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# Computable General Equilibrium Micro-Simulation Analysis of the Impact of Trade Policies on Poverty in Zimbabwe


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## Abstract

The paper uses a micro-simulation computable general equilibrium (CGE) model to study the impact on poverty of trade liberalisation in Zimbabwe. The model incorporates 14006 households derived from the 1995 Poverty Assessment Study Survey (PASS). The novelty of this paper is that it is one among a small group of papers that incorporates individual households in the CGE model as opposed to having representative households, allowing for a comprehensive analysis of poverty. The complete removal of tariffs favours export-oriented sectors and all imports increase. Poverty falls in the economy while inequality hardly changes. The results differ between rural and urban areas.

**Keywords:** **Computable General Equilibrium, Trade Liberalisation, Micro-simulation, Poverty, Inequality**.

**JEL Classifications:** **C68, D31, D58, I32**

This work was carried out with the aid of a grant from Poverty and Economic Policy (PEP) Research Network (**www.pep-net.org**), financed by the International Development Research Centre (IDRC). We are additionally grateful to the Laval University PEP team for intensive data and technical assistance. Special appreciation goes to Professors Bernard Decaluwe and John Cockburn, Dr Nabil Annabi ,Mr. Ismael Fofana and Professor Luc Savard. The paper has also benefited from comments by PEP workshop participants, especially Jim Davies. Any errors remain our own.

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**May 27, 2005**

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## 1. Introduction

There is an ongoing debate on the role of trade policies in alleviating poverty. Winters McCulloch, and McKay (2002), Reimer (2002) and Rajan and Bird (2002), among others, give a comprehensive literature review of the evidence on the impact of trade liberalization and poverty. Reimer (2002) summarizes the main links between trade and poverty from the Winters (2000) paper and concludes that there is no simple generalization about the relationship between trade liberalization and poverty, and that it is difficult in one study to take into account all these linkages. It does seem though that there is no strong evidence that trade liberalization will increase poverty or vulnerability but no guarantees either that the poor will always benefit. These conclusions seem to suggest that such evidence from a particular country must be obtained empirically. An important question is therefore, to what extent is the poverty in Africa attributable to trade liberalisation? Using the example of Zimbabwe, this paper explores how successful trade liberalisation has been in alleviating poverty and improving income distribution.

Like many other countries, Zimbabwe implemented a comprehensive trade liberalization programme in 1991 which reversed a long tradition of *dirigisme*. Import controls, industrial licensing and fixed exchange rate associated with the previous period were dismantled. Despite the serious drought in 1991-92, liberalisation policy was not reversed. The aggregate response of trade to the opening up was quite dramatic. Total trade rose from 45 % of GDP in 1988, to more than 100 % ten years later. Despite compelling evidence of its many benefits, trade liberalisation still remains an unfinished business in Zimbabwe.

While it is generally agreed that the programme significantly altered the contours of the Zimbabwean economy, it is also clear the programme could have sharpened inequality and

increased poverty. Poverty has been on the increase in Zimbabwe, particularly since the implementation of the structural adjustment program in 1991 leading people to blame the reforms for increased poverty. For the reader who is more interested in trade policy effects than Zimbabwe, the question is whether Zimbabwe's experience is an inevitable consequence of trade liberalization or whether it is simply a result of 'local' mismanagement. This paper will attempt to show that, while the last of these reasons is important, there are lessons to be drawn by a wider audience.

This paper aims to establish the longer-term impact of trade liberalisation on incomes, poverty and inequality in Zimbabwe. In thinking about these lessons, it is useful to realize that the majority of computable general equilibrium (CGE) models used in poverty and inequality analysis are aggregated CGEs with representative households used to infer changes on income distribution due to trade liberalisation. In such models, not much can be done in terms of poverty analysis since, by its nature, the study of poverty relies on micro data. To overcome this limitation we replace the assumption of a representative household by incorporating all the households from a nationally representative survey. In this way, we endogenize intra-group variations. To our knowledge there is no work yet that looks at poverty and trade at the household level in a CGE model in Zimbabwe.

The rest of the paper is arranged as follows; we first discuss some relevant country background, then we give a brief review of the literature with emphasis on different methodologies. The following sections discuss the model, and then the simulation results. The final section concludes.

## 2. Trade liberalization in Zimbabwe

Trade liberalisation meant a shift from the rationed allocation of foreign currency to market based access. The purpose of this was to extend the growth opportunity provided by international markets from the enclave of agriculture and mining during the eighties, to other activities in which Zimbabwe might have a competitive advantage. This was expected to create a high level of export growth and also open the economy to external competition. This would earn the country foreign currency, increase productivity, promote growth and employment and thus reduce poverty. The relocation of resources in response to the liberalisation was to be guided by the signals provided by trade and tax policies and these in turn have implications on income distribution and poverty.

Reforms in trade policy were gradually undertaken after the implementation of the structural adjustment programme. Import controls, industrial licensing and fixed exchange rate of the previous regime were dismantled. Before the liberalisation period, tariffs were used mainly as an instrument to raise revenue with the role of protection of industry being assigned to other import and exchange controls. This, however, changed after liberalisation because of the abolition of quantitative trade restrictions. Pressure on the balance of payments led government to turn to tariffs for reducing import demand. In 1997 a new tariff structure was launched (see Table 1). The major contribution was a reduction in the rates and a rationalisation of band structures. The other aim was to lower duties on raw materials and other inputs in an effort to eliminate or reduce tariff evasions that had been rife before that period. Some major policy reversals though have since occurred with some rates being increased and others lowered further.

In principle, trade liberalisation should lead to an acceleration of growth and productivity through greater allocative efficiency and better resource allocation. In practice, however, with the exception of perhaps Southeast and East Asia, the growth record of most other regions and countries during the 1980s and 1990s has not been impressive. In the case of Zimbabwe also, the growth rate was higher at 4.2 per cent during the 1980s than during Unilateral Declaration of Indpendence era (1971-79) (4.1 per cent) and during 1991-2000 (0.3 per cent). In 1999 GDP growth was flat, fell deeply in 2000 and an even bigger fall is forecast for the next few years at least. Over the period 1990 to 1998, the annual projected growth in population has been an average of 2.6 %. Alternate projections for 1995 to 2000 are an average population growth rate of 1.4 %. Bearing in mind that the economic growth rate was only 0.3 % between 1991 and 2000, this population growth rate suggests declining per capita growth and hence living standards. This has serious implications for poverty. Further, evidence also shows a fairly high level of income/wealth inequality in Zimbabwe.

Total exports grew steadily from slightly over Z$5 billion in 1991 to a little over Z$25 billion. Thus a broad analysis of the performance of exports in the regulated, transition and liberalized periods suggests that the reforms may have stimulated export growth. During the pre-adjustment period (1981-90) the US$ value of exports grew by only 2.4 per cent per annum. Between 1994 and 1998 export growth averaged 5% per year. The rate of growth was reversed in 1997 and there was a substantial decline in 1998. This downturn continues through the new millennium. Imports also grew steadily but by less than exports from Z$5 billion in 1991 to Z$20 billion in 1996 (Reserve Bank of Zimbabwe, 1997). Relative manufacturing output declined since the start of the reforms. In 1990, the manufacturing sector contributed 22.8% of GDP. By 1996 this had declined to 20.7% and to 17.1% by 1998. In the ESAP period, overall real GDP declined by 3.8%. The decline in the manufacturing

sector alone accounted for most of this. If it were not for positive growth in Finance and other sectors, GDP would have fallen by more than 3.8%. After 1994, although there was positive growth in GDP (11.9% increase up to 1998), with most sectors growing, the manufacturing sector continued its decline (see also Table 2 above). This suggests that the falling share of manufacturing can be interpreted as de-industrialization rather than simply relative shifts in sector sizes (Bhalla *et al*, 1999).

