Leena Kerkelä

Essays on Globalization – Policies in Trade, Development, Resources and Climate Change

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Abstract

This dissertation on globalization consists of an introduction on the methodology applied, a summary and four independent essays focussing on applied policy research in international trade. The study follows the CGE (Computable General Equilibrium) research tradition. The simulation environment is the publicly available GTAP model. The essays examine the specific topics of trade and aid policies, price liberalization of the Russian energy markets, trade preferences in the sugar sector of the EU and the role of carbon sinks in mitigating climate change.

The introduction presents an overview of the GTAP model with a more detailed description, among others, of the welfare decomposition. Benefits and disadvantages of using these types of models are outlined, including a discussion related to the use of Armington nesting in international trade. The introduction also outlines the summaries of each essay.

The first essay examines trade and aid policies in Mozambique. The essay analyses the impact of a number of alternative options available to Mozambique, including trade agreements, aid and trade facilitation. The results suggest that Mozambique has very little to gain from trade agreements or the Doha Round, although some agreements with the EU do yield some benefit. Trade facilitation and aid-for-trade programs on the other hand have the potential for larger benefits, but these need to be planned carefully. The case study for the aid-for-trade programs is focussed on the sugar sector.

The second essay examines the impact of liberalizing Russia's energy sector. Implementation with GTAP simulations is preceded by an analysis of implicit subsidies in the regulated prices of gas and electricity, which are then incorporated into the GTAP framework. The analysis focuses on the effect of different taxes and subsidies applied to the energy sector with respect to welfare

and real GDP in Russia and abroad. The results are shown to be sensitive to the assumptions on foreign trade. The second part of the paper studies suggested increases in the prices of gas and electricity and indicates that they shift output from domestic markets to exports but the positive increase in efficiency is reliant on the underlying base data.

The third essay investigates the impact of four alternative policy scenarios for liberalizing the EU's sugar sector. The study commences with the explanation of the complexities of the EU sugar market, and continues with a presentation of the policy scenarios that range from the trade preferences granted to LDCs under the EBA and EPA agreements to full liberalization of the EU sugar sector. One of the alternatives is full liberalization in which differences in cost structures of the exporting economies are taken into account. This constraint in production has been implemented by adjusting the shocks in tariffs. The simulations are further analysed with a sensitivity analysis that considers alternative elasticities from the literature. The results highlight the winners and losers of the different scenarios.

The fourth essay focuses on the effects of including carbon sinks into the analysis of the impacts of the Kyoto agreement. The impact of special treatment for Canada and Japan that allows them larger sinks is compared to the effects of the decision of the United States not to sign the Kyoto Protocol. The results indicate that larger sinks clearly benefit Canada and Japan, the role of sinks is also important in New Zealand and Sweden but the effect of the sinks on other countries is marginal. For the world economy and the emission reduction targets, the role of sinks is of minor importance, compared to the US withdrawal from the Kyoto Protocol.

Keywords: global economic analysis, trade liberalization, CGE models, policy analysis

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I hope that I will now have the time to spend even more precious and meaningful moments with all my family and closest friends. My children, Milka and Oskari, have found a slightly ironic way of referring to my research and work. But I know I am loved and appreciated by them all, regardless of my successes or failures at work, and for that, I am truly grateful.

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2. Kerkelä, L. (2004): Distortion costs and effects of price liberalization in Russian energy markets: A CGE Analysis, an edited version of BOFIT Discussion Paper 2:2004

3. Kerkelä, L. – E. Huan-Niemi (2005): Trade Preferences in the EU Sugar Sector: Winners and Losers, an edited version of VATT Discussion Papers, No. 358

4. Pohjola, J. – L. Kerkelä – R. Mäkipää (2003): Credited forest carbon sinks: How the cost reduction is allocated among countries and sectors, Climate Policy, Vol 3, Issue 4, pp. 445–461

