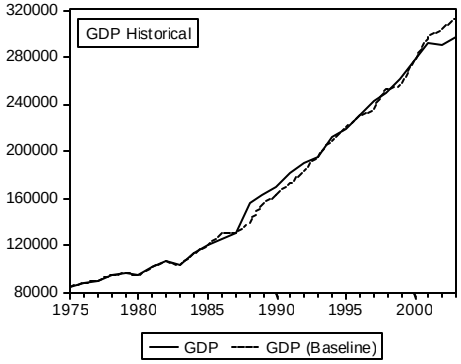
Policy variables can be affected by the socioeconomic environment and political change. Therefore, three different policy scenarios are considered in this paper, according to the different political and social situations that Nepal may face. Initially, a baseline scenario and then two additional scenarios consistent with Nepal's Tenth Plan are presented. Detailed explanations for the three scenarios are provided in the following subsections. A time series technique is considered to produce the projections for future values in all three scenarios for other exogenous variables.

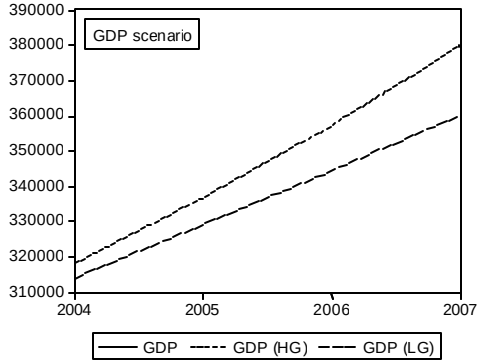
[20] In the user-friendly version the forecasting horizon can be set as either 5 years or 10 years.

[21] Efforts to internalize the exchange rate in an alternative setup was not successful. Since the Nepalese rupee was fixed to the Indian rupee in the past, the exchange rate did not show a significant response to any domestic macroeconomic variable.

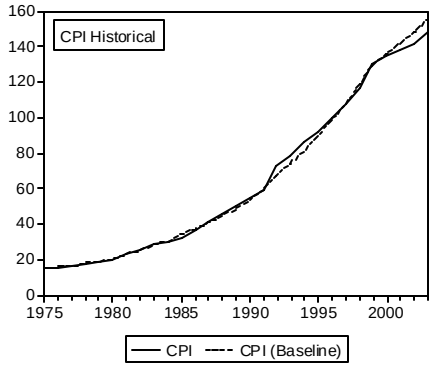
Figure 2: Historical and Policy Simulations[22]

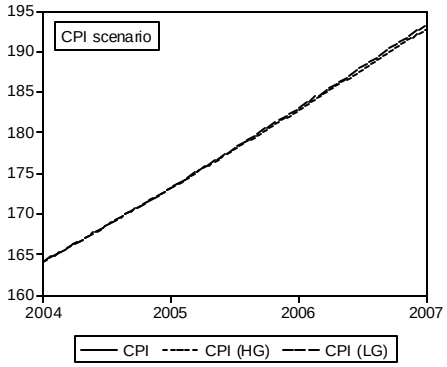
Gross Domestic Product (Real)