Poverty has increased in the nineties ever since the onset of the reform programme (World Bank, 1998). The Central Statistics Office (CSO)'s Income, Consumption and Expenditure Survey (ICES) of 1990-91 and 1995-96 are some of the major sources of most estimates on poverty and income inequality. Using this data the World Bank (1995) estimated that 25% of the population of Zimbabwe was poor whereas 7% were very poor in the early nineties. The results from the 1995 Poverty Assessment Study give higher poverty figures for 1995 than those for the World Bank, an indication that poverty has been increasing in the nineties (PASS, 1996). The PASS survey found that poverty is more prevalent in rural areas with 75% of households in the total poor category compared to 39% in the urban areas. The highest incidence of poverty is in the communal areas (84% of households), followed by the resettlement areas and small-scale commercial farms (70%), large-scale commercial farms (57%) and urban areas (39%). Rural areas have the highest distribution of all classifications of poverty as shown in Table 2 below.

As might be expected, the poorest households are those without employment, and the least poor are those that own businesses and are themselves employers (Table 3). In terms of skill, Table 4 shows that the unskilled workers are the poorest. These consist of unskilled workers in agriculture, industry and in the informal sector. By 1999 the population below the poverty

line had risen to 60% (World Bank, 2002).

With a Gini coefficient of 57.83, Zimbabwe ranked fifth in inequality in 1990 out of a total of 108 African countries. There are several lines along which inequalities occur in Zimbabwe. Some of the main ones are along racial lines, along urban and rural dwelling, along ownership of factors of production, and along skill. The CSO found that in 1990/91, the greatest inequality was measured in communal areas using the Theil index (CSO, 1995). It is here that the majority of Zimbabweans reside. Generally it is agreed that inequality in Zimbabwe has been on the increase since the beginning of the reforms. For instance, the share of GDP going to wages and salaries fell from 57.3% in the late eighties to 45% in the first half of the nineties while that of profits went up between the two periods. Thus, more poverty and income inequality was witnessed after the reform period.

The land reform policies and land invasions from 2000 have greatly disrupted the economy of Zimbabwe. The agricultural sector, which has traditionally been the main contributor to growth in Zimbabwe (contributing more than 60% of the foreign currency in the 1990s), has been severely slowed down. The controversial land reforms were meant to redistribute land from the mainly white minority to the black majority. However, the programme was widely criticised from both within and outside Zimbabwe. The reforms not only led to reduced output due to uncertainty but reduced output due to lack of resources and expertise on the part of the new farmers. The droughts that have occurred in most of the years since the reforms have only made things worse Agriculture's contribution has fallen drastically since the reforms. For instance, Tobacco's production fell by 25% by the end of 2000, maize production fell by 31.4%, wheat by 99% and cotton by 19% (Economic Commission for Africa, 2002). The results of the land reforms have spread to the whole economy mainly

though lack of foreign currency which has fuelled inflation. The negative impact of foreign perceptions and investors has also contributed to the decline in growth ever since the land reforms. Reduced food supply has adversely impacted on the poor. Thus, instead of reducing poverty as the redistribution of land was intended, it has increased poverty from about 61% of the population living below the poverty line in 1998 to 76% by 2000 (Poverty Reduction Forum, 2000). Clearly then there is an urgent need to study issues that are related to poverty in Zimbabwe, and specifically to try and understand the specific contributions of different policies.

This paper contributes towards our understanding of the trade liberalisation to poverty in Zimbabwe. An advantage of this methodology is that different policies and shocks can be evaluated separately in order to gain insights into the *ex-post* results of polices and shocks.

## 3. Model development

*A review of related models*

There has been some previous work on Zimbabwe focusing on the role of trade policy on growth, income distribution and indirectly on poverty (Davies *et al,* 1994; Rattso and Torvik, 1998; Bautista *et al*, 1998; Mabugu, 2001; Chitiga-Mabugu, 2001). As in most other places elsewhere in the world, these models use the representative household assumption and thus can only give results pertaining to average changes in income distribution after policy shocks.

The studies have each different angles, different type of trade liberalisation and different specification. The Davies *et al* (1994) model is the basis of the models by Rattso and Torvik (1998), Mabugu (2001) and Chitiga-Mabugu (2001). This is a static aggregated model using data from 1985. Among other specifications, trade is characterised by foreign currency

rationing rules and a fixed exchange rate. There is a shortage of foreign currency in the model reflecting the situation in the economy at that time. Most of the trade liberalisation experiments are variations of removal of rationing rules, devaluation of the exchange rate while in Mabugu (2001) the consequences of reduction in trade taxes is explored. For Rattso and Torvik (1998), trade liberalisation is characterised by the removal of foreign currency rationing in different stages and not by removal of tariffs. They found that, in the short run, there was a contraction of output and employment after that type of trade liberalisation. They also find that there was a consumption boom as people consumed previously forced savings leading to a rising trade deficit. They used four income distribution groups and generally found that this type of trade liberalisation favoured the richer groups.

Bautista *et al* (1998) offered a different version to these models. They use a Soacial Accounting Matrix (SAM) for 1991, a period marking the beginning of structural adjustment policies in Zimbabwe. They assume a fixed exchange rate and an endogenously determined current account balance to reflect the reality of the base year for their SAM. They also have quantitative import restrictions caused by rationing rules. They simulate among several experiments, a policy of trade liberalization. Trade liberalization in Bautista *et al* (1998) is an experiment or removal of non-tariff barriers, substantial lowering of the tariff rate to a lower uniform rate and removal of foreign exchange controls. This was an experiment directly related to the events of this period of structural adjustment. They find that trade liberalization benefits all groups in the economy although the benefits to the poorest majority group is the least.

In the past few years there has been growth of studies on trade liberalisation and poverty and income distribution using CGE models. Generally there are several approaches that have

been used to study these issues, (for a summary see Davies, 2003). The traditional method is to use an aggregated CGE with representative households to infer changes on income distribution due to trade liberalisation. In such models, not much can be done in terms of poverty analysis since, by its nature, the study of poverty relies on micro data. As a result, of this limitation, there have been attempts to try and pay attention to as much income distribution and poverty data as possible by greatly disaggregating the household types, (see for example Piggott and Whalley (1985)). However, even in such studies comprehensive poverty analysis is not permitted.

As a response to this shortcoming of standard CGE models, various authors have gone back to earlier work by Adelman and Robinson (1979) of assuming a distributional form for the income and using this to estimate poverty changes after a simulation. Demery and Demery (1991) used a lognormal distribution to analyse poverty impacts of policies. Decaluwe *et al* (1999) have used a Beta function as opposed to the lognormal distribution because it is more flexible. A similar type of study was done by Stifel and Thorbecke (2002). These studies show that there is much in terms of poverty and inequality analysis that can be done using this type of analysis. In all the above cases, the traditional CGE is only linked to the micro data after the simulation. Thus the representative household assumption is maintained. Thus, there is no consideration of intra-group distributions which allow for an in depth analysis of poverty. To capture as much heterogeneity as possible among households one needs to use a micro-simulation approach, whose history dates back to Orcutt (1957). The particular form of micro-simulations relevant for this paper is the one where one incorporates household data into the CGE model and simulates the model with all the individual households, (see Cogneau and Robilliard, 2000).

