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Acknowledgements

This paper was prepared as a background paper for the ongoing macro monitoring work on Nepal. It is a simple CGE model with basic distributional analysis, based on the '123 PRSP' model. It was presented in Nepal in December 2006 and had good feedback. We thank Abhishek Basnyat, Shanta Devarajan and the participants of the December 2006 Nepal seminar for their insights and comments. Errors are our sole responsibility.
# Table of Contents

1. Introduction .................................................................................................................. 1

2. The Model .................................................................................................................... 3
   2.1. Overall Structure ........................................................................................................ 3
   2.2. Macroeconomic Framework ...................................................................................... 4
   2.3. 1-2-3 Model ............................................................................................................. 5
   2.4. Long-Term Growth Projections ............................................................................... 5
   2.5. Short-Term VARs ..................................................................................................... 8
   2.6. Distributional Impact ............................................................................................... 9

3. Scenarios ....................................................................................................................... 10
   3.1. Static simulations .................................................................................................... 10
   3.2. Dynamic simulations .............................................................................................. 12

4. Conclusion .................................................................................................................... 15

5. References ................................................................................................................... 16

6. Annexes ....................................................................................................................... 17
A Simple Macroeconomic Model for Nepal

1. Introduction

South Asian economies have grown remarkably in the past two decades. This has even raised expectations that the coming decade could truly make a dent on poverty (Devarajan and Nabi, 2006). The growth experience in Nepal – which was with Sri Lanka one of the earliest and quickest liberalizer in the region – was in the 1980s and 1990s as encouraging as in neighboring countries – but these high levels could not be sustained in the 2000s, while growth in the other South Asian economies (notably in India, Figure 1) was further accelerating.

![Figure 1: GDP per capita Growth – India and Nepal](image)


At the same time, the incidence of poverty in Nepal declined from 42 percent in 1995/96 to 31 percent 2003/04 (World Bank, 2006). This strong performance can partly be attributed to economic growth, even though the investment climate gradually deteriorated with the intensification of the conflict. Another key factor driving the reduction in poverty incidence has been the rapid increase in remittances to more than 12 percent of GDP: an increasing numbers of Nepalis are going abroad to work particularly as low wage workers in India, Middle East countries, Malaysia, Korea and others. Other factors driving the significant reduction in poverty are an increase in agricultural real wages, increased urbanization and reduction in dependency ratios.

Questions about the sustainability of this trend are however numerous. Is the growth deceleration of the early 2000s leading to an increase in poverty? Can fiscal policy help accelerate the reduction in poverty? Other questions are raised about Nepal's external position, the role of remittances and the fluctuations of the real exchange rate. For instance, are the pressures on the exchange rate (with some real appreciation in recent years) having a further distributional impact? Are the increasing inflows of remittances (possibly coupled with increasing external assistance in the future) having an impact on the exchange rate (“Dutch disease”, by which inflows of foreign currency lead to a real appreciation of the national currency, which has a negative impact on exports)? These questions motivate this paper and the development of a framework linking the macroeconomic policy environment.
and poverty outcomes. Indeed, while a wide variety of macro-econometric and computable general equilibrium type models have been developed for Nepal, they have usually faced three key limits.

First, their usefulness has generally failed to transcend the immediate purpose or time for which they were initially built, mainly a reflection of their complexity. For example, the macro-model built by the Energy Commission Sector to forecast energy demand in 1987 was too parochial in its scope and although the multi-sector model developed by Khanal, Thapa and Elbers in 1987 had economy-wide coverage, its utility did not outlast the Seventh Plan. Similarly, a fairly comprehensive input-output matrix covering 39 sectors was developed by the Development Study Consultants in 1990, but the matrix has not been updated since then. Another notable work is the computable general equilibrium model that was developed under the auspices of the International Development Research Center’s (IDRC) Micro Aspects of Macro Adjustment Policies (MIMAP) to analyze the poverty impact of trade liberalization in Nepal in 2001. While this is perhaps the only work that models and combines the general equilibrium effects of macroeconomic policies with distributional effects, its coverage is limited to trade policies and it does not lend itself conveniently to generalizations over a broader set of macro policies.

Second, their complexity has also often limited their influence in policy dialogue. Macroeconomic shocks and policies have indeed complicated effects on growth and income distribution as they get transmitted through the economy. Policymakers in Nepal feel that there is a glaring absence of a rigorous framework to analyze the poverty and distributional impact of macroeconomic policies in Nepal and the proposed macroeconomic model is intended to be a contribution towards filling this void.

Third, complex models also require a detailed data input. Even if such data can be made available, the intensity of the effort required and the difficulty to update frequently this input reduce considerably the life expectancy of these complex models.

For that purpose, we use a model proposed by Devarajan and Go (2003) for Zambia and a few other PRSP countries. Drawing lessons from past endeavors to institutionalize such models into the government’s policymaking machinery, the proposed model should be simple, its data requirements not overly demanding, and its mechanics relatively easy to understand and use. Under these criteria, the 123-PRSP model seems appropriate for the kind of policy questions that this paper seeks to tackle. Here, we also highlight the potential usefulness of the model by reviewing a few policy questions related to oil prices, remittances, real exchange rate levels, public expenditures, and growth.

The paper is structured as follows. The next section reviews the model, its overall structure and its five main modules. The following section outlines a number of hypothetical scenarios and their growth and distributional implications. A final section concludes.
2. The Model

2.1. Overall Structure

The model is based on Devarajan and Go (2003). The objective of this model is to be a middle ground between existing macroeconomic consistency frameworks and multi-sector Computable General Equilibrium (CGE) models (with distributional analysis). It is a middle ground in the sense that it strikes a balance between complexity and simplicity, striving for an outcome easy to understand for policy makers which capture enough of the multiplicity of channels by which policies influence poverty.

