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Trade Liberalisation and Poverty in Nepal
A Computable General Equilibrium Micro Simulation Analysis[*]

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Concern is growing regarding the poverty impacts of trade liberalization. The strong general equilibrium effects of trade liberalization can only be properly analysed in a CGE model. However, the aggregate nature of CGE models is not suited to detailed poverty analysis. We bridge this gap by constructing a CGE model that explicitly models all households from a nationally representative household survey. We find complex income and consumption effects that would be missed in standard CGE models. Urban poverty falls and rural poverty increases as initial tariffs were highest for agriculture. Impacts increase with income level, resulting in rising income inequality.

Keywords: computable general equilibrium modelling, international trade, poverty, Nepal.

JEL: D33, D58, E27, F13, F14, I32, O15, O53

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1. Introduction

In recent years, the impacts of macro-economic shocks, such as fiscal reform and trade liberalisation, on income distribution and poverty have become the subject of intense debate. Which tax regime is most equitable? Do the poor share in the gains from freer trade? What alternative or accompanying policies could be used to ensure a more equitable distribution? What are the mechanisms involved?

From a research perspective, the analysis of macroeconomic shocks and the analysis of income distribution and poverty use very different techniques and sources of data. Given its economy-wide nature and the strong general equilibrium effects they imply, the impacts of macroeconomic shocks are ideally examined in the context of a computable general equilibrium (CGE) model based on national accounting data. In contrast, income distribution and poverty issues are generally analysed on the basis of household or individual data in recognition of the heterogeneity of these agents and the importance of capturing their full distribution. A variety of income and, more recently, multidimensional indicators are used in this poverty analysis.

In this study we attempt to meld these two currents. By explicitly integrating into a CGE model **all** households from a national household survey, we are able to simulate how each individual household is affected by trade liberalisation. Each household is characterised primarily by its sources of income and consumption patterns. Conceptually speaking, we replace the representative household(s) of a conventional CGE by a nationally representative sample of actual households to construct a CGE micro-simulation model. In this way, we are able to simulate the impact of macroeconomic shocks on conventional poverty and distributional indicators. Indeed, we generate all the individual household income and consumption data required to calculate and compare these indicators under alternative policy scenarios. Furthermore, we demonstrate that the technique is easy to implement and requires only a standard CGE model and a nationally representative household survey with information on household income and consumption.

The technique is illustrated through the analysis of the elimination of all import tariffs in Nepal. We use a conventional CGE model of Nepal that was constructed by Prakash Sapkota of the Himalayan Institute of Development (HID) in collaboration with us. Household data is obtained from the Nepalese Living Standards Survey (NLSS), a nationally representative survey of 3373 households.

2. Survey of the literature

There have been numerous attempts to adapt CGE models to the analysis of income distribution and poverty issues. The simplest approach is to increase the number of categories of households. In this context, it is possible to examine how different types of households (rural vs. urban, landholders vs. sharecroppers, region A vs. region B, etc.) are affected by a given shock. However, nothing can be said about the relative impacts on households within any given category as the model only generates information on the representative (or "average") household. There is increasing evidence that households within a given category may be affected quite differently according to their asset profiles, location, household composition, education, etc. Of course, this problem of intra-category variation decreases with the degree of disaggregation of household categories. Yet even in the most disaggregate versions – Piggott and Whalley (1985) have over 100 household categories – substantial intra-category heterogeneity in the impacts of a given shock are likely to subsist.

A popular alternative is to assume a lognormal distribution of income within each category where the variance is estimated using base year data (see De Janvry, Sadoulet et Fargeix, 1991). In this approach, the CGE model is used to estimate the change in the average income for each household category, while the variance of this income is assumed to be fixed. Decaluwé et al. (2000) argue that a beta distribution is preferable as, unlike the lognormal, it can be skewed left or right and thus better represent the different types of intra-category income distributions commonly observed.

Regardless of the distribution chosen, one must assume that all but the first moment is fixed and unaffected by the shock analysed. This assumption is hard to defend given the heterogeneity of income sources and consumption patterns of households even within very disaggregate categories. Indeed, it is often found that intra-category income variance amounts to more than half of total income variance.

The alternative, of course, is to model each household individually. As we explain below, this poses no particular technical difficulties as it simply implies constructing a model with as many household categories as there are in the household survey providing the base data. An independent strand of literature performs such individual-level analysis, commonly referred to as micro-simulations, of macro shocks. This literature traces its origins to research by Orcutt (1957 and 1961). More recently, some authors have developed micro-simulation models using household surveys to study issues of income distribution (Bourguignon, Fournier and Gurgand, 2000). However, these models are not in a general equilibrium framework.

Decaluwé, Dumont and Savard (1999) present a CGE micro-simulation model for 150 households based on fictional archetypal data. They construct the model so as to allow comparisons with the earlier approaches with multiple household categories and fixed intra-category income distributions. They show that intra-category variations are important, at least in this fictional context.

The only general equilibrium micro-simulations with true data are Tongeren (1994), Cogneau (1999) and Cogneau and Robillard (2001). Tongeren models individual firms rather than individual households. Cogneau's study concerns a city, Antananarivo, rather than a nation and is primarily concerned with labour market issues. Cogneau and Robillard examine the impact of various growth shocks, such as increases in total factor productivity, on poverty and income distribution in the context of a national model of Madagascar. They find that "although mean income and price changes are significant, the impact of the various growth shocks on the total indicators of poverty and inequality appears relatively small". They show that the neglect of general equilibrium effects, as in standard micro-simulations, and the assumption of a fixed intra-group income distribution, as in standard CGE models, both strongly bias results. However, their model's disaggregation of the household account is obtained at the cost of sectoral disaggregation as the model distinguishes only three branches and four goods. As the poverty and income distribution effects of macroeconomic shocks are mediated primarily by differences in household income and consumption patterns, this level of aggregation fails to capture many of the intra-household differences.

In this paper, we develop a CGE micro-simulation model that is simple in structure – maintaining the characteristics of an archetypal CGE model – while allowing full integration of 3373 households. Furthermore, this household disaggregation is obtained without sacrificing the disaggregation of factors, branches and products required to capture the links between trade liberalisation and household-level welfare. Indeed, we trace the impacts of trade liberalisation as it affects production in 45 separate branches (15 branches, 3 regions), with quite different initial tariff rates. These sectoral effects in turn influence the remuneration of 15 separate factors of production (skilled and unskilled labour, agricultural and non-agricultural capital, and land; all broken down into three regions). As the household survey data provide information on each household's income from each of these factors and each household's consumption of each of the 15 goods produced by the branches, the links between trade liberalisation and household welfare are complete.

3. Methodology

The construction of a basic CGE micro-simulation model is technically straightforward although, obviously, more sophisticated approaches can be envisaged. The objective is to integrate every household from a nationally representative household survey directly into an existing CGE model. In the case of Nepal, we use an existing CGE model constructed by Prakash Sapkota of the Himalayan Institute of Development in Kathmandu, in collaboration with us. This model is itself based on an archetypal CGE training model developed by Martin, Souissi and Decaluwé (1995). Household income, expenditure and savings data is obtained from the Nepalese 1995 Living Standards Survey (NLSS), based on a nationally representative sample of 3373 households.

The Nepalese CGE model is based on a 1986 social accounting matrix (SAM) of Nepal that includes the following 50 accounts:

Factors: skilled and unskilled labour, land, agricultural and non-agricultural capital.

Agents: households (urban; small, large and non-farm Terai; small, large and non-farm Hills and Mountains), firms, government, savings and the rest of the world.

Branches of production: paddy; other food crops; cash crops; livestock & fisheries; forestry; mining and quarrying; manufacturing; construction; gas, electricity and water; hotel and restaurant; transportation and communication; wholesale and retail trade; banking, real estate and housing; government services and other services.