Such an approach was taken by Cockburn (2001) who looks at trade liberalization and poverty in Nepal. He replaces the assumption of a representative household by incorporating all the households from a nationally representative survey. In this way, he endogenizes intra group variations. The households in his model are characterized by their sources of income and consumption patterns. Cockburn's findings lend support to the view that micro simulations are very important for poverty analysis. Cororaton (2003) has also used the same methodology for the Philippines with 24,797 households. He is able to carry out a comprehensive poverty and income distribution analysis.

Decaluwe *et al* (1999) give a comparison of results of poverty and income distribution using three methodologies. They compare three main types of methods: traditional CGEMs with representative households; use of household data or other forms to infer the distribution of each representative household; and the use of household data into the CGEM itself. Their comparisons show that the last mentioned methodology of micro- simulation, is superior to all the others in terms of a comprehensive analysis of poverty and thus, it is a worthwhile exercise for poverty analysis. These results are also confirmed by Savard (2004).

*Model description*

The model used is based on EXTER+ model, (see Decaluwe, Dumont and Savard, 1999; Cockburn and Cloutier, 2002; and Cockburn, Decaluwe and Robichaud, 2004). The model is calibrated to a 1995 SAM for Zimbabwe (Chitiga *et al* 2000). The model has 16 production sectors and activities as shown in Table 5. Eight of these sectors are agriculture based, 4 are manufacturing, 1 mining sector, and 3 are services, including electricity. The model uses 4 factors of production namely, skilled labour, unskilled labour, capital and land. The model incorporates 14006 households. These households are derived from the 1995 Poverty

Assessment Study Survey (PASS). The income and expenditure data for the survey was extracted and reconciled to the SAM sectors, institutions and factors of production.

The total production (XS) is a nested production function, which on top is determined by a Leontief function between value added and intermediates. Intermediate demand by sectors is also modeled in a Leontief function. The produced commodities are all sold through the market. The factors of production are modelled as a CES function between capital and labour. Firms aim to minimize costs and through this determine their factor demands. In the agricultural sector, land is also included in the CES function between the composite factor (capital and labour) and land. Labour skills are modeled as a CES function between skilled and unskilled labour. Capital and land are fixed, and capital is sector specific. For the labour factors, we use a closure where factors are freely mobile between sectors. The labour market closure is therefore that labour is freely mobile, its volume is given and wages for each skill type adjust to clear the market.

The nominal exchange rate is taken as the numéraire. All other prices are variable. The local price is made up of the producer price plus indirect tax. The import price and the domestic price then form the composite price for the composite commodity. The local import price is the world price adjusted by the exchange rate and import taxes. The experiment of removing import taxes will thus have an impact on the composite price. Output price affects the export price and is itself affected by input prices.

The produced output is an aggregate output sold in the domestic market or in the export market. At this stage there is imperfect transformation of the aggregate good into exports and domestic goods given by a constant elasticity of transformation (CET) function. Producers

seek to maximize the revenue from their sales given the constraint in the transformation. Export demand is assumed infinitely elastic. The price received by producers is given in local currency. In the domestic market the good is sold to households, the government and used for investment and intermediate inputs. Domestic prices are flexible and they equilibrate the demand and supply of the different commodities. In the domestic market there are also imported commodities. These are combined in a CES function to form a domestic composite demand commodity (Armington, 1969). International supply of imports are assumed to be perfectly elastic at the given world prices. These Armington specifications allow for twoway trade as well as some degree of independence in domestic prices which reflects the real situation of many countries.

Institutions consist of households, government, firms and the rest of the world. Households receive the bulk of their income from the factors of production. They also receive income transfers from the government, firms, other households and the rest of the world. They spend their income on payment of taxes, transfers to other institutions, savings and then on consumption of commodities. While savings propensity is fixed, we add an auxiliary variable that allows savings to adjust to given investment levels. Consumption demand is specified as a linear expenditure system obtained from maximizing a Stone Geary utility function. Enterprises receive income from capital and transfers from other institutions. They pay taxes, save and transfer income to other institutions but do not consume sectoral output.

The government receives taxes from institutions, commodities and activities. These taxes are given as fixed *ad valorem* rates. Direct taxes apply to enterprises and rich households. Government expenditure is on commodities and on transfers to other institutions. All transfers to households are fixed shares. The government expenditure is fixed and a

compensatory tax by means of a direct tax is instituted. This tax adjustment handles any adjustments required to restore government revenues following a policy shock. Total investment and the current account deficit are fixed and this has the effect of ruling out possible occurrences of a 'free lunch' from unlimited international inflows. The model is square in the sense that the number of equations is equal to the number of variables. It is solved as a system of simultaneous non linear equations. The model reflects a Walrasian economy that solves for relative prices.

**4. Simulation results**

The simulation conducted is a total removal of import tariffs. We present the sectoral and macro results of this experiment first. The data in the appendix shows various base year statistics useful for understanding the results. For instance, we see in Table A1 that three of the agricultural sectors were subjected to tariffs as well as all tradable manufacturing, mining and private services. We expect these sectors therefore to be directly affected by the fall in the price of imports induced by a tariff removal. Table A1 in the Appendix also shows various base case sectoral shares of imports, exports and total output. We see, for instance, that the sector 'all other manufacturing' has the largest share of imports while tobacco has the largest share of exports. Most agricultural goods are exported with almost all tobacco and tea and coffee being exports. We also see that the largest contribution to value added is the tertiary sector followed by the industrial sector and then the primary sectors.

As expected, the initial effect of the experiment is to reduce all import prices in local currency by an overall 10.9%. As a result, imports go up overall by 4.9% as Table A2 in Appendix 1 shows. Figure 1 shows that the sectoral import price effect is related to the initial tariff. The higher the initial tariff, the higher the price fall. The main beneficiaries in

increased imports are the sectors that had previously high protection such as horticulture (39%), and grain (21.3%). It should be mentioned however, that except for manufacturing sectors, imports contribution to total output in most other sectors is quite low as seen in Table A2. Thus the output effects and price advantages from reduced tariffs are also affected by this. The increase in imports, which implies a reduction in domestic demand, forces domestic prices to fall. However, in the agriculture sectors there is a reallocation of resources to the export-oriented sectors leaving the grain and livestock sectors with much less production than before. The result of this reduced output puts pressure on prices in these sectors, thereby increasing the price of food. However, for most other sectors, the domestic prices fall.

The result of reduced domestic prices against given export prices is that the export market becomes more competitive than the local market. All previous major exporters, such as tobacco and cotton, some manufacturing, mining and private services increase their exports. These sectors also show an increase in overall production. Thus in terms of total output, only some agriculture sectors, such as cotton and tobacco (11.8%), tea and coffee (5.8%) and some mining (1.8%) and private service sectors (1.5%) see an increase. All other sectors, particularly the manufacturing sectors, end up shrinking in size after this simulation. The grain sector is additionally affected by the fact that it was highly protected before the simulation. Thus, trade liberalization has lead to a phenomenon similar to a de-industrialization in the manufacturing sector. The economy-wide output effect is a fall in production of –0.2%.