Table of Contents

1 Introduction and Summary **1**

1.1 Applied general equilibrium models in the analysis of global policies 3
1.2 Description of GTAP model 6
1.3 Interpreting the results 14
1.4 Implications from the composite Armington structure in trade for welfare analysis in trade liberalization 16
1.5 Summaries of the essays and main findings 22
1.5.1 Essay 1: Trade and aid policies: Their impact on economic development in Mozambique 23
1.5.2 Essay 2: Distortion costs and effects of price liberalization in the Russian energy markets: A CGE analysis 24
1.5.3 Essay 3: Trade preferences in the EU sugar sector: Winners and losers 25
1.5.4 Essay 4: Credited forst carbon sinks: How the cost reduction is allocated among countries and sectors 26
1.5.5 Technical part 27
1.6 Conclusions 31
References 31

2 Trade and Aid Policies: Their Impact on Economic Development in Mozambique **37**

2.1 Introduction 38
2.2 Mozambique's position in trade regimes 40
2.3 Aid, aid dependency, and donor behaviour 43
2.3.1 Aid allocation 43
2.3.2 Donor approaches to private sector development 45
2.4 Measuring trade and aid in CGE framework 50
2.4.1 Trade agreements and welfare in Mozambique 50
2.4.2 Measuring the welfare gain from aid 52
2.5 Structural effects of trade and aid 54
2.5.1 Aid, trade and development – description of simulations 54
2.5.2 Results of the simulations 56

2.5.3 Sensitivity of aid and trade facilitation shocks 60
2.5.4 Special case study – sugar exports to the EU 63
2.5.5 Discussion 68
2.6 Concluding comments 68
References 70
Appendices 75

3 Distortion Costs and Effects of Price Liberalization in the Russian Energy Markets: A CGE Analysis 77

3.1 Introduction 78
3.2 The role of Russian energy in trade and the domestic economy 80
3.3 Elements of energy market reform in Russia 85
3.3.1 Price liberalization 86
3.3.2 Tax reform 87
3.3.3 Design of market structure 88
3.3.4 Global interest for Russian energy reform 89
3.4 Analysis of Russian energy markets with the GTAP model 90
3.5 The costs of distorted energy markets 93
3.6 The impact of price increases of domestic gas and electricity 100
3.7 Conclusions 105
References 106
Appendices 109

4 Trade Preferences in the EU Sugar Sector: Winners and Losers 115

4.1 Introduction 116
4.2 The EU sugar sector, world sugar market and trade preferences 117
4.2.1 EU preferential agreement with the African, Caribbean, and Pacific countries 120
4.2.2 EU preferential agreement with the Least Developed Countries (LDCs) 121
4.3 Studying the changes in the global sugar markets by using the GTAP model 122
4.3.1 Implied tariffs from the tariff quota system of the EU sugar regime 125

4.3.1.1 Tariffs, quotas and tariff rate quotas 125
4.3.1.2 Changes made within the tariff quota system of the applied EU trade preferences 128
4.3.2 Complete liberalization of sugar imports into the EU for only a set of countries or for all countries in the world 130
4.4 Simulation results for the unilateral liberalization of the EU sugar sector 132
4.4.1 The elasticity of substitution for sugar trade 136
4.5 Discussion and caveats 139
References 140
Appendices 143

5 Credited forest carbon sinks: How the cost reduction is allocated among countries and sectors 151

5.1 Introduction 152
5.2 Carbon sinks in the Kyoto Protocol and in the model simulations 153
5.2.1 Forest carbon sinks under Articles 3.3 and 3.4 153
5.2.2 Treatment of forest carbon sinks in the policy simulations 157
5.3 Description of the model 158
5.4 Scenarios 161
5.4.1 Baseline projections 161
5.4.2 Policy scenarios 162
5.5 Results and discussion 163
5.5.1 Which countries benefit from carbon sinks? 163
5.5.2 What is the importance of the sinks agreement compared to the US withdrawal? 165
5.5.3 How are other countries and different sectors affected by the larger sinks allowed for Canada and Japan? 166
5.5.4 Can we find any basis for allowing larger sinks for Canada and Japan? 168
5.5.5 How are benefits from carbon sinks distributed within the economy? 170
5.6 Conclusions and caveats 171
References 175
Appendix 178