Goods for domestic consumption: same as above, plus non-competing imports.

Export goods: other food crops; cash crops; livestock and fisheries; forestry; manufacturing; hotel and restaurant; transportation and communication; wholesale and retail trade; and other services

The household categories in the existing CGE model were first aggregated to three categories (urban, Terai, and hills/mountains) to facilitate reconciliation with the NLSS data[2]. The household income and expenditure vectors in the aggregate SAM were then recalculated using the NLSS data. This involved first establishing links between each of the 15 domestic final consumer goods in the SAM and the consumption categories used in the NLSS. In the same way, links were established between the household income sources in the SAM (remuneration of the five factors; dividends; net transfers from government and from the rest of the world) and

[2] The Terai region is an area of fertile plains.

the sources of income identified in the NLSS. Once these links were established, we calculated aggregate values for the three household categories by multiplying individual household values by their respective NLSS sampling weights and summing over all households in each region[3].

With the introduction of the NLSS data, the SAM inevitably becomes unbalanced. To re-establish equilibrium, we fixed the NLSS-based household income and expenditure vectors, and modified all other values in the SAM until row and column sums were all equal. For this purpose, we prepared a simple program that seeks to establish equilibrium while minimising the variations in all SAM cells. Several optimisation criteria could be imagined. We chose to minimise the sum of the square of the rates of variation between the original ($A0_{ij}$) and new (A_{ij}) SAM values: $\text{Min } \Sigma_i \Sigma_j ((A_{ij}-A0_{ij})/A0_{ij})^2$

subject to $\Sigma_i A_{ij}=\Sigma_j A_{ij}$ and: $A_{hj}=A0_{hj}$ where h represent the household account in the SAM.

When the aggregate SAM was balanced and coherent with the household survey data, we increased the number of household categories in the CGE to 3373, the number of households in the NLSS survey, and introduced individual household income, consumption and savings data. Income and expenditure vectors for each household were first multiplied by their sample weights before introduction into the model. The rest of model calibration and resolution remains unchanged with respect to a standard CGE[4].

Household consumption is modelled using a LES expenditure function:

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[3] A number of adjustments were required in the process. Income data in the NLSS were not clearly distinguished between labour (skilled and unskilled) and capital (land, agricultural capital and non-agricultural capital) remuneration. Shares of remuneration of these factors from the base SAM were applied to the NLSS data in order to separate out these sources. Total income data appeared to be under-estimated, as is often observed in household survey data. We first increased all income by a region-specific rate so as to ensure that average regional savings rate were equal to those in the base SAM. Even with this change, total income was not sufficient to cover reported consumption for a large number of households (roughly 30%). We assume that this is due to the failure of the household survey data to capture inter-household transfers. Consequently, we increased the income of these households to equal their reported consumption and compensated this income increase by a reduction in the income of the other households that was applied at a uniform region-specific rate. As the SAM underlying the CGE model dates to 1986 and the NLSS data concerns 1995, all NLSS income, consumption and savings data were also deflated by a uniform rate so that total household income, summed over the three household categories, is equal to its 1986 value. A 1996-97 SAM will be available shortly and used in future research.

[4] See Cockburn (2001) for a full description of the model.

$$CH_{hh,i} = MINI_{hh,i} + \beta_{hh,i}^{C} (CTH_{hh} - \sum_j PC_j \; MINI_{hh,j})/PC_i$$

where, for household hh, $CH_{hh,i}$ is its consumption of good i, $MINI_{hh,i}$ is its minimum subsistence requirement of commodity i, $\beta_{hh,i}^{C}$ is the marginal share of good i in its consumption, CTH_{hh} is its total consumption and PC_j is the composite price of good j. Calibration of this function is obtained using estimates of income elasticities and Frisch parameters from the literature[5]. This specification captures differential impacts on households of trade liberalisation-induced changes in relative consumer prices.

Household income comes from factor remuneration and from transfers by firms (dividends), government (transfers minus income tax) and the rest of the world. Factor payments to households are a fixed share of the total remuneration of each factor, where the shares for each household are calibrated from the household survey data. As macro shocks modify the relative returns to these factors, households are affected according to their factor endowments. Transfers from the government and the rest of world are assumed fixed. Income tax is a small fixed share (1.5 to 5.0%; depending on the household's region of residence) of income. Dividends are a fixed share of firm capital income.

In order to better capture the channels through which trade liberalisation affects households, all sectors and factors of production are separated into the same three regions as households: urban, Terai, and hills/mountains[6]. Factors are mobile between sectors within each region but not between regions[7]. Agricultural capital is only mobile among agricultural sectors[8], just as non-agricultural capital is mobile between all other sectors. National production in each sector is a CET combination of regional productions. As they are expected to be close substitutes, we use high elasticities of substitution (=10). Investment volume is fixed to avoid intertemporal welfare effects and foreign savings is also fixed. The numeraire is the "nominal exchange rate".

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[5] See Dervis, de Melo and Robinson (1982), Frisch (1959) and Lluch, Powell and Williams (1977).
[6] See Fafchamps and Shilpi (2001) for a discussion of the spatial division of labour in Nepal.
[7] The introduction of a migration function would be an interesting extension of the model.
[8] Agricultural sectors are: paddy; other food crops; cash crops; livestock & fisheries; forestry.

Government consumption volume is fixed as welfare analysis is based on household consumption alone. Imported and domestic goods are imperfect substitutes in domestic consumption (Armington hypothesis), and exports and local sales are imperfect substitutes from the viewpoint of local producers. World prices for Nepal's imports and exports are fixed (small country hypothesis). The rest of the model is standard. Poverty and income distribution analysis is performed using DAD software[9].

4. Simulation results

To illustrate the analysis that can be performed with this type of model, we study the impact of the elimination of all import tariffs with a compensatory uniform consumption tax designed to maintain government revenue constant. Of course, this is just one example of the numerous policies that could be studied using this model.

Generally speaking, we might expect that the elimination of import tariffs will be pro-poor if the tariffs initially protect sectors that use factors (capital, etc.) that provide a small share of income for the poor. On the other hand, the poor may consume proportionately less of import (or import-competing) goods and thus benefit less from the resulting reduction in the prices of these goods[10]. In this general equilibrium framework, the resulting income and consumption effects will, in turn, feed back into the model and influence the overall results.

We begin with the initial tariff rates and trace the impacts of their elimination through the model, from sectoral supply and demand to factor remuneration and, finally, household income and consumption, bearing in mind that in a CGE model all variables interact and are determined simultaneously. We examine the case where the elimination of import tariffs is compensated by the introduction of a uniform 1.1% consumption tax, endogenously determined so as to maintain revenue neutrality. As the consumption tax is applied uniformly to all goods, it does not create

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[9] Duclos, Araar et Fortin (2001). DAD is available free with a user's manual at: www.mimap.ecn.ulaval.ca.
[10] Chan, Ghosh and Whalley (forthcoming) study the consumption effects of trade liberalisation.

any distortions in the relative consumption prices allowing us to focus on the impacts of the elimination of all tariffs.

Table 1 presents sectoral supply and demand effects. Initial tariff rates (tm) are highest in the paddy, other food crop, mining and gas/electricity/water sectors and it is these sectors that experience the greatest increase in import volumes (dM) following the elimination of tariffs. However, imports represent a small share of local consumption (M/Q) in all but the manufacturing sector and, to a lesser degree, the transport/communication, mining and trade sectors. Thus, despite high Armington elasticities of substitution between imported and local goods (=5), the impact on local demand for domestic production (dD) is small for all but the mining and manufacturing sectors, and the decline in producer prices for local sales (PD) is moderate.