Labour is one of the main resources in which the poor are abundantly endowed and thus, determines their status after a shock. The sectors that show an increase in labour demand after this experiment are mainly primary and tertiary. These sectors use more unskilled workers

than the sectors which have shrunk. We thus expect an increase in demand for this type of labour and a fall in demand for skilled labour. The prices of the factors move to equilibrate the labour market and the results in Table A4 show that the increase in demand for unskilled labour works to increase its price (10.4%), while the reduced demand for skilled labour leads to a fall in the price (-11.4%) of this factor. Land values increase because of the increase in some of the agricultural sectors. This tends to reduce the demand for the factor. For capital, the fall in the general economic performance depresses demand for the factor leading to a fall in its return by 6.2%. The results suggest benefits especially for agriculture farmers that produce export oriented crops and the factors of production that they use. Generally, we see that the experiment leads to a reallocation of resources from other sectors to the export sectors, mainly agriculture and mining.

The income distribution impact on the households varies depending on their sources of income and composition of expenditures. The generally well off households relying on skilled labour and capital income have been hit the hardest by this policy reform. Those reliant on unskilled incomes benefit through increased income. On the other hand, it may be expected that farmers in the rural areas have benefited from this policy because their incomes have gone up. However, we must be careful to recall that rural households are very diverse in that there is a small group of large scale farmers coexisting with a large group of communal farmers. Although the land reform process would have somewhat affected this mid-nineties picture, we expect that the general picture would still be a case of many small communal farmers, coexisting with a smaller number of larger more commercial oriented farmers at the end of the land reforms.

As mentioned earlier, the advantage of micro-simulation is that a further probe into the

impact of the policy on poverty and inequality can be carried out. This is because we introduce household income explicitly into the model. We have thus introduced heterogeneity and dispensed with the assumption of the representative household. We compute some poverty indicators as shown in Table 6. This is done by using the Foster, Greer and Thorbecke (FGT) measures to decompose poverty into the poverty headcount (population below the poverty line) poverty gap and the severity of poverty. We compute these measures using the software DAD (Duclos, Araar and Fortin, 2002).

For the continuous case, the FGT index is defined as:

1. $$P_\alpha = \int_0^z \frac{(z-y)^\alpha}{z} f(y)dy$$

Where z is the poverty line, y is income and α is the degree of aversion to poverty.

The poverty headcount index, when the degree of aversion to poverty is given as α= 0, gives us the number of households below the poverty line divided by the total households in the group. This thus shows the prevalence of poverty but does not give us an indication of the degree of poverty. Poverty depth informs us on the mean shortfall of the poor's income below the poverty line. In this case α=1 and we are able to tell the level of income transfer needed to bring all poor households to the poverty line. Finally, we calculate an index for the severity of poverty, which considers the inequality among households that are poor. In this case with α= 2, and more importance is accorded to the shortfalls of the poorest households. The weight assigned to each household is equal to its shortfall from the poverty line (see also Ravallion, 1994). Using the household size and the consumption results, the following poverty results were found for this experiment.

We see from Table 6 that the removal of reforms leads to a fall in poverty, seen through the reduction in head count, poverty gap and the severity of poverty between the base and after simulation FGT values. Further, we notice that on comparing the changes between rural and urban areas, the greater reduction in poverty occurs in the urban areas as opposed to rural areas. This is partly explained by the fact that most unskilled people whose incomes increase due to the reforms are urban based.

FGT measures are quite sensitive to the choice of the poverty line. To check that for a wide range of selected poverty lines, the results are maintained, we plot the difference in the before and after simulation FGT measures for a wide range of poverty lines. We see in Figure 2 that for the full range, for all the population, poverty is reduced after the simulation. This same result was also found for poverty severity and the poverty gap measures.

Figure 3 shows that the final choice of the poverty line matters. By looking at the variation in headcount ratio, there appears to be some increase in the number of those who are the very poor but a definite reduction in the number of those that are poor to moderately poor, who form the larger of the two groups. This confirms the result already found that in general, poverty is reduced by this trade policy reform.

The poverty gap variations reinforce these results as seen in Figure 4. There is only a slight increase in the poverty gap among the very poorest, but there is a fall in poverty among the rest of the poor groups. Figure 5 shows the variation in terms of poverty severity, and the same results are supported. Apart from the small very poor group, poverty severity falls in the economy with trade liberalization.

Next we compute inequality indexes. First we use the Gini- coefficient, whose formula is:

2. $$Gini = \frac{1}{\mu N(N-1)} \sum_{i} \sum_{j} |x_i - x_j|$$

where x is income and N is population. `

The assumption that all capital is fully mobile between sectors has meant that the general reduced activity in the industrial sector has dampened all capital prices. This includes also agricultural capital. As a result even though incomes of export agriculturalists increase, their income from capital falls. This against the fact that low incomes have increased means that we expect incomes of the poor to rise while those of the rich are not increasing as much. Indeed the inequality indexes show that there is a fall in inequality although it is very small. Thus, with free mobility, we see that tariff reduction will tend to slightly reduce inequality through income benefits for the poorer groups of society as seen in Table 7. In the short run with no free mobility of capital we would expect agricultural capitalists to benefit from their scarce capital, thereby leading to increased inequality in the rural areas.

The inequality results are confirmed by the Atkinson index of inequality whose results are reported in Table 8. This index is given by the following formula:

3. $$I_e = \left[ \sum_{i=1}^{n} f(I_i) I_i^{1-\varepsilon} \right]^{1/1-\varepsilon}$$

It calculates 1-($I_e$/U) where $I_e$ is the uniform income level which when received by all households leads to the same total welfare as the actual income distribution. U is then the

prevailing mean income. We use both $\varepsilon = 0.5$ and 0.75 to indicate difference level of the society's aversion to poverty.

The results show that, inequality has either remained the same or has slightly fallen after the reforms. This is because of the improvement of incomes for the unskilled workers with a fall in capital incomes as well as skilled incomes. This inequality result is most likely driven by the factor closure. For instance, had capital not been allowed free mobility, we would have expected large scale farmers to benefit much more, than presently leading to increased inequality in the rural areas. This result tells us that in the longer run, trade liberalisation does not harm income distribution and could even improve it. The Lorenz curves in figure 6 for the whole population confirm the above results by showing that there is hardly any difference in distribution before and after the simulation.

Cockburn (2001) finds that for Nepal, a complete removal of tariffs reduces poverty in urban areas but increases it in rural areas especially in the case of those moderately poor. Inequality increased in urban areas and some rural areas. Corroraton (2003) finds that poverty falls in the Philippines after a complete tariff reduction but that income distribution worsens.

**5. Summary and conclusion**

The paper uses a micro simulation computable general equilibrium model to study the impact on poverty of trade liberalisation in Zimbabwe. The model is static in nature and of the neoclassical type. It is based on the Exter+ family of models developed by Decaluwe *et al* (2001) and Cockburn *et al* (2003). It contains sixteen sectors, four factors of production and fourteen thousand and six households. The data are from 1995. The complete removal of tariffs favours export oriented sectors. The unskilled labour factor used intensively in

agriculture, mining and services benefits from this policy. Most manufacturing sectors shrink leading to a fall in demand for skilled labour and capital. These factors have to reduce their remuneration for equilibrium to occur. Returns to land increase as export agriculture expands. Overall consumer prices fall and consumption expenditure also falls in the economy.