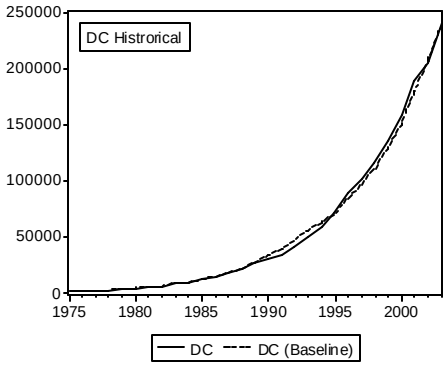


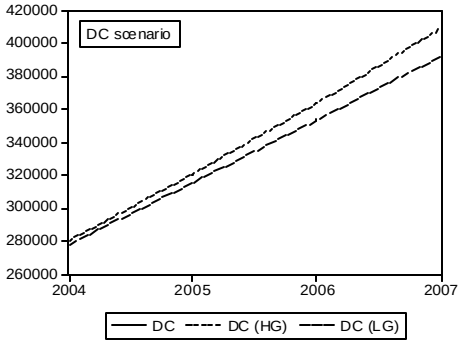
Consumer Price Index





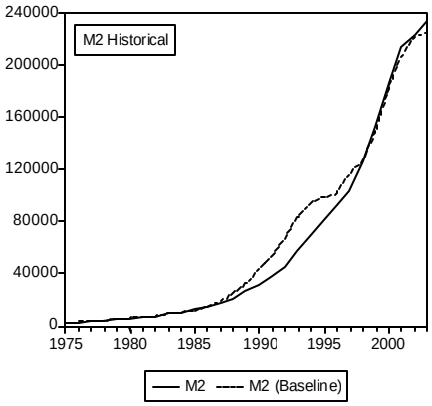
Domestic Credit

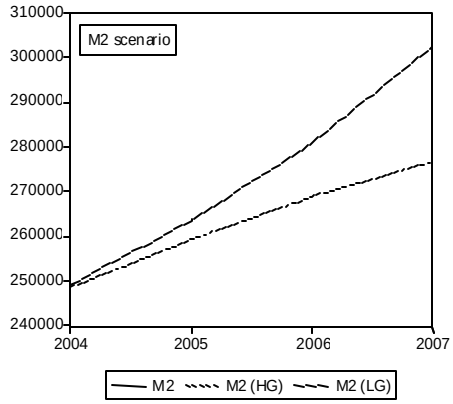




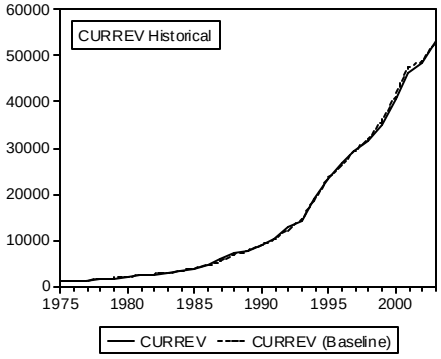
[22] HG denotes high growth scenario and LG denotes low growth scenario.

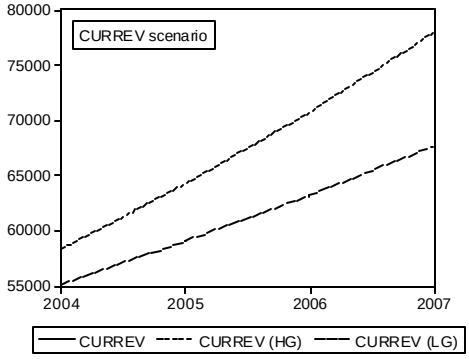
Broad Money (M2)



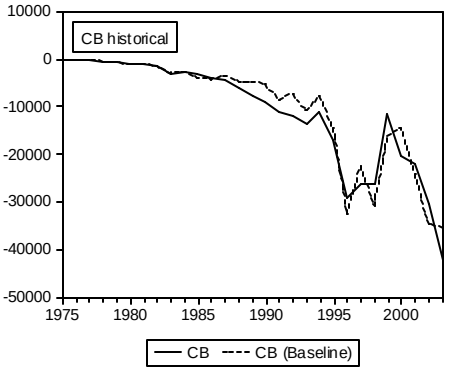


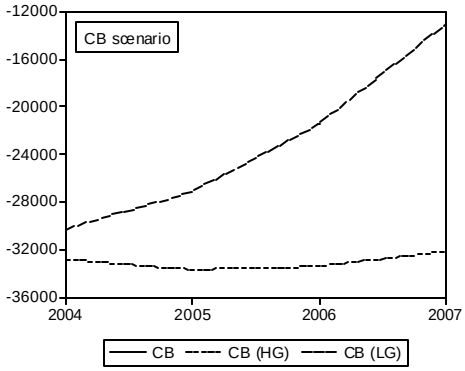
Current Revenue





Current Account Balance





A. Baseline Scenario

Instead of making ad hoc assumptions on the policy variables, the baseline scenario simply extrapolates recent trends of policy variables as well as exogenous variables over the next 5 years. Simple extrapolation of policy variables using a time series technique implies that political or social changes are not considered and that the recent trends in policy variables continue. A time series model of auto regression [AR(2)] with a time trend does a reasonably good job for most variables.[23] Table 2 shows the forecasted values for policy variables. The second column, FY1986–FY2002, indicates the actual values during the period from FY1986 to FY2002. The last column shows the averages of predicted values from FY2003 to FY2007.[24]