Place Table 1 **here**

Faced with a moderate reduction in local prices and fixed export prices, producers of exportable goods divert a portion of their sales to the export market with a CET elasticity of 5. In sectors where a large share of local production is initially exported (EX/XS) – hotel and restaurant, transport/communication, trade and manufacturing – this export response leads to an increase in total sectoral production (dXST) or, in the case of manufacturing, partially offsets the decline in local sales. In the other sectors, the change in total sectoral production (dXST) is roughly equal to the change in local sales (dD). Sectors with high export shares also experience a reduction in their output price (dPT) that is inferior to that of their local sales given that export prices are fixed. As elasticities of substitution between regions in sectoral production are assumed to be high (=10), there is little regional variation in the production response (dXS (=dVA)) or producer price changes (not shown) within any given sector.

In summary, trade liberalisation engenders a clear sectoral reallocation of resources from the mining and manufacturing sectors, where initial tariffs and import shares were relatively high, in favour of the hotel/restaurant, trade and transport/communication sectors, with the other sectors remaining relatively unaffected. Prices decline the most in the agricultural sectors, although the differences are small.

Let us now see how these production effects influence factor remunerations (Table 2). The general decline in nominal factor remuneration rates should be considered in the framework of a trade liberalisation-induced 3.2% fall in consumer and producer prices. In this context, we are most interested in how the rates of remuneration of factors change relative to one another.

Place Table 2 **here**

To understand these results, we take into account, for each factor, the share of each sector in its total remuneration (Table 3). Unskilled labour is primarily remunerated by agricultural sectors except in urban regions where construction, banking/real estate, transport/communication and manufacturing are important employers. As output prices fall by roughly 4% in the agricultural sector, we see similar declines in the remuneration of unskilled labour[11]. The decline is smaller for urban unskilled labour as it is not so tightly linked to the agricultural sector. Skilled labour is employed primarily by the government services sector and, consequently, the variation in skilled wage rate closely follows that of the government sector output prices. Agricultural capital (upper half of column "Capital") and land are remunerated primarily by the cash crops, paddy and livestock/fisheries sectors. As agricultural output prices decline the most following trade liberalisation, these purely agricultural factors are the biggest losers, particularly in the urban region where agricultural production experiences the largest declines. Non-agricultural capital is the biggest relative winner.

Place Table 3 **here**

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[11] Variation in value added prices may differ from those of output prices according to the intermediate consumption patterns of each sector. We do not find large differences and so do not present the variations in value added prices.

How do changes in the factor remunerations affect nominal household income? This depends on the share of income the household draws from each factor. In Table 4 we decompose the average income changes for households in each region into changes in income from each factor[12]. The latter are equal to the factor's share in the household income multiplied by the change in the factor's remuneration rate (drawn from Table 2).

Place Table 4 **here**

Terai and hill/mountain households derive their income from similar sources, primarily unskilled labour and land. As the remuneration of these two factors undergoes the largest declines, we can understand that households in these two regions have a more substantial loss in nominal income than do urban households. Indeed, urban households receive nearly one-third of their income from non-agricultural capital, which experiences the smallest reduction in terms of remuneration rates.

In summary, on the income side we find that trade liberalisation in Nepal encourages a reallocation of resources from the agricultural sector, particularly the heavily-protected and inward-oriented paddy and other food crop sectors, to the service and non-manufacturing industrial sector. This, in turn, leads to a fall in the remuneration of land and unskilled labour relative to skilled labour wages and, a fortiori, non-agricultural capital. These changes tend, in turn, to favour urban households over rural households.

Now let us look how trade liberalisation affects these households on the consumption side (Table 5). Sectoral consumer prices reflect changes in import prices (dPM), changes in the prices of local sales by domestic producers (dPD) and the share of imports in local consumption (M/Q). They also reflect the 1.1% uniform consumption tax. We have already seen that initial tariff rates are highest – and, consequently, the fall in import prices is greatest, in the paddy, other food crops, mining and gas/electricity/water sectors. We also saw that import intensities

[12] Bernard Decaluwé suggested this decomposition.

are highest in the manufacturing and transport/communication sectors and how the combination of these factors determines how the domestic producers' local prices evolve. On this basis, it is easy to understand that consumer prices fall most in the initially highly protected agricultural sector and the initially moderately protected but import-intensive manufacturing sector.

Place Table 5 **here**

While urban households consume a smaller share of agricultural goods than Terai or hill/mountain households (65% vs. 79%), they consume more manufacturing goods (19% vs. 13-15%). Consequently, there is practically no difference in the impacts of trade liberalisation on the consumer price indices of households in these three regions. This said, it should be underlined that all households consume almost exclusively the goods that experience the greatest price declines, which implies a strong consumption payoff from trade liberalisation, despite the imposition of a uniform 1.1% consumption tax.

Combining income and consumption effects in equivalent variations, we find that revenue-neutral trade liberalisation has practically no aggregate welfare effects. This is not surprising as we are replacing a moderately distortionary import tariff, varying from 3.4 to 13.5% (Table 1), by a uniform consumption tax in a second-best framework where distortionary income and production taxes remain. In terms of its distributive effects, urban households benefit from liberalisation, whereas Terai and Hill-Mountain households lose out (Table 6). This result can be traced to the pro-urban income effects above.

Place Table 6 **here**

What conclusions can we draw in terms of poverty? If, for example, we consider the urban poor, we might conclude that trade liberalisation is beneficial. However, we saw that the smaller reduction in nominal incomes observed among households in the urban sector was due in large part to their greater endowment of non-agricultural capital and their lesser dependency on income from land and unskilled labour. Yet it is likely that among urban households, the poor are precisely those households with the least access to capital and the greatest dependency on unskilled wages. We may therefore suspect that households **within** this region will be affected quite differently. Indeed, when we examine the distribution (standard deviation) of the above nominal income variations and equivalent variations, there is an enormous degree of heterogeneity in the impacts of trade liberalisation among households in each region (Table 7).

Place Table 7 **here**

One solution is to disaggregate households in each region into the poor and non-poor with, presumably, quite different factor endowments and consumption patterns. While this may reduce the intra-household heterogeneity, it would be difficult to eliminate heterogeneity altogether in a model with five production factors and 16 consumer goods. When we adopt one-half the nationwide median income as the poverty line, we see that the urban poor appear to be affected more favourably than the non-poor. However, there remain substantial differences in the effects of trade liberalisation not only between poor and non-poor within a region, but also **within** these categories (Table 8).

Place Table 8**here**

An alternative is to assume a fixed income distribution, estimated on the base year data, within each region. However, it is unlikely that the income of all households will increase in the same proportion or in such a way that the income distribution shifts in parallel. In our urban example, it is likely that the increase in the returns to non-agricultural capital relative to unskilled wages will result in an increase in income disparities. We examine these issues as we analyse various poverty and distributional indicators below.

The advantage of the micro-simulation approach is its capacity to incorporate all the heterogeneity of household income sources and consumption patterns directly in the model so that we can model the impacts of trade liberalisation on each individual household. In effect, we use the micro-simulation model to generate the data from a hypothetical new household survey if it were to be executed after trade liberalisation. We then use these data and the base year data (drawn from the NLSS) to calculate and compare standard income-based poverty and distribution indicators before and after the simulation.

We convert all data in terms of individuals, rather than households, using the following standard equivalence scale (ES): $ES_i=1+0.7(Z_i-1-K_i)+0.5K_i$

where i is the household index, Z is the number of household members and K is the number of children. Thus the first adult counts as 1, the other adults are each 0.7 and children are 0.5, to take account of scale economies and age.