The policy reduces overall poverty in the economy. On closer inspection we notice that poverty falls more in the urban than in the rural areas. In terms of income distribution, we see that there is hardly any change in inequality but a slight tendency towards more equitable distribution. This is not too surprising given that, in general, poor people gain while the capital owners and the skilled labourers are adversely affected.

The methodology used has helped us to understand the impact of this policy on overall poverty as well as on regional poverty. Thus, whereas the macro CGE model might have been able to tell us the changes in income, the richer poverty and inequality information can only be obtained from such a micro-simulation CGE model. The particular changes in poverty and inequality that occur in rural versus urban areas are important for the government in its implementation of such recovery programmes as the social dimensions of adjustment that were implemented in the nineties to try and alleviate the effects of reforms.

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**Tables and figures in the order in which they are discussed in the article.**

Table 1: Structure of tariff rates

| Goods | Previous rates of duty (before 1997) (%) | New rates of duty (from 1997) (%) |
|---|---|---|
| Raw materials | 0-40 | 5 |
| Merit goods: | | |
| -Education | 0-40 | 5 |
| -Medical | 0-20 | 0-20 |
| -Goods for the blind | 0-10 | 0 |
| Capital goods | 0-25 | 0 |
| Tools | 0-20 | 5-15 |
| Spares | 0-56 | 15 |
| Partly Processed Inputs | 0-55 | 15 |
| Intermediate goods and consumables | 0-35 | 20-30 |
| Finished goods | 0-85 | 40-85 |

Source: (Reserve Bank of Zimbabwe, 1997 p20).

Table 2: Households % distribution of poverty by region

| | **Very poor %** | **Poor %** | **Non poor %** |
|---|---|---|---|
| **National** | 45 | 16 | 39 |
| **Rural** | 60 | 15 | 24 |
| **Urban** | 21 | 18 | 61 |

Source: Table 3.2 PASS

Table 3: Employment status by poverty level

| Employment status | Very poor | Poor | Non poor | Total |
|---|---|---|---|---|
| **Employer** | 15.0 | 9.7 | 75.3 | 100.0 |
| **Own account worker** | 44.8 | 19.8 | 35.4 | 100.0 |
| **Unpaid family worker** | 77.8 | 11.4 | 10.8 | 100.0 |
| **Paid employee** | 21.7 | 19.8 | 58.5 | 100.0 |
| **Unemployed** | 52.8 | 19.3 | 27.9 | 100.0 |

Source: Table 3.2.3 PASS

Table 4: Persons by poverty level and skill level – Rural

| | Rural | | | Urban | | |
|---|---|---|---|---|---|---|
| **Skill** | **Very poor** | **Poor** | **Non poor** | **Very poor** | **Poor** | **Non poor** |
| **Professional** | 15.6 | 7.8 | 76.5 | 6.6 | 6.9 | 86.5 |
| **Skilled** | 45.4 | 17.5 | 37.1 | 12.8 | 10.6 | 70.5 |
| **Semi skilled** | 53.6 | 18.3 | 28.1 | 18.5 | 21.5 | 60.0 |
| **Unskilled** | 73.2 | 14.0 | 12.8 | 32.3 | 23.4 | 44.3 |

Source: Table 12.11 PASS

Table 5 Sectors included in the model

| Name used in Games code and reporting | Meaning of the name |
|---|---|
| Agrain | Grain crops |
| Ahoticu | Horticulture crops |
| Ateacoffe | Tea and coffee |
| Acottobc | Cotton and tobacco |
| Alivestock | Livestock |
| Afishery | Fishery |
| Aforestry | Forestry |
| Amining | Mining |
| Afoodproc | Food processing |
| Atextile | Textile |
| Allothemauf | All other manufacturing |
| Aconstrn | Construction |
| Aewtdts | Water, electricity and other trade services |
| Apubsv | Public services |
| Aprivsv | All other private services |

Figure 1: Initial tariff rates (tm) and the resulting fall in import prices (PMi) after the shock.

Source, SAM 1995, Chitiga *et al*, (2000) .

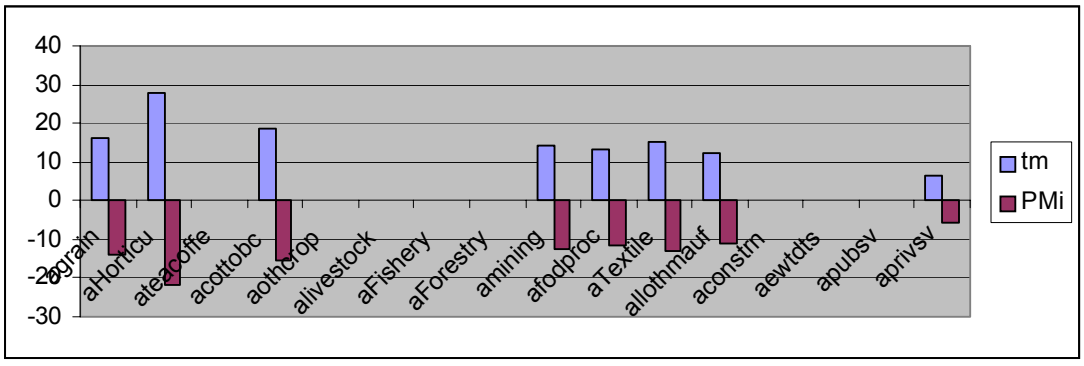


Table 6: Poverty results using Normalized FGT measures

| | | Base | After simulation | Variation |
|---|---|---|---|---|
| Poverty head count ($\alpha$=0) | | | | |
| | **ALL** | 0.62 | 0.6 | -3.33 |
| | | *0.00485* | *0.00487* | |
| | **rural** | 0.72 | 0.71 | -1.41 |
| | | *0.005247* | *0.005299* | |
| | **urban** | 0.27 | 0.26 | -3.85 |
| | | *0.00885* | *0.008736* | |
| Poverty gap ($\alpha$=1) | | | | |
| | **ALL** | 0.33 | 0.32 | -3.13 |
| | | *0.003248* | *0.003226* | |
| | **rural** | 0.398 | 0.389 | -2.31 |
| | | *0.003736* | *0.003713* | |
| | **urban** | 0.077 | 0.074 | -4.05 |
| | | *0.00346* | *0.003364* | |
| Poverty severity ($\alpha$=2) | | | | |
| | **ALL** | 0.21 | 0.2 | -5.00 |
| | | *0.00485* | *0.00488* | |
| | **rural** | 0.26 | 0.25 | -4.00 |
| | | *0.00308* | *0.00304* | |
| | **urban** | 0.035 | 0.033 | -6.06 |
| | | *0.00226* | *0.00221* | |

Note: The figures in italics are standard deviations

Figure 2: Headcount ratio curves (FGT with α = 0)