Table 2: Policy Variables under Baseline Scenario

(%)

Variables	FY1986-FY2004	FY2005-FY2007	Variables	FY1986-FY2004	FY2005-FY2007
TAX/GDPN	8.1	10.7	REGEXP/GDPN	7.2	13.5
DEVEXP/GDPN	10.2	5.5	FBORR/(-)OVSURFG	59.2	17.8
ERA	8.0	5.7	FBORR/GDPN	3.1	0.6

Note 1: Figures for ERA (exchange rate) refer to the depreciation rates.
Note 2: A minus sign in front of overall balance after grants (OVSURFG) denotes a government deficit after grants.

While the average tax ratio was 8% over the last 17 years, it is forecast to rise to 10.7% over the next 3 years in the baseline scenario. The share of government expenditures out of nominal GDP is forecasted to increase slightly over the next 3 years. However, the composition of government expenditures is expected to change markedly. The share of regular expenditures will increase from 7.2% to 13.5%, whereas the share of development expenditures is expected to decline from 10.2% to 5.5%. The decline of development expenditures can be attributed to the recent decline in foreign borrowing, the major financing source for development expenditures.

The foreign borrowing ratio is forecast to decrease from 59.2% to 17.8% reflecting the recent drop in foreign borrowing. The actual ratio of foreign borrowing over budget deficit (FBORR/(-)OVSURFG) was 40.8%, 17.9% and 13.8% in FY2001, FY2002, and FY2003, respectively. The huge drop in the foreign borrowing ratio (with respect to the government's overall balance after grants) reflects its downward trend in recent years. As the recent declining trend in foreign borrowings is due to the onset of political instability in 2001/02, the return of political stability in the near future would lead to an understated foreign borrowing ratio in the baseline forecast.

[23] Reported tax revenue and reported regular expenditures by the AR(2)+trend model were forecasted. Necessary adjustments of firm registration fees, loans and investments, and principal payments were also made. These adjustments for the period of FY2003–FY2007 are discussed in the next section. For other exogenous variables, the following assumptions or time series models were used. STD =0, FDI=0 for all periods, AR(2)+trend specification (IS, DCO, OM2, INT, CAPREV, PRPAY, PECO), AR(1)+trend specification (XIND, MIND, NTRS), AR(2) specification (INDP, NSER).

[24] The figures in Table 4 follow the ADB format, and therefore, differ from the official Government of Nepal statistics.

However, if political stability is not restored, the baseline scenario indicates that it will become increasingly difficult for Nepal to obtain external financing in the form of loans and grants.[25] The Nepalese rupee is expected to depreciate against the US dollar, yet the rate of depreciation will slow from 8.0% to 5.7% over the next 3 years.

B. Two Policy Scenarios

The political situation often imposes a constraint on government policies and affects resource allocation. However, it is difficult to address the uncertainty about future changes in the political and socioeconomic environment in the policy simulation. Indeed, future political situation seems unpredictable in Nepal. Taking this into account, the baseline scenario documented in the previous subsection implicitly assumes that recent trends in policy variables will continue to hold in Nepal. Nevertheless, alternative scenarios can be considered to examine how the economy responds to the alternative policy shocks associated with them.