The model works as follows (Figure 2):

- for each period, a simple static CGE model (called 1-2-3) generates a set of prices (wages, sector-specific profits, and relative prices) which is consistent with (i) a set of macroeconomic policies and (ii) external shocks; this block estimates the distributional effect of policies and external shocks, while being essentially growth-neutral;

- the same set of macroeconomic policies and external shocks generate a set of short- to medium-term GDP growth rates through two growth models (a short-term and a medium-term model); this block focuses only on growth, without distributional impact;

- both the growth trajectory over time and changes of relative prices have an impact on poverty through the combined effect of across-the-board income growth and changes in the distribution;

- consistency between both aspects is also maintained through a set of macroeconomic identities.

![Figure 2: Structure of the Nepal 123PRSP Model](source)

The balance of this section reviews the five subcomponents of this model.
2.2. Macroeconomic Framework

The macroeconomic framework is based on the RMSM-X model, maintained by the World Bank's Nepal economic country team. This framework is consistent with the macroeconomic scenario that underpins the IMF's program with the Government of Nepal (GoN).

- Real growth is expected to pick up from 2.5% to 4.5%, i.e. from around 0.5% to 2.5% in per capita terms. This is mainly based on an analysis of medium-term growth trends (see also Section 2.4). Growth in this scenario is notably driven by an increase in private investment, gradually leading to a rebound in exports.
- Inflation would remain under control at around 5%.
- Domestic revenues would gradually increase, but less than public expenditures, hence leading to a higher fiscal deficit. The increase in public expenditures would be driven by a mix of recurrent and capital spending.
- The current account would remain in surplus with further growth in remittances – but the trade deficit would further increase, the increase in exports being more than offset by strong demand for imports. The current account surplus would largely translate into an increase in gross reserves.

### Table 1: Macroeconomic Framework

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<tbody>
<tr>
<td>Real Growth (%)</td>
<td>4.5</td>
<td>5.3</td>
<td>3.4</td>
<td>3.4</td>
<td>2.5</td>
<td>3.0</td>
<td>3.0</td>
<td>4.0</td>
<td>4.5</td>
</tr>
<tr>
<td>Net Exports (% GDP)</td>
<td>(11.1)</td>
<td>(11.4)</td>
<td>(14.1)</td>
<td>(13.0)</td>
<td>(16.4)</td>
<td>(15.9)</td>
<td>(15.1)</td>
<td>(14.2)</td>
<td>(13.5)</td>
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<tr>
<td>Imports</td>
<td>31.7</td>
<td>37.7</td>
<td>36.1</td>
<td>38.6</td>
<td>31.8</td>
<td>31.2</td>
<td>33.1</td>
<td>32.5</td>
<td>31.7</td>
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<tr>
<td>Consumption (% GDP)</td>
<td>93.0</td>
<td>86.0</td>
<td>88.0</td>
<td>86.4</td>
<td>90.6</td>
<td>90.5</td>
<td>87.2</td>
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<td>11.1</td>
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<tr>
<td>Private</td>
<td>94.3</td>
<td>77.1</td>
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<td>75.2</td>
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<td>78.5</td>
<td>76.1</td>
<td>74.2</td>
<td>72.7</td>
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<td>Investment (% GDP)</td>
<td>18.1</td>
<td>25.3</td>
<td>26.1</td>
<td>26.5</td>
<td>25.7</td>
<td>25.3</td>
<td>27.9</td>
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<tr>
<td>Private</td>
<td>17.2</td>
<td>16.3</td>
<td>15.9</td>
<td>16.5</td>
<td>15.7</td>
<td>20.3</td>
<td>20.3</td>
<td>20.3</td>
<td>20.3</td>
</tr>
<tr>
<td>Net Exports (US$ million)</td>
<td>(563)</td>
<td>(496)</td>
<td>(812)</td>
<td>(928)</td>
<td>(904)</td>
<td>(1,096)</td>
<td>(1,193)</td>
<td>(1,287)</td>
<td>(1,408)</td>
</tr>
<tr>
<td>Net Income Receipts (US$ million)</td>
<td>(10)</td>
<td>8</td>
<td>9</td>
<td>(23)</td>
<td>24</td>
<td>26</td>
<td>27</td>
<td>29</td>
<td>30</td>
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<tr>
<td>Net Official Transfers (US$ million)</td>
<td>38</td>
<td>102</td>
<td>145</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
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<tr>
<td>Net Private Transfers (US$ million)</td>
<td>61</td>
<td>309</td>
<td>837</td>
<td>1,610</td>
<td>1,174</td>
<td>1,244</td>
<td>1,350</td>
<td>1,400</td>
<td>1,488</td>
</tr>
<tr>
<td>Current Account Balance (US$ million)</td>
<td>(294)</td>
<td>(28)</td>
<td>150</td>
<td>200</td>
<td>406</td>
<td>370</td>
<td>348</td>
<td>341</td>
<td>311</td>
</tr>
<tr>
<td>Gross Reserves (US$ million)</td>
<td>302</td>
<td>657</td>
<td>1,184</td>
<td>1,478</td>
<td>1,546</td>
<td>1,598</td>
<td>1,737</td>
<td>1,803</td>
<td>1,641</td>
</tr>
<tr>
<td>Consumer Price Index (%)</td>
<td>9.7</td>
<td>8.1</td>
<td>4.7</td>
<td>4.0</td>
<td>4.1</td>
<td>5.0</td>
<td>5.5</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Exchange Rate (N. Re / US$: average)</td>
<td>28.6</td>
<td>57.0</td>
<td>77.8</td>
<td>73.3</td>
<td>72.0</td>
<td>71.7</td>
<td>73.0</td>
<td>78.8</td>
<td>77.0</td>
</tr>
</tbody>
</table>