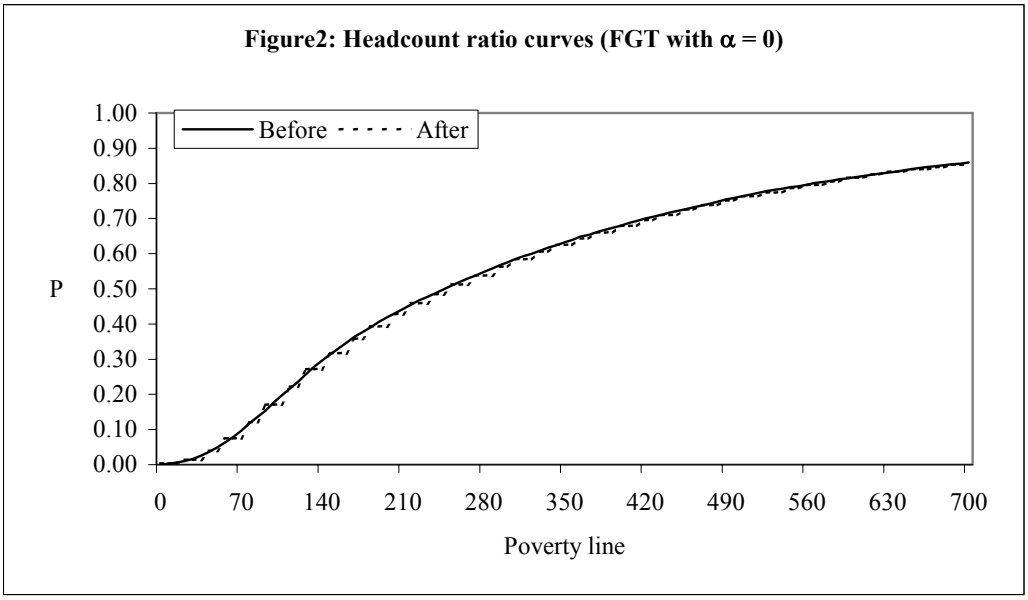



Figure 3: Variation in headcount ratio Curves (FGT with α = 0)

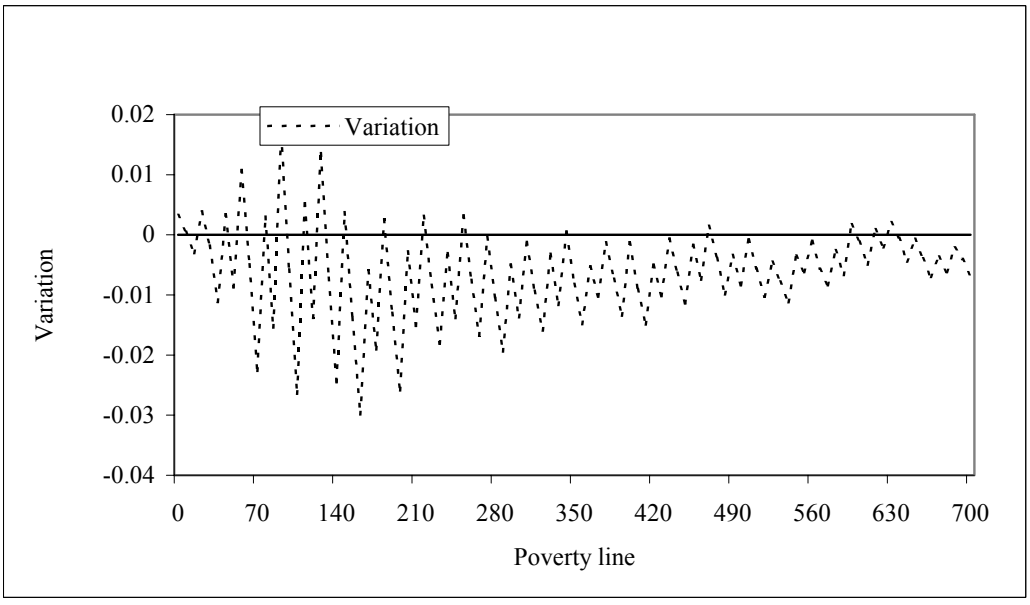


Figure 4: Variation in poverty gap curves (FGT with α = 1)

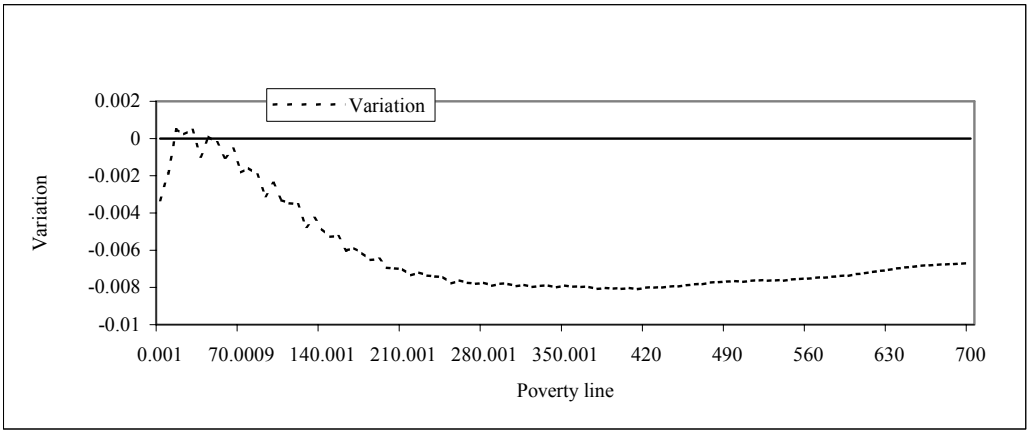



Figure 5: Variation in poverty severity curves (FGT with α = 2)

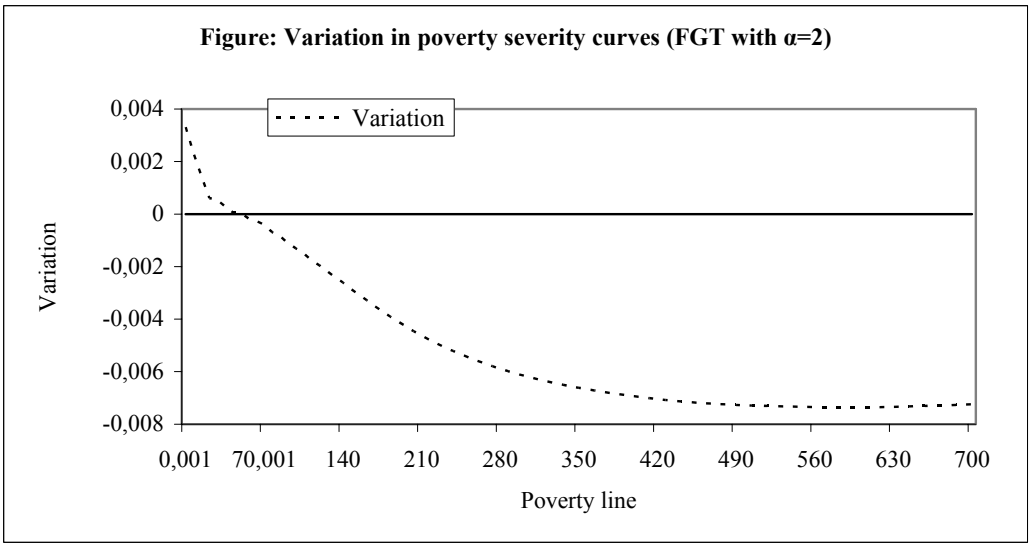



Table 7: Gini index of inequality

| | Base | After simulation | variation |
|---|---|---|---|
| **ALL** | 0.603 | 0.6 | -0.50 |
| | *0.02037* | *0.02093* | |
| **Rural** | 0.616 | 0.614 | -0.33 |
| | *0.02864* | *0.029236* | |
| **Urban** | 0.479 | 0.477 | -0.42 |
| | *0.028207* | *0.02921* | |