List of tables and figures

Table 1.1 An open economy SAM with a government sector
Table 1.2 Welfare decomposition in a simple simulation
Table 1.3 Description of simulations in the study
Table 2.1 Average tariffs in agriculture between Mozambique and its main trading partners
Table 2.2 Changes in production (percentages) in different scenarios
Table 2.3 Changes in exports (percentages) in different scenarios
Table 2.4 Revelead comparative advantage in Mozambican exports
Table 2.5 Sensitivity of production and exports in Mozambique
Table 2.6 Selected results for African countries if sugar markets are liberalised in the EU
Table 2.7 Regional aggregation in the study
Table 2.8 Commodity aggregation in the study
Table 3.1 Sectoral composition of GDP in the Russian Federation and EU
Table 3.2 Ad valorem tax rates and subsidies on Russian Energy Commodities
Table 3.3 Aggregate changes of the total removal of distortions in Russian energy sector
Table 3.4 Effect of total removal of distortions on output and prices in Russia
Table 3.5 Scenario plan
Table 3.6 Industry effects of price increase in gas and electricity
Table 3.7 Exports of energy commodities from Russia, EG1, incl. SSA results
Table 3.8 Regional aggregation in the study
Table 3.9 Commodity aggregation in the study
Table 3.10 Sectoral composition of GDP in the Russian Federation and EU, original GTAP data
Table 4.1 EU imports of sugar classified to different types of tariff rate quotas
Table 4.2 Sugar trade flows to the EU (USD million)
Table 4.3 The aggregate welfare effects in Mio USD
Table 4.4 Percentage changes in the aggregate imports of sugar into EU
Table 4.5 Major sugar producers, importers and exporters
Table 4.6 The import quota for raw sugar under the ACP/EU Sugar Protocol
Table 4.7 The EBA import quota for raw sugar under the Framework Agreement
Table 4.8 Regional aggregation in the study
Table 4.9 Changes in the production of sugar (in percent)
Table 4.10 Changes in the production of sugar (in USD million)
Table 5.1 Projections of CO2 emissions for the year 2010
Table 5.2 Regions in this study
Table 5.3 Sectors in this study
Table 5.4 Change in welfare in 2010

Figure 1.1 The production technology tree in the GTAP model
Figure 3.1 Dual-track partial price liberalization in energy markets
Figure 3.2 Decomposition of changes in GDP with respect to changes in taxes and subsidies
Figure 3.3 Decomposition of changes in utility with respect to changes in taxes and subsidies
Figure 3.4 Allocative efficiency effect decomposed by commodities
Figure 3.5 Aggregate effects of price increases on Russia
Figure 4.1 The EU sugar regime and trade agreements
Figure 4.2 Price effects and supply responses in tariff rate quota (TRQ) regime
Figure 4.3 Quota rents for the 20 regions totalling USD 149.8 million
Figure 4.4 The ranking of countries according to the production costs index
Figure 5.1 Carbon tax needed to reach the Kyoto target without US participation
Figure 5.2 Change in welfare in 2010 in Annex I countries without US participation
Figure 5.3a Change in terms of trade in 2010 in Annex I and non-Annex I countries under different credits for carbon sinks
Figure 5.3b Change in terms of trade in 2010 in Annex I and non-Annex I countries with and without US participation
Figure 5.4 Changes in production levels in Canada in 2010 without US participation

1 Introduction and Summary

This thesis is a collection of essays in applied international trade. In all of the applications, the quantitative evaluations have been performed with a global multiregion general equilibrium model GTAP (Hertel and Tsigas 1997). The model is developed and supported by the Global Trade Analysis Project at the Purdue University. The applications range from trade liberalization and development aid in Mozambique to trade in energy under a policy reform regime in Russia, the changing regulated sugar markets of the EU and the role of sinks in mitigating climate change. All the issues here are analysed within an international trade framework and quantified with the simulation model.

In his foreword in the book documenting GTAP model; Global Trade Analysis – Modeling and Applications (Hertel 1997), professor Alan A. Powell praises the replicability of the research also in the field of applied general equilibrium (AGE) studies. As the models constitute heavy investments in intellectual effort and data-garnering, it would be a considerable waste of resources if part of the effort were not to be a public good.