Foster-Greene-Thorbecke (FGT) indices are the most common poverty indicators:

$$P_a = \frac{1}{Nz^a} \sum_{j=1}^{J} \left(z - y_j \right)^a$$

where j is a sub-group of individuals with income below the poverty line (z), N is the total number of adult equivalents in the sample, y_j is the income of individual j and α is a parameter that allows us to distinguish between the alternative FGT indices. When α is equal to 0, the expression simplifies to X/N or the headcount ratio, a measure of the incidence of poverty. Poverty depth is measured by the poverty gap, which is obtained with α equal to 1. The severity of poverty is measured by setting α equal to 2[13].

We define the poverty line as one-half of the nationwide median income and thus ours is a measure of relative rather than absolute poverty[14]. Further on, we will present FGT curves, which map out these results for a wide range of possible values for the poverty line. Our analysis is based on both real income and real consumption data. Post-liberalisation income and

[13] See Ravallion (1984) for a full discussion of poverty indicators.
[14] Roughly 1350 Nepalese rupees ($US 65) per person. A common alternative measure of absolute poverty is obtained when the poverty line is defined as the minimum income required to cover "basic needs".

consumption data are deflated by household-specific Laspeyres consumer price indices to account for the general fall in these prices[15].

These results suggest that the impacts of this fiscal reform on poverty are quite small and statistically insignificant (Table 9). As we will see, given the substantial heterogeneity of households and individuals within each region, poverty results are extremely sensitive to the choice of poverty line and the use of FGT curves is preferable.

Place Table 9 **here**

As the choice of poverty line (one-half median income) is debatable, we present the variation, between the base case and counterfactual equilibria, in the headcount ratios and poverty gaps for a wide range of poverty lines (from zero to twice the median income) in the figures below. The results are highly sensitive to the choice of poverty line. While there is some evidence of a slight reduction in the number of the very poorest (under 900 rupees, or $US 43, per capita annual income), the number of moderately poor appears to increase as a result of trade liberalization (Figure 1). At the regional level (Figures A1-A3 in Appendix), trade liberalization appears to reduce the incidence of poverty in urban areas and to increase its incidence in the two rural areas.

Place Figure 1 **here**

Examination of poverty gap curves reinforces the message from the head count ratio: a slight reduction in the depth of poverty among the very poorest and a clear increase in poverty among the moderately poor (Figure 2). Indeed, as we will see further on, it appears that the very wealthiest individuals are the main beneficiaries of trade liberalization. At the regional level, the results contrast dramatically (Figures A4-A7 in Appendix). Urban-dwellers are the clear winners,

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[15] $CPI_{hh} = \sum_i PC_i CH^0_{hh,i} \Big/ \sum_i PC^0_i CH^0_{hh,i}$, where PC_i is the consumer price in sector i, $CH_{hh,i}$ is household hh's consumption of good i and superscript 0 refers to base year values.

with the exception of a group of moderately poor. In rural areas, the very poorest are relatively unaffected but there is a clear increase in the depth of poverty among the moderately poor.

Place Figure 2 **here**

Similar results are observed when we examine poverty severity (Figure 3). Regional results resemble those for the poverty gap and are therefore not presented.

Place Figure 3 **here**

To obtain a broader perspective on the distributive effects of trade liberalization, we look at changes in the density function for income (Figure 4). The density function measures the percentage of individuals with a given income. With some exceptions, there seems to be a movement of individuals from the middle-income brackets (3000-6500 rupees annual per capita income) toward lower income brackets (1000-3000 rupees). This suggests that further trade liberalisation would increase income disparities in Nepal. There is also a clear urban-rural dichotomy (Figures A7-A10 in Appendix). In urban areas, there is a clear movement of individuals from the lower and middle income brackets (1000-6000 rupees) toward the highest income brackets (8000-15000 rupees). In contrast, there is an increase in the density of income among the very poorest (1000-3000 rupees) and an increase among the moderately poor (3,000 to 5,000-6,000 rupees).

Place Figure 4 **here**

We can see how income levels change according to income ranking using quantile curves (Figure 5). This analysis generates quite striking results. Individuals in most quintiles experience a loss of income as a result of trade liberalization, with the notable exception of the very richest percentiles. Indeed, we truncated the quantiles at 0.95 as the increases among the highest five percentiles went off the scale. Regional results allows us to see that the gains in the urban region tend to increase with the level of income and that the very poorest actually see their incomes fall (Figures 10-12 in Appendix). In the rural areas, income losses also appear to increase, as does the variability of the impacts of trade liberalization.

Place Figure 5 **here**

The above results suggest that income inequality may be affected by trade liberalization. Two popular inequality indicators are the Atkinson and Gini indices. They clearly show that inequality increases as a result of trade liberalization, primarily in the urban areas but also in the hills and mountains region (Table 10).

Place Table 10 **here**

5. Conclusion

We have shown that it is straightforward to adapt a standard CGE model to explicitly integrate a large number of households (over 3000 in this case). Using data on household income sources and consumption patterns collected in most standard household surveys, we are able to model the impacts of trade liberalisation (or any other macroeconomic shock) on **individual households** and how these impacts feed back into the general equilibrium of the economy.

Combining household data from the Nepalese Livings Standards Survey and a standard CGE model, we are able to simulate the elimination of all tariffs. As the model estimates income for each household, we are able to generate all the data required to carry out standard income-based poverty and income distribution analysis. We conclude that trade liberalisation in Nepal favours urban households as opposed to Terai (fertile plains) and Hill/Mountain households. This resulted is traced mainly to the high initial tariffs in agricultural sectors.

However, these average results disguise an enormous variation in the impacts on individual s within each geographic region, even when we separate households into poor and non-poor. In this context, traditional poverty and inequality indicators can be useful to better understand these impacts. Generally speaking, the impacts of trade liberalisation on income distribution appear to be small, however some interesting results emerge.

Urban poverty falls and rural poverty increases, particularly among the moderately poor as opposed to the very poorest. The absolute impact of trade liberalization, whether it is positive (in the urban areas) or negative (in the rural areas), generally increases with the level of income.

Indeed, there appear to be very strong, mostly positive, impacts on the very richest individuals. This explains the increased income inequality found in the urban and hills/mountains regions.

We conclude that CGE-based micro-simulations can be constructed with very little technical difficulty and that this type of model is indispensable for studying the poverty/distributional impacts of any macro-economic policy or shock, such as trade liberalisation, that is likely to have general equilibrium effects.

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Table 1: **Effects of trade liberalisation on sectoral production (%)**

	Imports/local sales					Exports/Production				dXS=dVA		
	tm	dM	M/Q	dD	dPD	dEX	EX/XS	dXST	dPT	Urban	Terai	Hills
AGRICULTURE												
Paddy	13.5	52.4	0.2	-0.8	-4.0	21.6	0.1	-0.7	-4.0	-0.7	-0.5	-1.4
Other food crops	12.2	43.4	0.6	-0.8	-4.0	21.9	0.2	-0.8	-4.0	0.8	0.4	-1.7
Cash crops	7.0	11.7	3.5	-0.7	-4.3	23.8	2.0	-0.2	-4.2	-1.3	-0.8	0.4
Livestock/fisheries	4.4	-1.5	1.2	-0.9	-4.4	24.0	1.9	-0.4	-4.3	-1.0	-0.9	0.0
Forestry				0.8	-4.2	25.1	0.1	0.9	-4.2	-0.5	0.6	1.6
NON-AGRICULTURE												
Mining	12.3	39.8	8.6	-10.4	-2.6			-10.4	-2.6	-12.2	-11.8	-9.8
Manufacturing	8.1	15.8	47.0	-8.1	-3.1	7.8	16.8	-5.4	-2.6	-6.0	-5.4	-3.5
Construction				-0.9	-2.4			-0.9	-2.4	-1.2	-0.7	-0.6
Gas, electricity, water	10.9	47.7	2.4	-2.3	-2.0			-2.3	-2.0	-2.4	-1.9	-1.9
Hotel and restaurant				1.6	-2.4	14.9	55.9	9.1	-1.0	9.2	10.1	6.6
Transport/commun.	6.0	13.8	13.3	-1.4	-2.9	14.4	30.5	3.5	-2.0	3.4	4.0	3.0
Trade	3.4	2.2	6.8	1.5	-3.1	18.9	20.9	5.2	-2.4	3.2	6.4	10.0
Banking and real estate				0.9	-2.1			0.9	-2.1	0.5	1.6	0.5
Government services				-0.1	-2.5			-0.1	-2.5	-0.1	-0.3	0.3
Other services				-0.1	-2.2	11.6	0.8	0.0	-2.2	1.6	0.2	-2.7