*Source: World Development Indicators, Staff estimates.*

This baseline scenario is contingent on a number of factors, in particular improvement in the political and security situation. This would drive an improvement in the investment climate and better demand prospects, hence leading firms to increase investment. Better security

1. Currently the year 2003/04 is used as a base year. This makes the base year consistent with the most recent household survey (NLSS II, cf. World Bank, 2006). Once estimates of the national accounts are finalized for subsequent years, this could be updated to make 2004/05 or 2005/06 the base year.
2. The consistency framework allows to review implications of the policies and shocks on monetary accounts. However, none of the blocks explicitly deal with monetary issues (they all work in real terms).
would also ease the recent inflationary pressures. It would also reduce the pressure on recurrent expenditures in the security sector, while allowing further revenue growth and implementation of capital expenditures. The nominal exchange rate is assumed to remain pegged to the Indian Rupee.

2.3.  1-2-3 Model

The 1-2-3 Model is a simple, spreadsheet-based CGE model (Devarajan, Lewis, Robinson, 1990). Its name refers to its simple structure, covering 1 country, 2 sectors (exports vs. all other final goods produced, called domestic goods), and 3 commodities (domestic, imports, and exports). It captures the impact of macroeconomic policies on the relative price of the domestic good to either exports or imports, a relative price which can be interpreted as a real exchange rate (see the equations in annex).

The outcome of the model is a set of relative prices, sector-specific profits and wages that are consistent with the calibration of the model. The equilibrium is reached by setting the prices that are driving (i) the productive allocation between domestic goods and exports and (ii) the consumption allocation between domestic goods and imports. Government and households are subject to a budget constraint. In addition, there is an external balance constraint (with the current account being equal to an exogenous level of foreign savings). The model assumes that, behind the goods sectors, the labor market is competitive and the equilibrium wages bring the market to full employment. Capital is assumed to be fixed and sector-specific.

In its static version, the model is calibrated with a small set of macroeconomic indicators (all from the national accounts). In addition, the calibration requires two elasticities, the elasticity of transformation between the two production sector (domestic goods and exports) and the elasticity of substitution in the utility function between the two goods used in the country (domestic goods and imports). For Nepal, both are set at 0.60 (see Devarajan, Go, Li, 1999).

In our model, based on the 123PRSP framework, this static model is run for each year of the simulation (it still remains a static model as there is no intertemporal maximization or constraint). In other words, the model is calibrated for each year with the baseline macroeconomic framework (Section 2.2), which, in variant analysis, is adjusted by either long-term growth projections or short-term shock impacts (see next two sub-sections).

2.4.  Long-Term Growth Projections

An alternative to the base case growth projections is to use a model for medium- to long-term growth. Our model uses a module developed by Ianchovichina and Kacker (2005). It is based on cross-country growth regressions (cf. Loayza et al., 2005, using GMM systems estimators on a 5-year average panel dataset). The key drivers are shown in Table 2 (and data sources are presented in Box 1) and include: initial conditions (level of income per capita and output gap vs. potential output); macroeconomic environment (terms of trade; real exchange rate; volatility; trade openness; banking crises; financial sector); human and physical capital endowment (education; telephone); and role of Government (governance and government consumption).
As shown in Table 2 and Figure 3, the model – which is estimated on a panel of countries, not on Nepal only – has a good fit for Nepal in the past, with an underestimation of the growth acceleration in the first half of the 1970s and an overestimation of growth since the mid-1990s. The latter gap is likely to be related to the political and security issues that Nepal confronted during the recent period: assuming a brighter future for the country from that point of view, the model can be expected to generate realistic projections for the future (a "peace and stability" growth dividend).