Nepal formulated the Tenth Plan to implement an appropriate development strategy for the period from FY2003 to FY2007. Given the uncertain fiscal prospects and political climate, the Tenth Plan addresses two alternative scenarios: an optimistic normal growth scenario and a pessimistic low growth scenario. In line with these scenarios in the Tenth Plan, two policy scenarios are developed. They are also named as normal growth scenario (NGS) and low growth scenario (LGS). Future values for policy variables in NGS and LGS are specified to match those of the corresponding variables in the Tenth Plan. Although the exchange rate is a policy variable in the NMM, the future path of exchange rate is not included in the Tenth Plan. Therefore, the exchange rate is forecast by AR(2) plus a time trend model which is used for both the NGS and LGS.

Table 3: Average Growth Rates of Policy Variables under NGS and LGS

(%)

Variables	FY1986-FY2004	NGS 2005-07	LGS 2005-07	Variables	FY1986-FY2004	NGS 2005-07	LGS 2005-07
TAX	15.7	9.6	6.1	REGEXP	17.0	2.6	3.5
DEVEXP	10.4	7.4	7.4	FBORR	27.0	35.2	33.1
ERA	8.0	5.7	5.7	FGRT[a]	20.0	11.2	11.9

[a] Not a policy variable but a simple exogenous variable.

Table 3 shows the average growth rates of the policy variables and also reports the growth rates of foreign grants though it is an exogenous variable and not a policy variable in the NMM. Under both NGS and LGS, tax revenues will rise, but at a much slower rate than in the past 19 years. Since economic growth is higher under NGS, the growth rate of tax revenue is also expected to be higher under NGS than LGS. Compared to the past, development expenditures are likely to increase rapidly under NGS but much more slowly under LGS. In contrast, the growth rates of

[25] Two possible paths for foreign grants were considered. Even though foreign grants are not policy variables, the amount can be affected by domestic situations.

regular expenditures are lower than that of development expenditures under both NGS and LGS. The time-series extension predicts that the depreciation rate of the Nepalese rupee against the US dollar will decrease during the Tenth Plan period, FY2005–FY2007. It may be surprising that the growth rate of foreign borrowing is higher during the Tenth Plan period. Foreign borrowings have somewhat recovered in FY2004 since the substantial decline in FY2002 and FY2003 and they are assumed to rebound to normal levels in FY2005 in NGS and LGS, leading to a higher growth rate of foreign borrowings in Table 3.[26] However, the growth rates of foreign grant inflows are assumed to decline under NGS and LGS.

While Table 3 shows the growth rates of the policy variables under NGS and LGS, Table 4 shows the level of the policy variables to compare their forecast under the baseline scenario in Table 2. In Table 4, policy variables are scaled by nominal GDP, while foreign borrowing is scaled by the government's overall balance after grants.[27]

Table 4: Policy Variables under NGS and LGS

(%)

Variables	FY1986-FY2004	NGS 2005-07	LGS 2005-07	Variables	FY1986-FY2004	NGS 2005-07	LGS 2005-07
TAX/GDPN	8.1	9.2	9.1	REGEXP/GDPN	8.6	8.1	8.9
DEVEXP/GDPN	10.2	7.2	6.2	FBORR/(-)OVSURFG	59.2	125.0	168.9
ERA	8.0	5.7	5.7	FBORR/GDPN	3.1	1.6	1.6

While the growth rate of tax revenue is expected to slow under the two scenarios, the tax burdens scaled by nominal income will rise by 1.1% and 1.0%, respectively. The higher tax burdens suggest that taxes will be more important in financing government expenditures in the future, particularly under the NGS scenario. Despite the lower tax revenue under LGS, total government expenditures will be higher. An interesting finding is that the composition of government expenditures changes dramatically. The volume of development expenditures exceeded that of regular expenditures during the FY1986–FY2004 sample period, but this will not be the case during the Tenth Plan period. The change in the composition of expenditures is more significant under LGS. The decline in development expenditures is related to the anticipated decline of foreign borrowings under NGS and LGS, a major financing source of development expenditures. The average ratio of foreign borrowing to nominal GDP is expected to decline from 3.1% to 1.6% under both scenarios.

[26] Foreign borrowing decreased by 61% in FY2002; normal growth scenario and low growth scenario assume that it increases by 148% and 143%, respectively, in FY2004.