Table 2: **Effects of trade liberalisation on factor remuneration**

	Wage rate		Returns to:			Change in
	Unskilled	Skilled	Ag. Cap.	Non-ag. Cap	Land	other income
Urban	-2.9	-2.3	-5.4	-1.7	-5.4	0.02
Terai	-4.1	-2.3	-5.1	-0.6	-5.1	0.02
Hills and Mountains	-4.3	-2.3	-4.4	-0.8	-4.4	0.02

Notes: Ag. cap=Agricultural capital; Non-ag. Cap.=Non-agricultural capital

Table 3: **Sectoral breakdown in total factor remuneration (%)**

	Unskilled labour				Skilled labour				Capital				Land			
	U	**T**	**H**	**TOT**	**U**	**T**	**H**	**TOT**	**U**	**T**	**H**	**TOT**	**U**	**T**	**H**	**TOT**
Paddy	11	28	11	**17**	1	6	3	**3**	31	34	13	**23**	32	35	13	**23**
Other food crops	5	9	20	**14**	0	2	6	**3**	10	7	14	**11**	9	6	13	**10**
Cash crops	4	17	21	**18**	0	5	8	**5**	16	27	36	**31**	16	29	36	**32**
Livestock/fisheries	10	16	28	**22**	0	2	4	**2**	27	16	27	**23**	28	15	28	**23**
Forestry	3	7	5	**6**	0	2	2	**2**	16	16	10	**13**	16	15	10	**12**
TOTAL AGRICULTURE	**34**	**77**	**84**	**76**	**2**	**18**	**23**	**15**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Mining	0	0	0	**0**	0	0	0	**0**	0	0	2	**1**				
Manufacturing	8	2	1	**2**	2	3	2	**2**	18	18	12	**16**				
Construction	22	8	6	**8**	1	3	2	**2**	22	26	28	**25**				
Gas, electricity, water	1	0	0	**0**	2	0	0	**1**	2	1	1	**1**				
Hotel and restaurant	3	1	0	**1**	0	0	0	**0**	4	3	2	**3**				
Transport/communication	11	4	3	**5**	4	7	7	**6**	14	17	21	**17**				
Trade	2	0	0	**0**	1	1	1	**1**	20	12	10	**15**				
Banking and real estate	14	5	4	**5**	4	8	7	**6**	18	21	23	**20**				
Government services	0	0	0	**0**	82	56	55	**63**	0	0	0	**0**				
Other services	5	2	1	**2**	3	4	4	**3**	1	2	2	**2**				
TOTAL NON-AGRICULTUR	**66**	**23**	**16**	**24**	**98**	**82**	**77**	**85**	**100**	**100**	**100**	**100**				

Legend: U=Urban; T=Terai; H=Hills and mountains; TOT=Total

Table 4: **Sources of household income by region**

	Income shares (%)			Change in factor Remuneration rates			Income change		
	U	**T**	**H**	**U**	**T**	**H**	**U**	**T**	**H**
WAGES									
Unskilled	24.5	33.8	36.1	-2.9	-4.1	-4.3	-0.7	-1.4	-1.6
Skilled	22.0	10.4	9.2	-2.3	-2.3	-2.3	-0.5	-0.2	-0.2
RETURNS TO:									
Ag. Capital	0.4	1.9	1.8	-5.4	-5.1	-4.4	0.0	-0.1	-0.1
Non-ag. Capital	32.5	18.8	11.6	-1.7	-0.6	-0.8	-0.6	-0.1	-0.1
Land	6.2	30.5	34.1	-5.4	-5.1	-4.4	-0.3	-1.6	-1.5
OTHER INCOME	14.27	4.65	7.14	0.0	0.0	0.0	0.30	0.08	0.14
TOTAL	**100.0**	**100.0**	**100.0**				**-1.8**	**-3.3**	**-3.3**

Legend: U=Urban; T=Terai; H=Hills and mountains

Table 5: **Effects of trade liberalisation on consumer prices**

	dPM	dPD	M/Q	dPC	Urban	Terai	Hills/Mtns
AGRICULTURE					**65.0**	**79.2**	**79.0**
Paddy	-11.9	-4.0	0.2	-3.0	14.1	32.1	18.2
Other food crops	-10.9	-4.0	0.6	-3.1	5.9	13.5	18.1
Cash crops	-6.5	-4.3	3.5	-3.4	24.1	24.2	28.8
Livestock/fisheries	-4.2	-4.4	1.2	-3.4	4.4	4.0	5.0
Forestry	0.0	-4.2	0.0	-3.2	16.5	5.4	8.8
NON-AGRICULTURE					**35.0**	**20.8**	**21.0**
Mining	-10.9	-2.6	8.6	-2.5	0.0	0.0	0.0
Manufacturing	-7.5	-3.1	47.0	-3.7	19.5	13.2	15.1
Construction	0.0	-2.4	0.0	-1.4	0.0	0.0	0.0
Gas, electricity, water	-9.8	-2.0	2.4	-1.2	0.5	0.1	0.0
Hotel and restaurant	0.0	-2.4	0.0	-1.4	0.3	0.1	0.1
Transport/communication	-5.7	-2.9	13.3	-2.2	2.9	1.1	1.1
Trade	-3.2	-3.1	6.8	-2.1	0.0	0.0	0.0
Banking and real estate	0.0	-2.1	0.0	-1.1	0.2	0.5	0.1
Government services	0.0	-2.5	0.0	-1.4	10.0	5.0	4.0
Other services	0.0	-2.2	0.0	-1.1	1.6	0.8	0.6
				Total	**100.0**	**100.0**	**100.0**
				Consumer price indices	**-3.1**	**-3.1**	**-3.2**

Table 6: **Equivalent variations (as % of base income)**

	Urban	Terai	Hills/Mountains	All
Equivalent variation	0.47	-0.09	-0.06	0.01

Table 7: Distribution of Income Variations and Equivalent Variations By Region

		Income Variation	Equivalent Variation
Urban	**Mean**	-1.81	0.50
	Standard deviation	(5.61)	(2.25)
Terai	**Mean**	-3.32	-0.10
	Standard deviation	(2.29)	(0.76)
Hills/Mountains	**Mean**	-3.32	-0.09
	Standard deviation	(2.18)	(0.77)

Table 8: Distribution of Income Variations and Equivalent Variations By Region

		Income Variation	Equivalent Variation
Urban non-poor	Mean	-1.89	0.39
	Standard deviation	(5.51)	(2.44)
Urban poor	Mean	-1.42	0.59
	Standard deviation	(6.02)	(2.08)
Terai non-poor	Mean	-3.33	-0.12
	Standard deviation	(2.31)	(0.77)
Terai poor	Mean	-2.97	0.06
	Standard deviation	(1.78)	(0.70)
Hills/Mountains non-poor	Mean	-3.32	-0.12
	Standard deviation	(2.23)	(0.83)
Hills/Mountains poor	Mean	-3.25	0.00
	Standard deviation	(1.34)	(0.53)

Table 9: Normalised FGT poverty indices (%)