### Table 2: Long-Term Growth Projections

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</thead>
<tbody>
<tr>
<td>Initial GDP-Per Capita (US$)</td>
<td>865</td>
<td>893</td>
<td>965</td>
<td>877</td>
<td>908</td>
<td>946</td>
<td>1,081</td>
<td>1,172</td>
<td>1,233</td>
</tr>
<tr>
<td>Initial Output Gap</td>
<td>2.2%</td>
<td>1.1%</td>
<td>0.1%</td>
<td>-2.7%</td>
<td>1.2%</td>
<td>-1.3%</td>
<td>-0.1%</td>
<td>1.8%</td>
<td>-1.2%</td>
</tr>
<tr>
<td>Education: Secondary Enrollment</td>
<td>14.2</td>
<td>14.2</td>
<td>15.1</td>
<td>14.9</td>
<td>21.7</td>
<td>28.4</td>
<td>36.4</td>
<td>37.4</td>
<td>41.9</td>
</tr>
<tr>
<td>Financial Depth: Private Domestic Credit/GDP</td>
<td>1.3</td>
<td>2.0</td>
<td>4.0</td>
<td>5.0</td>
<td>6.0</td>
<td>11.1</td>
<td>14.5</td>
<td>25.5</td>
<td>14.3</td>
</tr>
<tr>
<td>Trade Openness: Trade Volume/GDP</td>
<td>56.4</td>
<td>60.4</td>
<td>58.1</td>
<td>58.8</td>
<td>58.5</td>
<td>58.2</td>
<td>60.3</td>
<td>68.6</td>
<td>71.3</td>
</tr>
<tr>
<td>Government Burden: Government Consumption/GDP</td>
<td>7.1</td>
<td>7.7</td>
<td>8.3</td>
<td>7.7</td>
<td>8.3</td>
<td>9.3</td>
<td>8.4</td>
<td>9.1</td>
<td>9.8</td>
</tr>
<tr>
<td>Public Infrastructure: Main Telephone Lines per 1000 people</td>
<td>0.79</td>
<td>1.16</td>
<td>1.44</td>
<td>0.92</td>
<td>0.93</td>
<td>1.85</td>
<td>3.57</td>
<td>7.49</td>
<td>13.07</td>
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<tr>
<td>Governance</td>
<td>(1.24)</td>
<td>(1.24)</td>
<td>(1.24)</td>
<td>(1.24)</td>
<td>(1.24)</td>
<td>(1.24)</td>
<td>(1.24)</td>
<td>(1.24)</td>
<td>(1.24)</td>
</tr>
<tr>
<td>Lack of Price Stability: 100-Inflation Rate</td>
<td>103.34</td>
<td>105.06</td>
<td>110.57</td>
<td>105.06</td>
<td>110.56</td>
<td>111.13</td>
<td>111.36</td>
<td>107.91</td>
<td>103.48</td>
</tr>
<tr>
<td>Cyclical Volatility: S.D. Of Output Gap</td>
<td>2.0%</td>
<td>2.4%</td>
<td>2.3%</td>
<td>0.7%</td>
<td>3.2%</td>
<td>1.4%</td>
<td>1.1%</td>
<td>0.8%</td>
<td>1.7%</td>
</tr>
<tr>
<td>Real Exchange Rate: 2000=100</td>
<td>194</td>
<td>204</td>
<td>218</td>
<td>193</td>
<td>170</td>
<td>149</td>
<td>109</td>
<td>67</td>
<td>86</td>
</tr>
<tr>
<td>Systemic Banking Crisis</td>
<td>-0.5%</td>
<td>-1.4%</td>
<td>-5.2%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>-2.0%</td>
<td>0.4%</td>
</tr>
<tr>
<td>Terms of Trade Growth</td>
<td>-0.8%</td>
<td>-1.4%</td>
<td>-5.2%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>-2.0%</td>
<td>0.4%</td>
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</table>

**Per capita growth**

<table>
<thead>
<tr>
<th></th>
<th>0.2%</th>
<th>0.9%</th>
<th>0.3%</th>
<th>2.6%</th>
<th>0.8%</th>
<th>2.9%</th>
<th>3.0%</th>
<th>1.5%</th>
<th>1.2%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>0.7%</td>
<td>0.2%</td>
<td>1.3%</td>
<td>0.7%</td>
<td>2.5%</td>
<td>3.8%</td>
<td>3.2%</td>
<td>2.2%</td>
<td>2.3%</td>
</tr>
</tbody>
</table>

**Source:** Ianchovichina and Kacker (2005).

### Box 1: Data Source for Long-Term Projections

The key variables used in the long-term projections are discussed in this box. Ianchovichina and Kacker (2005) presents more details on these variables and highlight how many of these are highly correlated with other potential proxies (e.g. telephone lines with other public infrastructure indicators).

- **Output Gap**: difference between the log of actual per capita GDP and the log of potential (trend) per capita GDP at the start of the period. The trend is identified using the Baxter-King filter.
- **Main Telephone Lines per 1000 People**: telephone mainlines are the lines connecting a customer's equipment to the public switched telephone network; from WDI (for the 1975-2002) and the GDN dataset for (1960-1975).
- **Secondary Enrollment**: ratio of total secondary enrollment, regardless of age, to the population of the age group that officially corresponds to that level of education. From WDI and the GDN dataset.
- **Private Domestic Credit/GDP**: ratio of the stock of claims on the private sector by deposit money banks and other financial institutions to GDP. Main data sources are Beck et al. (2000) and the WDI.
- **Trade Volume/GDP**: residual of a regression of the log of the ratio of trade (exports and imports) to GDP on the logs of area and population, and dummies for oil exporting and landlocked countries. Based on data from World Development Network (2002) and the World Bank (2002).
- **Terms of Trade Growth**: World Development Indicators and the GDN dataset.
- **Government Consumption/GDP**: ratio of government consumption to GDP from the WDI.
- **100+Inflation Rate**: Inflation – an indicator of macroeconomic stability – is measured by the consumer price index from WDI.
- **Standard Deviation (S.D.) of Output Gap**: by-product of the procedure to construct output gap.
- **Real Exchange Rate, 1995=100**: (measure for external imbalances and the risk of balance-of-payments crises): GDN dataset and WDI. An increase in the index indicates an appreciation.
- **Systemic Banking Crisis**: number of years in which a country underwent a systemic banking crisis relative to the number of years in the corresponding period. The source for these data is the WB dataset of banking crises.
Moving forward, a first set of projections assumes no progress in the underlying drivers of growth (left panel of Figure 4). This leads to a projection of less than 1% of per capita growth per annum, with fairly small confidence intervals (population growth is around 2.2% per annum, hence total real economic growth would be around 3%).³

In a high-case scenario, we assume the following:

- Secondary enrollment increases by 5 percentage points a year, which would be short of Government's objectives, but is in line with recent progress;
- A similar trend is assumed for infrastructure;
- Government consumption is somewhat reduced, with lower needs for security expenditures, a rationalization of some programs, somewhat offset by higher allocations for operations and maintenance of infrastructure and recurrent costs for health and education;
- Governance is assumed to gradually improve;
- Inflation remains around 5%, but growth volatility is reduced to levels observed in the 1980s; and
- The real exchange rate and terms of trade stay constant.