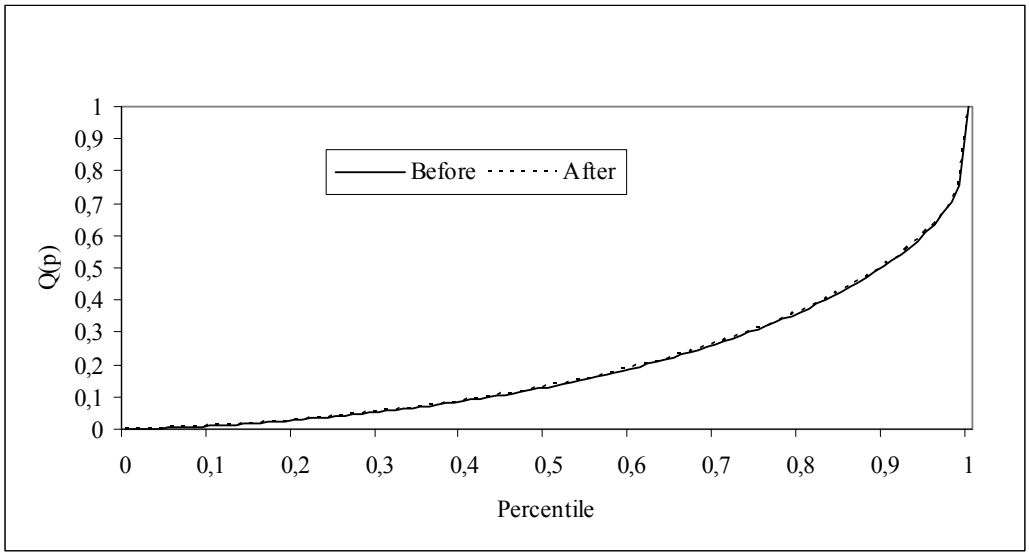
Note: The figures in italics are the standard deviations

Table 8: Atkinson index of inequality

| | | Base | After simulation | Variation |
|---|---|---|---|---|
| ε =0.5 | | | | |
| | **ALL** | 3.3 | 3.3 | 0.00 |
| | | *0.027739* | *0.028399* | |
| | **rural** | 3.5596 | 3.558 | -0.04 |
| | | *0.039513* | *0.04019* | |
| | **urban** | 2.077 | 2.077 | 0.00 |
| | | *0.032795* | *0.033912* | |
| ε =0.75 | | | | |
| | **ALL** | 4.23 | 4.23 | 0.00 |
| | | *0.027452* | *0.028037* | |
| | **rural** | 4.4 | 4.4 | 0.00 |
| | | *0.038968* | *0.040191* | |
| | **urban** | 2.75 | 2.74 | -0.36 |
| | | *0.03489* | *0.036069* | |

Note: The figures in italics are the standard deviations

Figure 6: Lorenz Curves



## Appendix A: Miscellaneous Tables

Table A1: Tariff rates, import prices, elasticities and various shares.

| Sectors | tm | PMi | CES | CET | VAi/VA | Mi/M | EXi/EX | Mi/Qi | EXi/XS |
|---|---|---|---|---|---|---|---|---|---|
| Agrain | 16.3 | -14 | 1.5 | 1.5 | 2.4 | 0.4 | 2.2 | 6.7 | 25.9 |
| AHorticu | 28 | -21.9 | 1.5 | 1.5 | 0.6 | 0.1 | 0.2 | 2.7 | 7 |
| Ateacoffe | 0 | 0 | 0 | 1.5 | 0.5 | 0 | 1.8 | 0 | 78.2 |
| Acottobc | 18.5 | -15.6 | 1.5 | 1.5 | 7.3 | 0.2 | 27.9 | 6 | 90.9 |
| Aothcrop | 0 | 0 | 0 | 1.5 | 1.7 | 0 | 3.9 | 0 | 49.4 |
| Alivestock | 0 | 0 | 0 | 1.5 | 2.6 | 0 | 6 | 0 | 48.9 |
| AFishery | 0 | 0 | 0 | 0 | 0.1 | 0 | 0 | 0 | 0 |
| AForestry | 0 | 0 | 0 | 0 | 0.3 | 0 | 0 | 0 | 0 |
| Amining | 14.4 | -12.6 | 1.5 | 1.5 | 4.5 | 1.3 | 12.5 | 9 | 50.3 |
| Afodproc | 13.3 | -11.7 | 1.5 | 1.5 | 7.8 | 6.7 | 2.5 | 17.1 | 7.4 |
| ATextile | 15 | -13.1 | 1.5 | 1.5 | 2.1 | 3.5 | 1.7 | 20.5 | 12.9 |
| allothmauf | 12.4 | -11.1 | 1.5 | 1.5 | 17.2 | 82.3 | 18.7 | 53.3 | 22.2 |
| aconstrn | 0 | 0 | 0 | 0 | 3.1 | 0 | 0 | 0 | 0 |
| Aewtdts | 0 | 0 | 0 | 0 | 19.4 | 0 | 0 | 0 | 0 |
| Apubsv | 0 | 0 | 0 | 0 | 14 | 0 | 0 | 0 | 0 |
| Aprivsv | 6.3 | -5.9 | 1.5 | 1.5 | 16.5 | 5.6 | 22.5 | 10.6 | 31.6 |
| ALL* | 12.3 | -10.9 | - | - | 100 | 100 | 100 | 34.6 | 34.2 |

* Average variation for volumes - Laspeyres index variation for prices , see definitions below.

Table A2: Volume and price changes after the simulation

| | Volume change | | | Prices | | |
|---|---|---|---|---|---|---|
| Sectors | dMi | dEXi | dXSi | dDi | dPDi | dPi |
| Agrain | 21.3 | -3.4 | -3.6 | -3.8 | 0.3 | 0.4 |
| AHorticu | 39 | -1.7 | -3 | -3.1 | -0.7 | -0.6 |
| ateacoffe | 0 | 7.8 | 5.8 | -3.4 | -8.2 | -2.5 |
| Acottobc | 1.8 | 13.6 | 11.8 | -3.8 | -12.3 | -3.1 |
| aothcrop | 0 | 1 | -0.4 | -2.1 | -2.2 | -1.1 |
| alivestock | 0 | -4.4 | -4.3 | -4.3 | 0.8 | 0.8 |
| aFishery | 0 | 0 | -2.1 | -2.1 | -4.2 | -4.2 |
| aForestry | 0 | 0 | -1.8 | -1.8 | 1.1 | 1.1 |
| Amining | 6.7 | 6.6 | 1.8 | -2.8 | -7 | -4.1 |
| afodproc | 10.1 | 1.2 | -3.4 | -3.7 | -3.5 | -3.2 |
| Atextile | 12.3 | -2.7 | -5.8 | -6.2 | -2 | -1.7 |
| allothmauf | 4.2 | 3.7 | -2.6 | -4.4 | -5.8 | -4.6 |
| aconstrn | 0 | 0 | -2.6 | -2.6 | -4 | -4 |
| Aewtdts | 0 | 0 | -0.6 | -0.6 | -3.1 | -3.1 |
| Apubsv | 0 | 0 | 0.2 | 0.2 | -6.7 | -6.7 |
| Aprivsv | 2.3 | 5.3 | 1.5 | -0.2 | -4.3 | -3.2 |
| ALL* | 4.9 | 6.3 | -0.2 | -2 | -4.3 | -3.6 |