Index	All			Urban		
	Before	After	Change	Before	After	Change
Head count ratio (a= 0)	7.16	7.15	-0.01	3.64	3.57	-0.07
	(0.49)	(0.49)	(0.11)	(1.03)	(1.03)	(0.57)
Poverty gap (a= 1)	1.40	1.41	0.01	0.63	0.59	-0.04
	(0.13)	(0.13)	(0.01)	(0.22)	(0.21)	(0.02)
Poverty severity (a= 2)	0.45	0.45	-0.00	0.18	0.15	-0.03
	(0.06)	(0.06)	(0.00)	(0.08)	(0.07)	(0.02)
Index	**Terai**			**Hills/Mountains**		
	Before	**After**	**Change**	**Before**	**After**	**Change**
Head count ratio (a= 0)	6.52	6.33	-0.19	8.21	8.36	0.15
	(0.79)	(0.78)	(0.18)	(0.71)	(0.71)	(0.13)
Poverty gap (a= 1)	1.02	1.02	-0.00	1.84	1.86	0.02
	(0.18)	(0.18)	(0.01)	(0.20)	(0.20)	(0.02)
Poverty severity (a= 2)	0.26	0.26	-0.00	0.65	0.65	-0.00
	(0.08)	(0.07)	(0.00)	(0.09)	(0.09)	(0.01)

Notes: Standard deviations in parentheses. Poverty line = 0.5*median income of individuals in region.

Figure 1: Variation in headcount ratio curves (All regions)

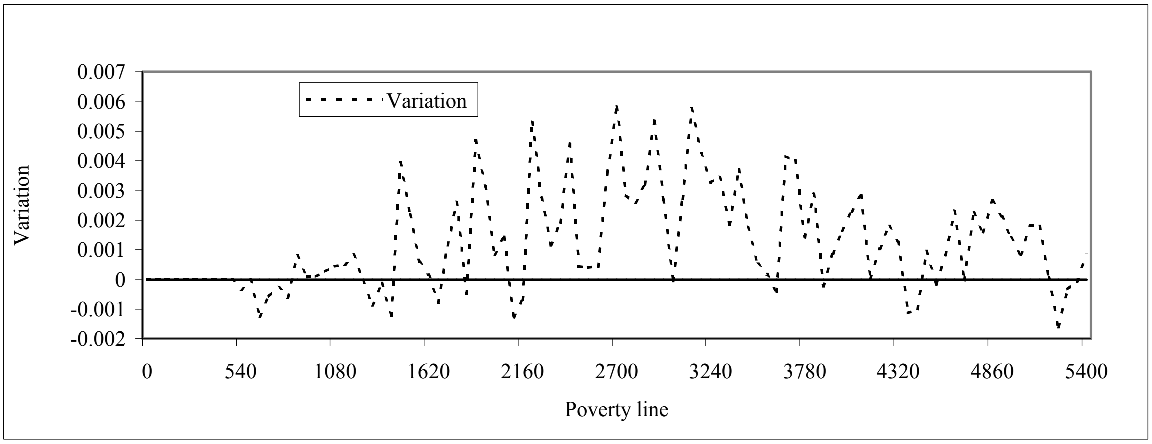

Figure 2: Variation in poverty gap curves (All regions)

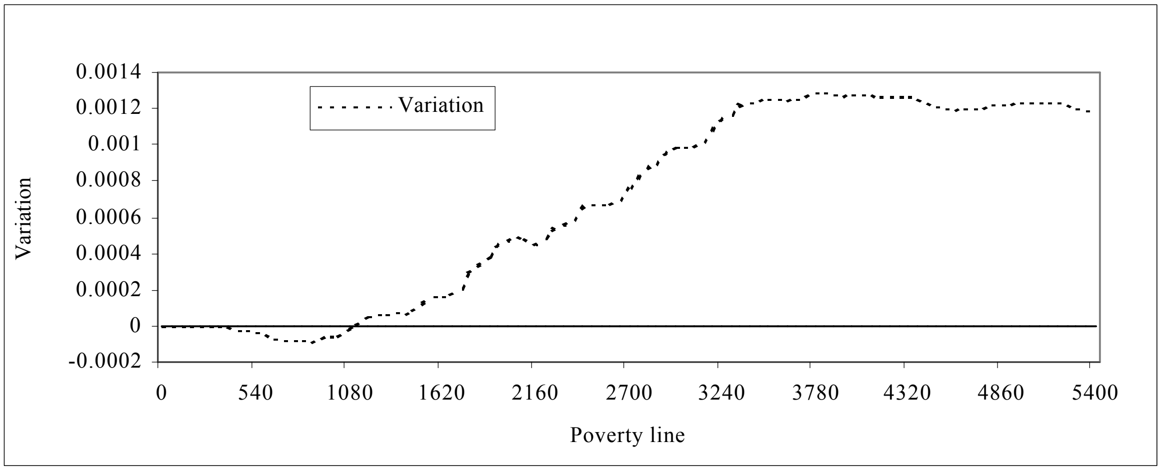

Figure 3: Variation in poverty severity curves (All regions)

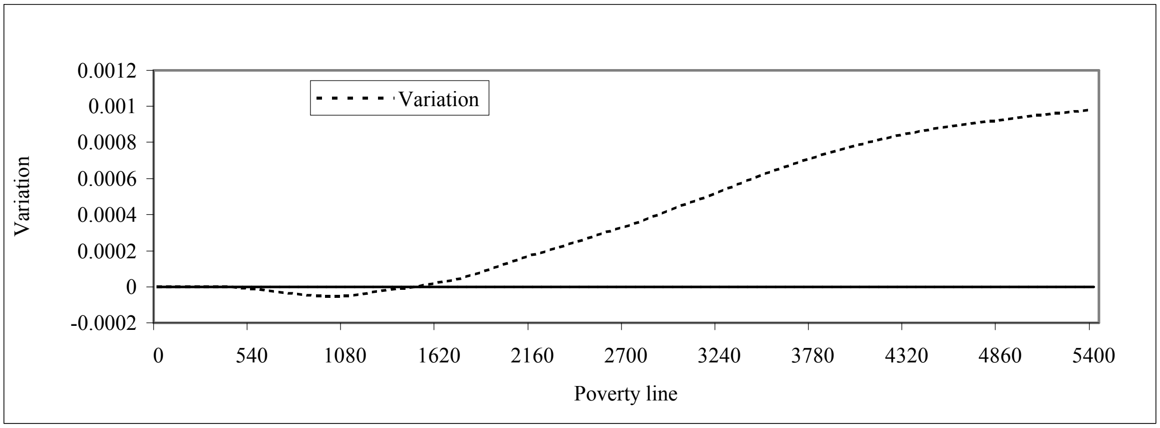

Figure 4: Variation in density functions

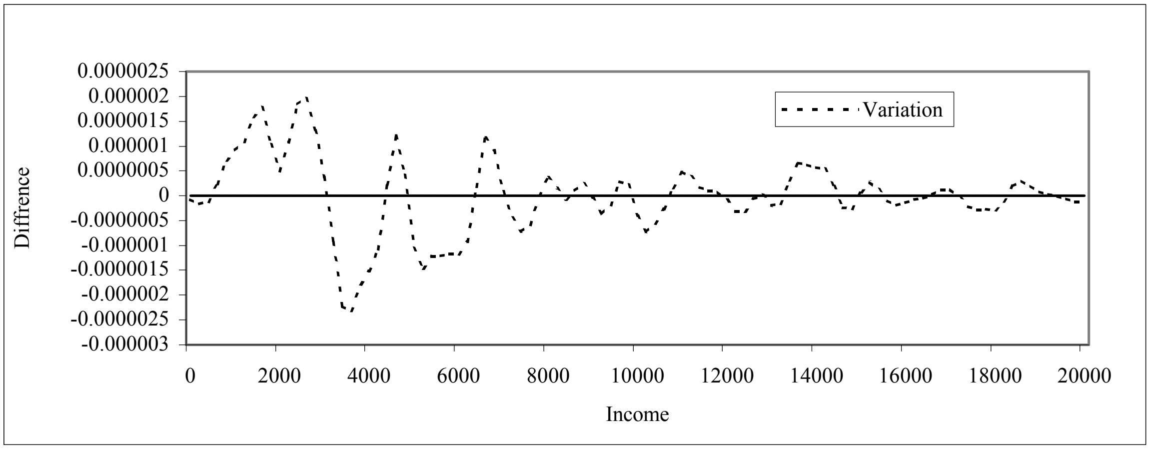

Figure 5: Variation in quantile curves (All regions)