³The confidence intervals are computed following the method in Kraay and Monokroussos (1999) which assumes that there is no uncertainty associated with the forecasted explanatory variables and the parameter estimates other than the transitional convergence effect. The formula for the 60% confidence interval is presented in Ianchovichina and Kacker (2005).
This leads to a second set of projections with growth picking up toward 2% per year and per capita (right panel of Figure 4). The baseline scenario (Section 2.2) is consistent with this second set of long-term growth projections.

2.5. Short-Term VARs

In addition to the central scenario discussed above for the short to medium term (Table 1) and the medium to long-term projections (Figure 4), the 123PRSP model includes the simulation of two different short-term shocks on the economy. This simulation is done through two trivariate autoregressive models (Vector Auto Regression, or VAR), as presented in Table 3.

First, a change in the real exchange rate\(^4\) would have a number of implications. Based on these estimated VARs, a positive shock (appreciation) has a negative impact on GDP growth the first year (a 10% appreciation reduces growth by 0.89 percentage points the first year), even though the impact is slightly reversed the second year. This reflects a typical J-curve reaction, where the trade deficit initially improves after the appreciation (because of price stickiness, volumes of imports and exports are initially unaffected, and the only effect is on prices, the appreciation making imports cheaper and exports more profitable) before deteriorating (as volumes of imports, which are now cheaper, increase and volumes of exports, now less competitive, decreases). In this case, the net effect of an appreciation is a deterioration in the current account balance (which assumes that the Marshall-Lerner holds—i.e. the sum of the demand elasticities to import and export is above 1).\(^5\)

<table>
<thead>
<tr>
<th>Table 3: Short-Term Growth Elasticities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shock on Real Exchange Rate</td>
</tr>
<tr>
<td>Shock on Government Expenditures</td>
</tr>
</tbody>
</table>

Note (a) Impulse response from the VAR for the first two periods; (b) RER is calculated as the trade weighted (share in total trade) average of bilateral RERs with two trading partners, India and the Rest of the World. Indian WPI, US CPI and US$ proxy for Indian prices, world prices and the world exchange rate respectively. Nepali CPI is used to capture domestic price movements in Nepal. Source: Authors' calculations (see Annex).

To link this simulation with the 123 model, it is assumed that the real appreciation would be caused by a terms of trade shock that would reduce (in real domestic terms) import prices (with an elasticity assumed to be 0.6) and increase export prices (with an elasticity assumed to be 0.2).\(^6\)

Second, a temporary increase in government expenditures would have a positive impact on GDP, with a multiplier effect (10% increase in expenditures translating in 12.4 points of GDP growth) in the first year, part of which is offset in the subsequent two years. To link

\(^4\) The real exchange rate is defined as the nominal exchange rate (foreign currency per unit of Nepali rupee) multiplied by the ratio of prices in Nepal over prices in other countries. An increase indicates an appreciation of the real exchange rate. The effective exchange rate is based on India and the US (the latter being used as a proxy for the rest of the world).

\(^5\) Thapa (2002) indeed concludes that this condition is met in the case of Nepal.

\(^6\) In both cases, it is assumed that firms do not fully pass through the change in exchange rate, with importers reducing their margins to remain competitive and exporters increasing their margins. Ideally, the VAR would directly link GDP to terms of trade: however such link was not directly significant with Nepal's data.
this with 123 model, it also assumed that such shock increases equally capital and recurrent expenditures, and that it also leads to an increase in the fiscal deficit.

Similar simulations were run for a number of other combinations of policy variables such as agricultural GDP (subject to exogenous climatic shocks), government consumption – which would presumably have a greater impact on short term growth – Indian GDP growth rate and the growth rate of Indian demand (the last two are key drivers of the external demand to Nepal). However, the impulses generated through the combination of these variables were not strong enough to generate enough variance in the poverty outcomes if they were transmitted through the system.

2.6. Distributional Impact

The final block of the 123PRSP model is related to the distributional analysis. This module is based on household data from the Nepal Living Standard Survey (NLSS, 2004/05). To map this data with results from the other blocks, changes in household utility is decomposed in three terms:

- the relative change in wages, weighted by salaries in the economy (average wage times labor supply)
- change in profits;
- minus changes in relative prices, weighted by the demand for each commodity.

To assess changes in utility for each decile, this approach requires decomposing wages, profits in the domestic sector, profits in the export sector, domestic expenditure for the import commodity, and domestic expenditure for the domestic commodity. This data is summarized in Table 4 below.

In terms of income, profits from the domestic sector, which includes traditional sectors (and agriculture), are a high proportion of income for the poorest, while profits from the export sector is biased toward richer deciles. Wages are somewhere in the middle, with the highest proportion toward the 3rd decile. With respect to expenditures, the proportion of imported goods in total consumption increases steadily throughout the income distribution, with poor household having virtually no access to them.

This pattern has important implications for the model. In particular, a real appreciation of the exchange rate will make imported goods cheaper relative to domestic goods, hence benefit mainly the less poor; at the same time, the poor, who get a relatively higher proportion of their income from profits in the domestic sector, will be relatively worse off.

---

7 This can be derived by looking at household's indirect utility as a function of wages, profits, and prices, differentiating this function, and applying Shephard's Lemma.
3. Scenarios

3.1. Static simulations

We first run a few simple static simulations (using 2004 as base year, cf. Table 5):  

- First, we increase the nominal exchange rate by 20%. Since this is the numeraire in the model, it implies that all prices and incomes increase by 20% as well, leaving all quantities unchanged.