[27] Solution values were used for GDPN and OVSURFG under NGS and LGS from FY2003–FY2007.

VI. FORECASTING RESULTS BY POLICY SCENARIOS

A. Baseline Simulation

Table 5 reports the forecasts for key macroeconomic variables for the baseline scenario.[28] Under the baseline scenario, real GDP growth rate will average 2.8% for the next 3 years. The average growth rates for private consumption and government consumption are 2.9% and 10.8%, respectively. However, private consumption is expected to decline sharply whereas government investments are expected to increase and CPI inflation will be around 5.3%. The current account deficit is expected to be around 7.1%, while the trade deficit will amount to 16% of nominal GDP. Despite the capital surplus, the BOP account will show an overall deficit of 2.7% of nominal GDP. The government budget deficit after grants is forecasted at 4.8% of nominal GDP. Reflecting the sharp drop in foreign borrowing in the baseline scenario, the percentage of borrowing from domestic sources to finance the budget deficit is predicted at over 86%. It should be noted, however, that if the sharp decline in foreign borrowing was due to temporary political instability, the projected volume of domestic financing might be overestimated.

Table 5: Baseline Simulation

(%)

Variables	FY1998-04 Actual	FY2005-07 Baseline	Variables	FY1998-04 Actual	FY2005-07 Baseline
CP	3.7	2.9	M2	15.3	2.9
CG	5.5	10.8	CURREV/GDPN	11.2	11.3
FCP	1.6	-3.1	OVSURFG/GDPN	-3.3	-4.8
FCG	3.1	5.4	DBORR/(-)OVSURFG	53.1	86.3
GDP	3.6	2.8	TB/GDPN	-15.1	-15.9
GDPN	8.5	7.8	CB/GDPN	-5.7	-7.1
CPI	5.3	5.3	KB/GDPN	7.2	4.5
DC	14.0	13.9	OB/GDPN	1.5	-2.7
NFA	15.9	-6.3	FAD/GDPN	4.4	3.3

Note: Except for the ratios with respect to GDPN or OVSURFG, the other figures are average annual growth rates.

B. Policy Simulations

Table 6 reports the forecasting results under the two scenarios, NGS and LGS, along with the actual values for the key variables during the period FY1998–FY2004. The growth rates of GDP are quite different under the two scenarios. During FY2005–FY2007, GDP is expected to grow on average at 5.5% under NGS and 4.4% under LGS, leading to a huge gap between the two GDPs at the end of FY2007. Under the baseline scenario in Table 5, the average growth rate of GDP is 2.8%. Among three policy scenarios in the NMM, it is not surprising to see the lowest

[28] Figures in the table follows the ADB format and are not directly compatible with the data format the Government of Nepal uses.

forecast under the baseline scenario considering its pessimistic projection for foreign borrowings. Also, the forecasts in the NMM are somewhat more pessimistic than the average growth projection of the Tenth Plan where the average growth forecasts are 6.2% and 4.3% in normal and low scenarios, respectively. As for inflation, it is forecasted to be around 5.4% (4.9% under the LGS), showing only a slight variation between the two scenarios and the baseline scenario.

Table 6 : Projections of Two Scenarios
(%)

Variables	FY1998–2004 Actual	FY2005–2007 NGS	FY2005–2007 LGS	Variables	FY1998–2004 Actual	FY2005–2007 NGS	FY2005–2007 LGS
CP	3.7	10.1	9.6	M2	15.3	3.5	3.6
CG	5.5	5.1	4.1	CURREV/GDPN	11.2	11.4	11.4
FCP	1.6	6.1	-0.7	OVSURFG/GDPN	-3.3	-1.4	-0.6
FCG	3.1	15.1	6.9	DBORR/ (-)OVSURFG	53.1	-25.0	217.5
XX	-1.9	5.4	5.4	XRUP	14.5	6.3	2.7
MM	1.5	1.7	-0.2	MRUP	3.9	7.5	2.6
GDP	3.6	5.5	4.4	TB/GDPN	-15.1	-13.7	-13.3
GDPN	8.5	10.7	9.5	CB/GDPN	-5.7	-5.2	-4.6
CPI	5.3	5.4	4.9	KB/GDPN	7.2	5.2	5.4
DC	14.0	9.6	8.2	OB/GDPN	1.5	0.0	0.8
NFA	15.9	0.6	14.6	FAD/GDPN	4.4	3.0	3.1

Note: All figures except for CURREV, OVSURFG, DBORR are average annual growth rates.