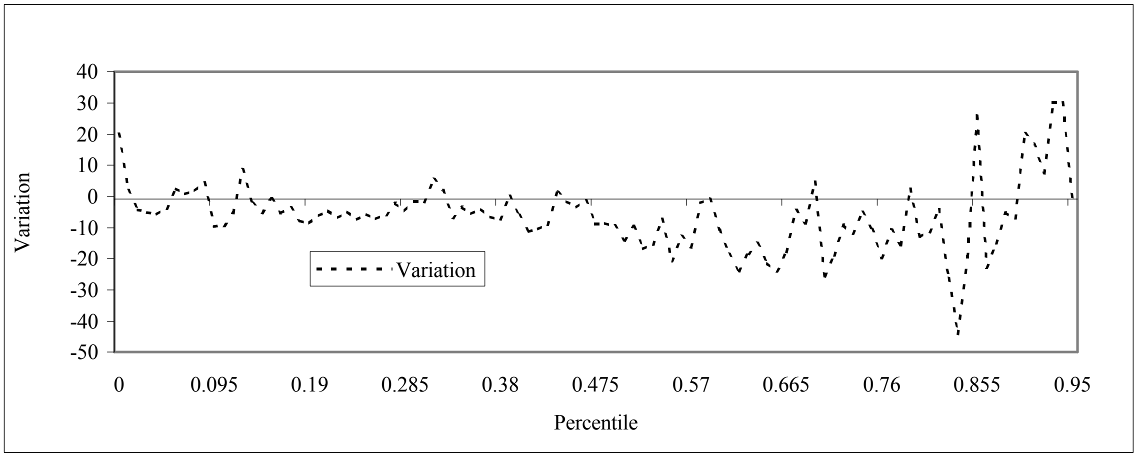

Table 10: Inequality indices

Index	All			Urban		
	Before	After	Change	Before	After	Change
Atkinson index (ε =0.5)	13.17 (1.19)	13.31 (1.19)	0.14 (0.04)	19.78 (2.22)	19.96 (2.23)	0.18 (0.09)
Atkinson index (ε =0.75)	17.74 (1.40)	17.91 (1.40)	0.17 (0.04)	26.75 (2.65)	26.98 (2.66)	0.23 (0.13)
Gini index	37.85 (1.38)	38.03 (1.38)	0.18 (0.04)	47.52 (2.63)	47.74 (2.63)	0.23 (0.13)
Index	**Terai**			**Hills/Mountains**		
	Before	**After**	**Change**	**Before**	**After**	**Change**
Atkinson index (ε =0.5)	6.19 (0.46)	6.18 (0.46)	-0.01 (0.02)	12.65 (2.10)	12.71 (2.09)	0.06 (0.05)
Atkinson index (ε =0.75)	8.85 (0.62)	8.83 (0.62)	-0.01 (0.02)	17.19 (2.46)	17.26 (2.46)	0.07 (0.06)
Gini index	26.99 (0.93)	26.95 (0.93)	-0.04 (0.04)	37.04 (2.43)	37.12 (2.42)	0.08 (0.06)

Appendix: Regional poverty/distribution indicators

Figure A1: Variation in headcount ratio curves (Urban)

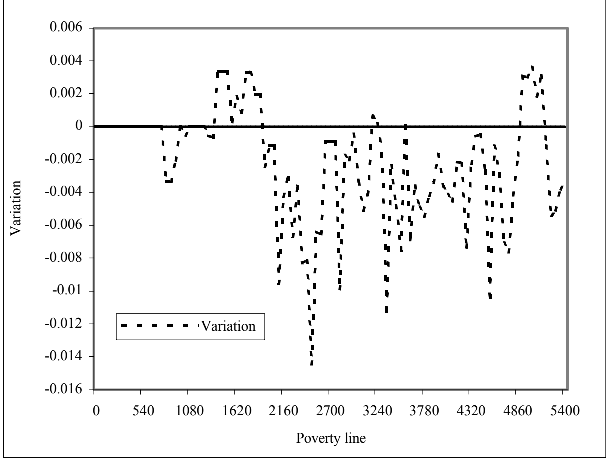

Figure A2: Variation in headcount ratio curves (Terai)

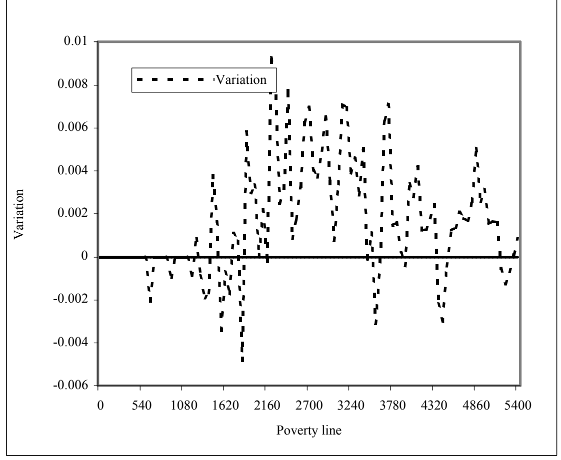

Figure A3: Variation in headcount ratio curves (Hills/Mountains)

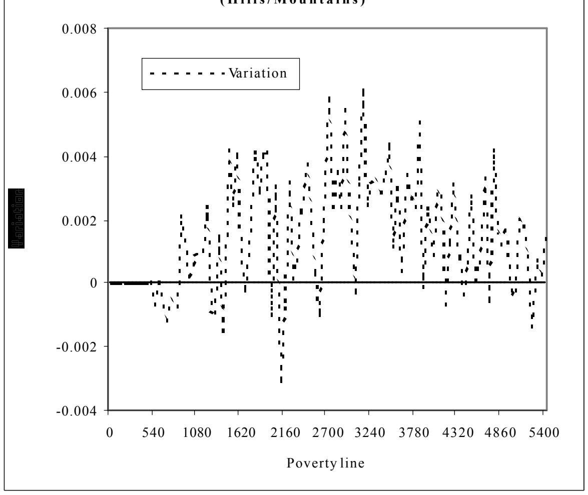

Figure A4: Variation in poverty gap curves (Urban)

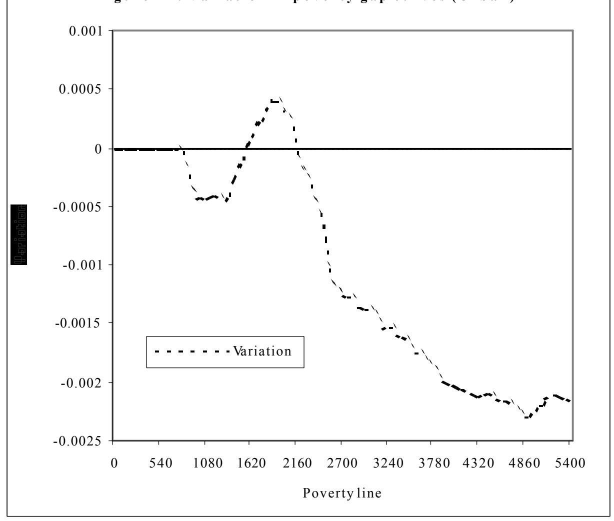

Figure A5: Variation in poverty gap curves (Terai)