---

7 In all these simulations, the user needs to define the “closure” of the model. As a base case, we always assume that savings are fixed – hence the adjustment is made on investment. In some cases, we suggest the implication of an adjustment on savings (with investment fixed), for instance through a change in foreign savings (current account).
Table 5: Static Scenarios

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>3bis</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Import</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prices</td>
<td>20.0%</td>
<td>20.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>-4.5%</td>
</tr>
<tr>
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<td>6.4%</td>
<td>0.9%</td>
<td>0.9%</td>
</tr>
<tr>
<td>Exports</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Prices</td>
<td>20.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Volume</td>
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<td>3.3%</td>
<td>-4.2%</td>
<td>-0.6%</td>
<td>1.2%</td>
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<tr>
<td>Domestic Goods</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prices</td>
<td>20.0%</td>
<td>-6.6%</td>
<td>9.1%</td>
<td>1.2%</td>
<td>-2.5%</td>
</tr>
<tr>
<td>Volume</td>
<td>0.0%</td>
<td>-0.8%</td>
<td>1.0%</td>
<td>0.1%</td>
<td>-0.3%</td>
</tr>
<tr>
<td>Real Wages</td>
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<td>7.4%</td>
<td>1.0%</td>
<td>-2.0%</td>
</tr>
<tr>
<td>Real Income</td>
<td>0.0%</td>
<td>-5.0%</td>
<td>-1.1%</td>
<td>-0.2%</td>
<td>0.4%</td>
</tr>
<tr>
<td>Expenditures</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Top 20</td>
<td>0.0%</td>
<td>-6.6%</td>
<td>3.2%</td>
<td>0.4%</td>
<td>-1.1%</td>
</tr>
<tr>
<td>Bottom 20</td>
<td>0.0%</td>
<td>-8.8%</td>
<td>3.9%</td>
<td>0.5%</td>
<td>-1.0%</td>
</tr>
<tr>
<td>Income</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Top 20</td>
<td>0.0%</td>
<td>-4.5%</td>
<td>-1.8%</td>
<td>-0.3%</td>
<td>0.6%</td>
</tr>
<tr>
<td>Bottom 20</td>
<td>0.0%</td>
<td>-6.3%</td>
<td>0.6%</td>
<td>0.1%</td>
<td>-0.1%</td>
</tr>
<tr>
<td>Poverty</td>
<td>32.0%</td>
<td>35.5%</td>
<td>31.5%</td>
<td>32.0%</td>
<td>32.0%</td>
</tr>
<tr>
<td>Gini (income)</td>
<td>24.5</td>
<td>24.7</td>
<td>24.3</td>
<td>24.5</td>
<td>24.6</td>
</tr>
</tbody>
</table>

Note: the calculations on poverty and gini coefficients are illustrative.

- Second, we assume a 20% increase in the overall price of imports (e.g. impact of large increase in international oil prices). This leads to a 15% decrease in imports as assuming no change in foreign savings (hence in the current account) – the country can afford less imports (the impact would be dampened had we assumed an adjustment through higher foreign savings). This is offset by a small (3%) increase in exports to increase Nepal’s capacity to buy imports. To ensure this reallocation of resources to the export sector, the price of domestic goods has to decrease – its decrease relative to the price of exports means a depreciation of the real exchange rate. This also leads to a decrease in the demand for domestic goods – but it is very small (less than 1%). The income and expenditure of poorer households suffer most from the shock. Hence both the overall reduction in income (about 5%) and the negative distributional impact add up to an increase in poverty.

- Third, we assume a 20% increase in private transfers (e.g. remittances). With the current account (or foreign savings) fixed, this allows the trade balance to deteriorate, hence imports can increase (6%). But it also allows more consumption, hence a larger supply of domestic goods, which drives an increase in the price of domestic goods. This drives away resources from the export sector (through an decrease in the relative price of exports), hence leading to a lower volume of exports (4%). This has a redistributive impact, as all income increases but the reduction in exports penalizes richer households. Overall poverty is reduced, but only slightly because of the impact of the exchange rate appreciation (“Dutch disease”).

Given the construction of the model, the impact of an increase in official grants has broadly speaking the same impact (but the impact is of a lower magnitude since a
20% increase in official grants implies, in absolute terms, a smaller impact than a 20% increase in private transfers.9

Finally, to assess the impact of the recent trade liberalization in Nepal, we assume a reduction of import tariff rates (from the current effective rate of 10% to 5%). This makes imports cheaper, leading to additional consumption (at the expense of investment) and a substitution of imports for domestic goods: imports increase by 1%. This leads to a lower price of domestic goods – a depreciation of the real exchange rate which benefits the export sector (also increasing by 1%), allowing the current account to remain balanced.10 However, we assume that the reform is financed by an increase in VAT: this leads to an increase in domestic prices, which reduced the impact on poverty. Overall, despite a small increase in income inequality, poverty remains constant.

3.2. Dynamic simulations

In this section, we review the implications of the medium-term base case (Section 2.2.) and of a number of scenarios as deviation from this base case. The base case assumes that real economic growth picks from around 2.5% to 4.5% in the next four years (around 0.5% to 2.5% in per capita terms), which is consistent with a slow improvement in the drivers of growth (Figure 4).

In this base case, real income increases with economic growth for all deciles (Table 6). The appreciation of the real exchange rate in this base case leads to some distributional shift, with the income of the richer deciles increasing (more dependent on exports) somewhat less than the income of poorer deciles (and a smaller opposite effect on expenditures, as richer deciles tend to consume more imports which are made relatively cheaper by the real appreciation). The effect leads to a small reduction in inequality (contrary to the increase observed between 95/96 and 03/04). Illustratively, this could lead to a reduction of poverty incidence from 32% to 24% in 5 years (cf. Figure 5). This would be a reduction of a magnitude similar to the previous five years.