It is a worthwhile exercise to try to find out the component of final demand that is responsible for the different GDP growth rates between the two scenarios. First, private consumption, the largest component of domestic demand, is determined by disposable income that, in turn, is primarily affected by GDP. Even though the tax rate is higher under NGS than LGS, private consumption grows faster under NGS due to higher disposable income or GDP. Given the specification of the private consumption equation, however, it is more appropriate to argue that consumption is higher under the NGS because GDP is higher rather than vice versa. The growth rate of nominal regular expenditures in Table 3 and the inflation rate in Table 6 suggest that the growth rates of real regular expenditures are essentially negative. Since government consumption is primarily determined by the real regular expenditures, the growth rates of government consumption are negative under both scenarios. Moreover, government consumption cannot explain the GDP growth rate differentials since the growth rates of regular expenditures are higher under the LGS than that of the NGS as can be seen in Table 3. Second, fixed investments, both real private fixed capital (94/95 base year) and real government fixed investment (94/95 base year), are primal components in explaining the different GDP growth rates. In the NMM, Real Government Fixed I

nvestment (94/95 base year) is specified to be a function of development expenditures and is assumed to grow at 15.1% under NGS and 6.9% under LGS. The difference between the two growth rates of development expenditures leads to huge difference in the growth rates of fixed investment and thereby, the GDP growth rates.

Third, foreign demand cannot be responsible for the different GDPs because the growth rates for exports are almost identical under NGS and LGS. Imports, however, grow at a faster rate under NGS than LGS as the volume of imports depends greatly on domestic economic activity. Consequently, the trade deficit is larger under NGS. Foreign direct investment, private capital, and errors and omissions are the same under both policy scenarios. Official loans and capital grants vary depending on the scenarios for foreign borrowing and the assumption for grants. Due to the assumption of a larger volume of grants under LGS, the ratio of the capital balance to nominal GDP is higher under LGS than NGS, though the difference is small. In sum, development expenditure is the most important factor that can explain the growth rate differentials between the NGS and the LGS.

C. Comparison with the Tenth Plan

Table 7 compares the annual forecasts of the NMM with those of the Tenth Plan—the current guide for economic policy in Nepal. The comparison shows that the forecasts from the two models are consistent. However, while the NMM forecasts for FY2005 are higher than those of the Tenth Plan, the average growth projection of the Tenth Plan is more optimistic than that of the NMM in the normal growth scenario. The average growth rate forecasts in the Tenth Plan are 7.2% in normal scenario and 5.2% in low scenario and 5.5% and 4.4%, respectively, in the NMM.

Table 7: Comparison with the Tenth Plan[a]

(%)

		FY2003		FY2004		FY2005		FY2006		FY2007	
		Nor	Low	Nor	Low	Nor	Low	Nor	Low	Nor	Low
GDP growth	10th Plan	3.3	2.0	6.1	4.0	6.5	4.5	7.5	5.0	7.5	6.0
	NMM	3.6	3.6	3.5	3.5	7.4	6.5	3.9	2.8	5.2	3.9

[a] Nor and Low denote the normal scenario and the low scenario, respectively. FY2003 and FY2004 figures under NMM are actual figures.

VII. CONCLUSION

This paper describes a medium-sized Keynesian macroeconometric model of the Nepalese economy. The model is useful for policy simulations, economic planning and debt sustainability analysis. The new model and the Tenth Plan produce comparable forecasts, suggesting that the model demonstrates good forecasting capacity and versatile potential for policy simulations. The satisfactory within-sample forecasting capacity of the model is illustrated by conventional measures

of the predictive accuracy of the model such as root mean square percentage error, which were computed for several key variables in both static and dynamic runs of the model.