* Average variation for volumes - Laspeyres index variation for prices

Table A3: Shares of factors in value added

| Sectors | QLDi/VAi | NQLDi/VAi | Kdi/VAi | LANDi/VAi | wQLDi/wQLD | wNQLDi/wNQLD | rKDi/rKD | rlLANDi/rlLAND |
|---|---|---|---|---|---|---|---|---|
| Agrain | 8.1 | 37.7 | 32.8 | 21.3 | 0.6 | 7.9 | 1.5 | 23.7 |
| Ahorticu | 11.8 | 28.4 | 40.7 | 19 | 0.2 | 1.6 | 0.5 | 5.8 |
| Ateacoffe | 26.9 | 6.7 | 50.7 | 15.7 | 0.4 | 0.3 | 0.5 | 3.5 |
| Acottobc | 29.3 | 7.6 | 47.6 | 15.5 | 6.2 | 4.9 | 6.6 | 53.3 |
| Aothcrop | 17.7 | 19.6 | 45 | 17.7 | 0.9 | 2.9 | 1.4 | 13.7 |
| Alivestock | 8.7 | 51.5 | 39.8 | 0 | 0.7 | 11.8 | 2 | 0 |
| Afishery | 22.7 | 11 | 66.4 | 0 | 0.1 | 0.1 | 0.1 | 0 |
| Aforestry | 8.9 | 50.6 | 40.4 | 0 | 0.1 | 1.2 | 0.2 | 0 |
| Amining | 24.9 | 2.9 | 72.2 | 0 | 3.3 | 1.2 | 6.2 | 0 |
| Afodproc | 12.3 | 1.5 | 86.2 | 0 | 2.8 | 1 | 12.8 | 0 |
| Atextile | 0 | 21.7 | 78.3 | 0 | 0 | 4.1 | 3.2 | 0 |
| Allothmauf | 34.6 | 7.9 | 57.5 | 0 | 17.3 | 12 | 19 | 0 |
| Aconstrn | 56.6 | 11.9 | 31.5 | 0 | 5.1 | 3.3 | 1.9 | 0 |
| Aewtdts | 35.9 | 11.7 | 52.4 | 0 | 20.2 | 20.1 | 19.4 | 0 |
| Apubsv | 63 | 5.1 | 31.8 | 0 | 25.7 | 6.4 | 8.6 | 0 |
| Aprivsv | 34.8 | 14.5 | 50.7 | 0 | 16.7 | 21.2 | 16.1 | 0 |
| ALL* | 34.4 | 11.3 | 52.2 | 2.1 | 100 | 100 | 100 | 100 |

Table A4: Change in factor remuneration and demand after the simulation.

| Sectors | dPVi | dVAi | dwqi | dwnqi | dri | drli | dQLDi | dNQLDi | dKDi | dLANDi |
|---|---|---|---|---|---|---|---|---|---|---|
| Agrain | 1.4 | -3.6 | -11.4 | 10.4 | -6.2 | 2.7 | -10.4 | -7.3 | 3.4 | -4.7 |
| Ahorticu | -0.5 | -3 | -11.4 | 10.4 | -6.2 | 2.7 | -9.1 | -5.9 | 2.3 | -5.7 |
| Ateacoffe | -5.1 | 5.8 | -11.4 | 10.4 | -6.2 | 2.7 | 6.9 | 10.7 | 6.9 | -1.5 |
| Acottobc | -5.1 | 11.8 | -11.4 | 10.4 | -6.2 | 2.7 | 12.8 | 16.8 | 13 | 4.1 |
| Aothcrop | -2.3 | -0.4 | -11.4 | 10.4 | -6.2 | 2.7 | -4.4 | -1 | 3.4 | -4.8 |
| Alivestock | 1.7 | -4.3 | -11.4 | 10.4 | -6.2 | 0 | -11.4 | -8.3 | 3 | 0 |
| Afishery | -5.5 | -2.1 | -11.4 | 10.4 | -6.2 | 0 | -4.4 | -1.1 | -1.4 | 0 |
| Aforestry | 1.6 | -1.8 | -11.4 | 10.4 | -6.2 | 0 | -9.2 | -6 | 5.5 | 0 |
| Amining | -7 | 1.8 | -11.4 | 10.4 | -6.2 | 0 | 3.5 | 7.1 | 1 | 0 |
| Afodproc | -6.6 | -3.4 | -11.4 | 10.4 | -6.2 | 0 | -1.5 | 2 | -3.7 | 0 |
| Atextile | -2.8 | -5.8 | -11.4 | 10.4 | -6.2 | 0 |  | -16 | -2.7 | 0 |
| Allothmauf | -6.7 | -2.6 | -11.4 | 10.4 | -6.2 | 0 | -2.6 | 0.8 | -3 | 0 |
| Aconstrn | -7.1 | -2.6 | -11.4 | 10.4 | -6.2 | 0 | -2.8 | 0.6 | -3.4 | 0 |
| Aewtdts | -6.1 | -0.6 | -11.4 | 10.4 | -6.2 | 0 | -1.6 | 1.8 | -0.5 | 0 |
| Apubsv | -8.6 | 0.2 | -11.4 | 10.4 | -6.2 | 0 | 1 | 4.5 | -2.2 | 0 |
| Aprivsv | -5.6 | 1.5 | -11.4 | 10.4 | -6.2 | 0 | -0.2 | 3.3 | 2.1 | 0 |
| ALL* | -5.9 | 0 | -11.4 | 10.4 | -6.2 | 2.7 | 0 | 0 | 0 | 0 |

* Average variation for volumes - Laspeyres index variation for prices

Definitions of variables used in the tables

| | |
|---|---|
| tm(i) | Import duties on good i |
| wq(i) | Skilled wage rate |
| wnq(i) | Unskilled wage rate |
| r(i) | Rate of return to capital |
| rl(i) | Rate of return to agricultural land |
| P(i) | Producer price of good i |
| PV(i) | Value added price for sector i |
| PM(i) | Domestic price of imported good i |
| XS(i) | Production of sector i |
| VA(i) | Value added in sector i (volume) |
| KD(i) | Sector I demand for capital |
| LAND(i) | Agricultural land demand |
| LD(i) | Sector i demand for aggregate labour |
| QLD(i) | Sector i demand for skilled labour |
| NQLD(i) | Sector i demand for unskilled labour |
| QLS(i) | Skilled labour supply |
| NQLS(i) | Unskilled labour supply |
| D(i) | Demand for domestic good i |
| Q(i) | Demand for composite good i |
| M(i) | Imports of good i |
| EX(i) | Exports of good i |