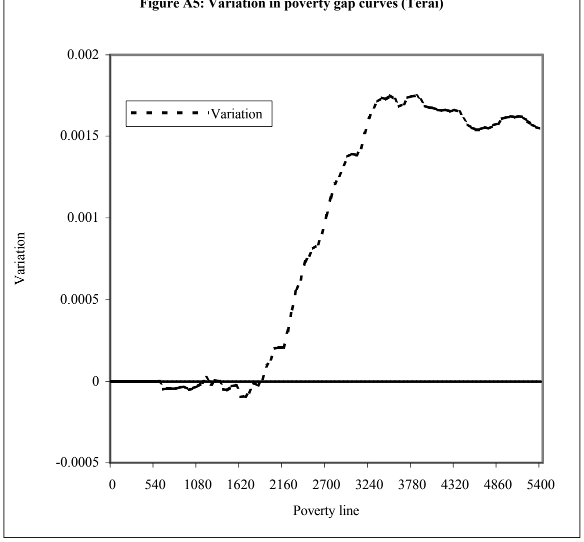

Figure A6: Variation in poverty gap curves (Hills/Mountains)

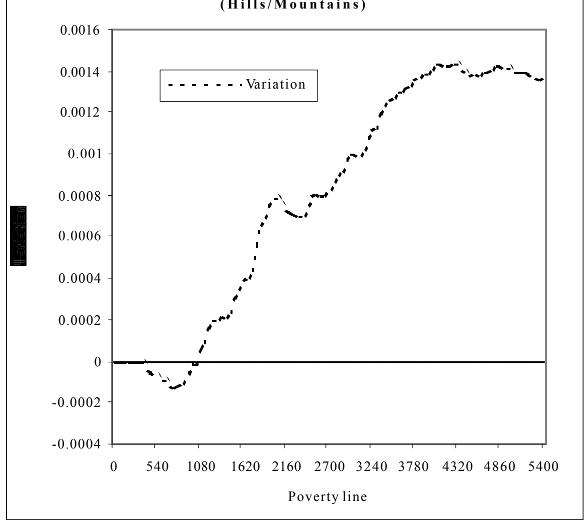

Figure A7: Variation in density functions (Urban)

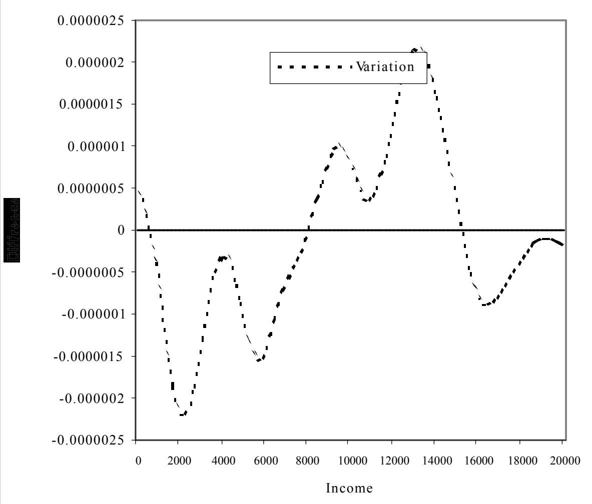

Figure A8: Variation in density functions (Terai)

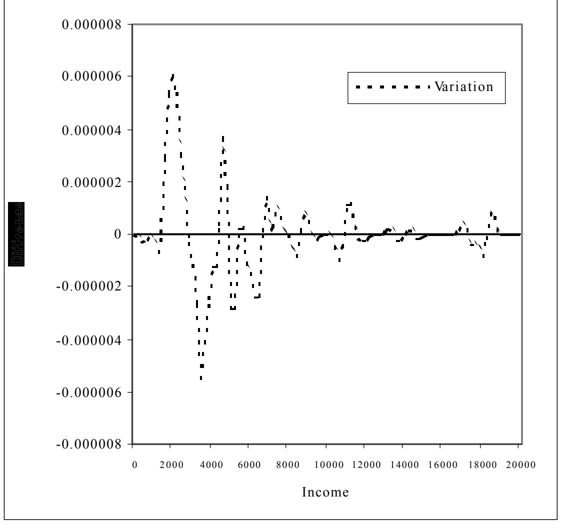

Figure A9: Variation in density functions (Hills and Mountains)

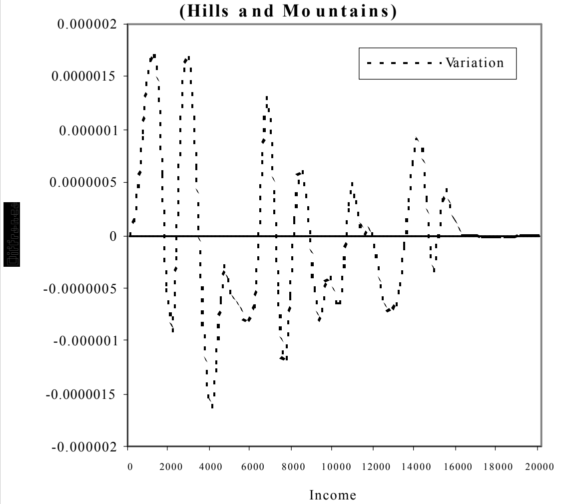

Figure A10: Variation in quantile curves (Urban)

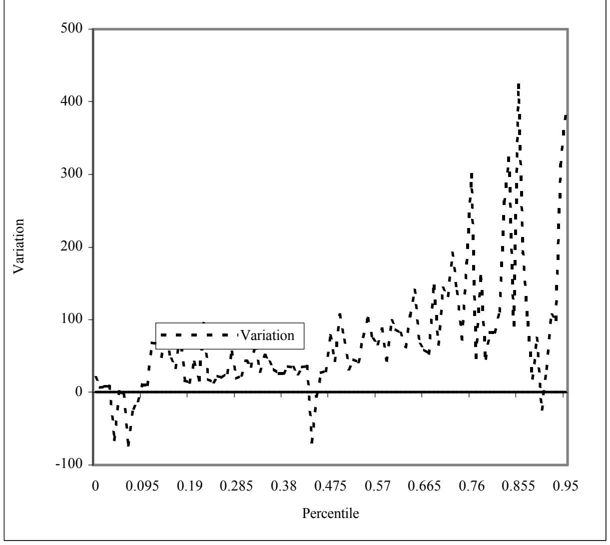

Figure A11: Variation in quantile curves (Terai)

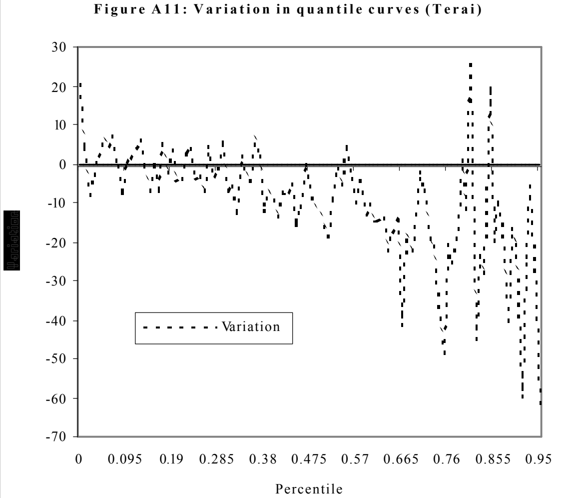

Figure A12: Variation in quantile curves (Hills and Mountains)