A comparison of the forecasts of the NMM with those of the Tenth Plan indicates that the growth projection of the Tenth Plan is overly optimistic compared with that of the NMM. The forecasting results show that political stability and the inflow of foreign borrowings are very important factors in determining the long run growth prospects for the Nepalese economy.

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LIST OF VARIABLES

Notation	Definition	Type	Unit
AMORT	Amortization		million NRs.
CAPREV	Sales of Fixed Assets or Capital Revenue	Exogenous variable	,,
CB	Current Account Balance		,,
CG	Real Government Consumption (94/95 base year)		,,
CP	Real Private Consumption (94/95 base year)		,,
CPI	National Urban Consumers' Price Index		95/96=100
CURREV	Current Revenue		million NRs.
DBORR	Domestic Financing		,,
DC	Domestic Credit		,,
DCG	Net Claims on Government		,,
DCO	Claims on Government Enterprises	Exogenous	,,
DCP	Claims on Private Sector		,,
DEVEXP	Development Expenditure	Policy variables	,,
DUM9498	Dummy for 1994~1998	Exogenous Variable	
DUM97	Dummy for 1997	Exogenous Variable	
DUM99	Dummy for 1999	Exogenous Variable	
ERA	Average Exchange Rate	Policy variables	NRs. per $
FAD	Foreign Aid Disbursement		million NRs.
FBORR	Foreign Borrowing	Policy variables	,,
FC	Real Gross Fixed Investment (94/95 base year)		,,
FCG	Real Government Fixed Investment (94/95 base year)		,,
FCP	Real Private Fixed Capital (94/95 base year)		,,
FDI	Foreign Direct Investment	Exogenous Variable	,,
FGRT	Grants	Exogenous Variable	,,
FLOANS	Foreign Loans		,,
GDP	Real GDP (base year 1994/95)		,,
GDPN	Nominal GDP		,,
GRANT	Grant of Foreign Aid Disbursement		,,
INDP	Indian CPI	Exogenous Variable	1995=100

(Continued on next page)

(table continued)

LIST OF VARIABLES

Notation	Definition	Type	Unit
INT	Lending Rates of Commercial Loans	Exogenous Variable	%
IS	Real Change in Stock (94/95 base year)	Exogenous Variable	million NRs.
KB	Capital and Financial Accounts Balance		,,
LINV	Loans and Investment	Exogenous Variable	,,
LLPAY	Lending Less Repayments		,,
LOAN	Loans of Foreign Aid Disbursements		,,
M2	Money Supply		,,
MIND	Merchandise Imports from India	Exogenous Variable	,,
MM	Real Imports of Goods and Non-Factor Services (-) (94/95 base year)		,,
MRUP	Merchandise Imports (CIF)		,,
NFA	Net Foreign Assets		,,
NOLCG	Official Loans (net) and Capital Grants		,,
NOLOANS	Official Loans (net)		,,
NSER	Services (net)	Exogenous Variable	,,
NTAX	Nontax Revenue		,,
NTRS	Transfers (net)	Exogenous Variable	,,
OB	Overall Balance or Change in Reserves		,,
OCGRANTS	Official Capital Grants		,,
OM2	Net Capital and Other Items (-)	Exogenous Variable	,,
OVSUR	Overall Balance		,,
OVSURFG	Overall Balance after Grants		,,
PCEO	Private Capital and Errors and Omissions	Exogenous Variable	,,
PGDP	GDP Deflator		94/95=100
PRPAY	Principal Repayments Received	Exogenous Variable	,,
REGEXP	Regular Expenditure	Policy variables	,,
STD	Real Statistical Discrepancy	Exogenous Variable	,,
TAX	Tax Revenue	Policy variables	,,
TB	Merchandise Trade Balance		,,
XIND	Merchandise Exports to India	Exogenous Variable	,,
XRUP	Merchandise Exports, FOB		,,
XX	Real Exports of Goods and Non-Factor Services (94/95 base year)		,,

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