---

9 There is however a different composition in the increase in income, with a higher proportion of consumption in the case of private transfers and a higher proportion of investment in the case of official grants, which presumably would have an impact over the long run in a dynamic simulation. Although the model does not capture this stylized fact, it is likely that an increase in official grants will have a lower import content than an increase in private transfers.

10 The increase of exports as a result of import tariff liberalization (i.e. “import tariffs are a tax on export”) is a standard result of such model. This largely disappears if the foreign savings can be adjusted: then the higher demand for imports is financed by more foreign borrowing, with almost no impact on exports.
Let us now assume that the new Government builds a budget with a 15% increase in expenditures (spread equally over recurrent and capital expenditures). This could for instance be viewed as the impact of more security spending or additional development investment. We assume that total investment adjusts to available savings (hence more public investment leads to less private investment, cf. footnote 8 on closure). The impact is as follows:

- GDP growth accelerates in the short-run (cf. VAR model in Section 2.5), but this is partly offset by subsequent declines after the temporary budget increase;

- The fiscal deficit blooms the first year. The assumption is that the access to foreign borrowing remains constant as a share of GDP. Hence the deterioration of the fiscal deficit raises issues of sustainability;

- Given the large savings rate of the private sector, the increase in GDP leads to an increase in private savings which more than offset the reduction in government savings. As a result, even though the current account (i.e. foreign savings) is fixed, investment can increase slightly (less than 1%) despite the lower government savings;

- The first year, there is a small depreciation of the exchange rate, which benefits the export sector;

- As a result, although the budget increase benefits the whole distribution through its short-term Keynesian effect, richer households benefit more from the accelerated growth of the export sector. As a result, the poverty headcount is reduced by an additional ½ point – i.e. the initial growth impact is somewhat offset by the subsequent slow-down and the distributional impact of the exchange rate depreciation.
If all this increase goes to very effective expenditures, we could assume that after this increase in expenditures (and its short-term demand effect) growth potential is increased, leading to a sustained increase in the growth rate. This would further reinforce the impact on poverty.

We now turn to a second scenario, with an appreciation of the exchange rate of 10% in 2006 and 2007 (resulting from a terms-of-trade shock, see Section 2.5). This can be viewed as analyzing the impact of the real appreciation that occurred when inflation pressures developed in Nepal in 2005 and 2006 (oil shock, supply constraints, etc.) while the currency remained pegged to the Indian rupee and inflation was steady in India. The impact is as follows (again assuming that investment adjusts to savings):

- GDP growth deteriorates by around 1% per year (cf. VAR, Section 2.5);
- The appreciation has a negative impact on external competitiveness, hence constraining exports (despite reallocations to reduce the price of exports in local currency). Imports on the other hand are boosted by their lower relative price (and despite overall lower demand).
- Lower relative domestic prices lead to an increase in private consumption (despite the overall decrease in GDP), which has a positive effect throughout the distribution (but with a higher impact on the poorest);
- Lower growth reduces household income, with the richest suffering most given the impact on the export sector: hence the overall distributional effect is more favorable for the poorest than for the richest;
- As a result, the poverty headcount would decrease by 1½ pt less than in the baseline in this scenario, despite a lower Gini;
- Let us finally note that the opposite scenario, a depreciation of the exchange rate, would have symmetric effect, boosting growth in the short-term, with expenditure...

**Table 6: Dynamic Scenarios**

<table>
<thead>
<tr>
<th></th>
<th>Base case</th>
<th>2</th>
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<tbody>
<tr>
<td></td>
<td>2004</td>
<td>2009</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Import</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prices</td>
<td>17.1%</td>
<td>18.3%</td>
<td>1.2%</td>
<td>14.2%</td>
</tr>
<tr>
<td>Volume</td>
<td>19.3%</td>
<td>21.5%</td>
<td>2.2%</td>
<td>26.3%</td>
</tr>
<tr>
<td><strong>Exports</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prices</td>
<td>29.8%</td>
<td>31.1%</td>
<td>1.3%</td>
<td>15.9%</td>
</tr>
<tr>
<td>Volume</td>
<td>12.5%</td>
<td>16.3%</td>
<td>3.8%</td>
<td>9.0%</td>
</tr>
<tr>
<td><strong>Domestic Goods</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prices</td>
<td>29.5%</td>
<td>29.2%</td>
<td>-0.3%</td>
<td>30.1%</td>
</tr>
<tr>
<td>Volume</td>
<td>19.5%</td>
<td>22.6%</td>
<td>3.1%</td>
<td>17.8%</td>
</tr>
<tr>
<td><strong>Real Wages</strong></td>
<td>1.6%</td>
<td>1.5%</td>
<td>-0.1%</td>
<td>1.4%</td>
</tr>
<tr>
<td><strong>Real Income</strong></td>
<td>17.3%</td>
<td>20.9%</td>
<td>3.6%</td>
<td>14.3%</td>
</tr>
<tr>
<td><strong>Expenditures</strong></td>
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<td></td>
</tr>
<tr>
<td>Top 20</td>
<td>17.8%</td>
<td>20.4%</td>
<td>2.7%</td>
<td>19.6%</td>
</tr>
<tr>
<td>Bottom 20</td>
<td>17.6%</td>
<td>20.1%</td>
<td>2.5%</td>
<td>20.4%</td>
</tr>
<tr>
<td><strong>Income</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Top 20</td>
<td>16.8%</td>
<td>20.6%</td>
<td>3.8%</td>
<td>13.5%</td>
</tr>
<tr>
<td>Bottom 20</td>
<td>18.5%</td>
<td>21.6%</td>
<td>3.2%</td>
<td>16.3%</td>
</tr>
<tr>
<td><strong>Poverty</strong></td>
<td>32.0%</td>
<td>23.5%</td>
<td>22.0%</td>
<td>-1.5%</td>
</tr>
<tr>
<td>Gini (Income)</td>
<td>24.3</td>
<td>24.4</td>
<td>24.5</td>
<td>0.1</td>
</tr>
</tbody>
</table>

Note: The calculations on poverty and gini coefficients are illustrative.
switching to domestic goods and production switching to exports, leading to a further reduction in poverty.