The Global Trade Analysis Project (GTAP) is such a venture where large part of the data and model are in the public domain. This kind of large effort has made multiregional AGE modelling possible for individual researchers in small countries, like Finland. Still, as John Whalley has said, for modellers it is a,

> *"necessity to be a jack of all trades. When involved in modelling activity in the applied general equilibrium area, one has to be familiar with general equilibrium theory, to be able to program, to be familiar with data and be able to manipulate and convert it into a model admissible form, to have a clear sense of policy issues and institutional structure, and to be able to interpret results. When confronted with this range of activities, it is perhaps not surprising*

> *that it becomes difficult for graduate students and others to enter this area" (as cited in Hertel 1997)*

This volume is a collection of GTAP applications in which I have participated with several co-authors. Studies applying AGE models are often used as background papers in real policy cases, in which policy makers formulate their views on development aid, trade agreements or sectoral support programmes. Utilising information on budgetary outlays in a wider context, i.e. the national accounting level, is often informative in itself. Sometimes the novelty of the studies relies on the perspective they offer and the real message in many cases has been to bring the global connection of domestic policies to the front. Another perspective is the interrelationships between different policy areas, e.g. agricultural policy and development policies (Essay 3 on sugar markets) or climate, energy and trade policy (Essay 4 on sinks). All studies in this volume are examples of global policy cases where international trade plays a major role. One can say that the work presented in this volume describes the methodology of how these policy cases are converted into the modelling language. Although the motivation for the applications has been formulated on the basis of real policy discussions, and merely not from the scientific discourse, the principles of conducting research have been adapted from the academic community.

The audience of the papers are often policy makers and public media who prefer quick explanations instead of digging into model assumptions that drive the results. This requirement often contradicts with the principle of research being conducted in a transparent manner. The motivation for publishing the studies in this volume is to open the black box, the term often used by non-modellers to describe AGE models. As the roots of the GTAP model are in the competitive international trade model, some of the results can be derived through intuition based on basic theories, and at times the intuition can be explained. When model specifications depart from the workhorse model, the explanations can be founded on other theories, or the explicit modelling solution. It is the task of a researcher

to explain these cases clearly. As the magnitude of the results is based on the base data and parameters of the model, in reporting the simulations, the role of data, model and parameters behind the conclusions needs to be made clear.

The rest of the chapter is organised as follows. The next section introduces the policy environment and infrastructure within which GTAP modelling framework has been developed. Next the structure of GTAP standard model and of the data base is presented. Then a few technical notes of the implications in the modelling structure for welfare analysis are presented. These modelling solutions are based on the nested Armington structure in international trade that makes a clear departure from competitive trade models. In the last section the essays and their main findings have been summarised.

1.1 Applied general equilibrium models in the analysis of global policies

Applied general equilibrium models (AGE) have become a common tool in analysing trade policy and tax issues in the domestic and international environment. These models, often called as computable general equilibrium (CGE) models, are useful in analysing welfare and resource allocation effects of changes in regimes but also to some extent in policy cases where resources can be expanded through productivity improvements or new extraction (e.g. land resources, mining). An early review of the studies utilising the approach is offered by Shoven and Whalley (1984).[1]

The theoretical foundation for AGE models is the competitive general equilibrium model, i.e. Arrow-Debreu type economy where all markets adapt as

[1] The emphasis of resource allocation issues is prevalent in AGE models of this type. When the focus of studies is e.g. on distributional issues between consumers, time-consistency of policies or government's interests, general equilibrium structure of the models is modelled in various ways, see e.g. Aaron and Gale (1996).

the outcome of utility maximising behaviour by consumers and profit maximising i.e. cost minimising behaviour by producers. The number of commodities and factors is given. The competitive equilibrium can be extended to a trade model, with varying assumptions of factor mobility within a country (Heckscher-Ohlin vs. Ricardo-Viner models). These classical approaches produce a variety of comparative statics results that are useful in analysing the model results as well. The models take, as given, the technology, preferences and resources and produce, as an outcome the prices and quantities and trade flows in an international context. The success of AGE models compared to their predecessors, the input-output models, is that they can trace the linkages that arise from economy-wide constraints like labour availability or trade-balance. The question of winners and losers in policy reforms can explicitly be analysed. Also the welfare analysis measured in monetary terms becomes possible with AGE models (Dixon and Parmenter 1996).