Finally, assuming we move to a higher-case growth scenario, with an additional 2% growth every year from 2005 to 2009 (hence above the high-case scenario in Figure 4), the poverty impact is even larger:

- By assumption, GDP growth is 2% higher every year, which reinforces the effect on poverty reduction;
- There is a slight shift from domestic production to exports, which has a distributional impact favoring richer households.

4. Conclusion

The simple model discussed in this paper is a good vehicle to highlight in a simple way some of the complex transmission mechanisms of economic policy to poverty. It raises a number of interesting questions with tentative quantified answers. First, not surprisingly, economic growth is a key driver to poverty reduction. From that point of view, the long-term growth model gives an interesting perspective on the impact of the conflict and political instability on economic outcomes and the potential prospects for a “peace dividend”. Second, through its implications on economic growth, both its level and composition (distributional effect), the real exchange rate is a key transmission mechanisms and cannot be ignored in the analysis of policies. This has important implications for the analysis of increased inflows of foreign currency – be it private remittances or public external assistance.

By developing a simple model, this work is expected not only to enhance the capacity to address selected policy issues, but also to generate a higher demand for such analytical work to inform policy choices. The next step with this simple model is therefore to expose it to a wide range of potential stakeholders to get their views and insights and assess how it can potentially help informing policy debates.

With respect to the model itself, it is of course tempting to refine in by adding to its complexity – looking at more sectors, refining the concept of poverty, introducing a refined dynamic in the model (notably about the impact of public investment on growth), etc. But this would of course be to the detriment to its simplicity. Hence the priority might be to expand the library of simulations done with this model, possibly adding some sensitivity analysis (on some of the key elasticities, the closure used, the quality of the underlying macro scenario, the assumptions required to calculate the distribution of income and expenditures by sector and commodity, etc.), and a number of other simulations (notably the VARs). Selected refinements can then be considered as long as they preserve the simplicity of the model.
5. References


Government of Nepal (200x), NLSS II.


6. Annexes

123 Model:

Real Flows
(1) \( X = G(E, D^A, \Omega) \)
(2) \( Q^A = F(M, D^A, \alpha) \)
(3) \( Q = C + Z + G \)
(4) \( ED^A = g(P^A, P) \)
(5) \( MD^A = f(P^A, P) \)

Nominal Flows
(6) \( T = f^R R \cdot pw^M - M + f^P P^A + f^Y Y - f^E E \cdot pw^E \cdot E \)
(7) \( Y = P^X X + tr \cdot P^A + re \cdot R \)
(8) \( S = s \cdot Y + R \cdot B + S^S \)
(9) \( C^P = (1 - s - t \gamma) \cdot Y \)

Prices
(10) \( P^M = (1 + f^R) \cdot R \cdot pw^M \)
(11) \( P^A = (1 + f^P) \cdot R \cdot pw^A \)
(12) \( P^A = (1 + f^P) \cdot P^A \)
(13) \( P^A = g_s(P^A, P) \)
(14) \( P^A = f(P^A, P) \)
(15) \( R = 1 \)

Equilibrium Conditions
(16) \( D^P - D^B = 0 \)
(17) \( Q^P - Q^B = 0 \)
(18) \( pw^M \cdot M - pw^E \cdot E - R \cdot re = B \)
(19) \( P^A \cdot Z - S = 0 \)
(20) \( T - P^A - tr \cdot P^A - R \cdot S^S = 0 \)

Accounting Identities
(i) \( P^X = P^* E + P^* D^B \)
(ii) \( P^A Q^B = P^M \cdot M + P^D D^P \)

Exogenous Variables:
- \( pw^M \): World price of import good
- \( pw^A \): World price of export good
- \( f^R \): Tariff rate
- \( f^P \): Export subsidy rate
- \( f^s \): sales/excise/value-added tax rate
- \( f^t \): direct tax rate
- \( tr \): government transfers
- \( ft \): foreign transfers to government
- \( re \): foreign remittances to private sector
- \( s \): Average savings rate
- \( X \): Aggregate output
- \( G \): Real government demand
- \( B \): Balance of trade
- \( \Omega \): Export transformation elasticity
- \( \alpha \): Import substitution elasticity

Endogenous Variables:
- \( E \): Export good
- \( M \): Import good
- \( D^A \): Supply of domestic good
- \( D^B \): Demand for domestic good
- \( E \): Supply of composite good
- \( Q^A \): Demand for composite good
- \( P^A \): Domestic price of export good
- \( P^B \): Domestic price of import good
- \( P^A \): Producer price of domestic good
- \( P^E \): Sales price of composite good
- \( P^X \): Price of aggregate output
- \( P^E \): Price of composite good
- \( E \): Exchange rate
- \( T \): Tax revenue
- \( S^A \): Government savings
- \( Y \): Total income
- \( C \): Aggregate consumption
- \( S \): Aggregate savings
- \( Z \): Aggregate real investment

Source: Devanajan and Go (2003).