The computable versions are calibrated on data based on real economies and the models convert into to a system of smoothly behaving demand and supply equations and a set of income-expenditure systems. The data utilised in the models: national accounts, trade statistics and input-output descriptions are produced in an environment under existing distortions such as subsidies, taxes and tariffs, which is why constrained optimisation is thought to have produced data that is distorted by subsidies or tariffs. The theory of second best is especially relevant for these types of models. Removing one distortion does not necessarily produce a Pareto efficient outcome. According to Francois and Reinert (1997) applied trade policy analysis is distinguished from theoretical trade policy analysis by i) detailed policy orientation, ii) models that produce results in a distorted, second-best world, iii) an emphasis on well built, accurate data bases and iv) data availability determining the structure of the model.

Globalization, defined as the increased interdependence of national economies, and the trend towards greater integration of goods and factor markets (Neary

2002) have contributed to the increasing need for utilising global models. The ever increasing international trade is the most visible channel for these interdependencies. Quantitative evaluations of domestic and global policies need a general equilibrium framework to build the linkages from goods to factor markets. The Arrow-Debreu type of general equilibrium models have limitations because of the perfect competition assumption and sticky market structures, but have nevertheless gained a wide use in several types of applications related to globalization and global policies.

Multilateral trade negotiations are the first obvious arena where CGE trade models have been utilised successfully. Already during the Uruguay round of negotiations, the models were widely used (see e.g. Piermartini and Teh 2005 for a survey). The CGE models appeared in the ever more detailed analysis of different proposals during the process and eventual failure of Doha negotiation round. GTAP framework or the data were used in almost all the quantitative, global analyses of the round. Regional trade agreements, or preferential trade, also utilise CGE models (see Panagariya 2000 for a criticism). The enlargement of the EU and agricultural issues are the focus of many GTAP based analyses in European context (see Vaittinen 2004, Bach et al. 2000)

In the background work of Intergovernmental Panel on Climate Change (IPCC), GTAP Data and the CGE modelling framework have been used for analysing in particular the mitigation costs of achieving the emission reduction targets (see e.g Weyant 1999). The global dimensions of the problem – efficiency and equity principles in burden sharing, leakages and pollution haven issues – show the clear need to analyse climate issues in a global framework where international trade also has a role. The link from trade liberalization to environmental concerns has also been on the agenda of WTO, and the role of trade in environmental issues cannot be overlooked (see for example Copeland and Taylor 2004).

The GTAP project, started in 1992, at the initiative of Professor Thomas Hertel at Purdue University, encompasses a network of researchers conducting analyses of international policy issues (GTAP Webpage, 2007). The project, which produces a global data base for conducting research in international economics (version 7 of the data base is the most recent release), has experienced considerable growth with the increasing awareness of globalization.

1.2 Description of GTAP model

The GTAP model is a multiregional model of trade and production. The publicly available standard model has been built partly for utilising the main current product of the project, the global data base. The main reference for the model documentation is Hertel and Tsigas (1997). The data base, version 6, is documented in Dimaranan (2006). It is the latest version utilised in this thesis. The purpose here is to give a short review of the main features of the model and the data.

The accounting identities establish the boundaries for the data and for modelling the economies. Open economy can best be examined by a Social Accounting Matrix that balances the expenditure and income sides within the economy.

Table 1.1 *An open economy SAM with a government sector*

Receipts	Expenditures Supply	Private expenditures	Government expenditures	Investment	Foreign Exchange	Totals
1. Suppliers	-	C	G	I	E	Demand
2. Households	Y	-	-	-	-	Income
3. Government	-	T	-	-	-	Receipts
4. Capital account	-	Sh	Sg	-	Sf	Savings
5. Rest of World	M	-	-	-	-	Imports
	1	2	3	4	5	

Additional variables

t42 = Sh = private savings
t43 = Sg = government savings
t45 = Sf = foreign savings
t13 = G = government spending
t32 = T = tax payments
t15 = E = exports
t16 = M = imports

Accounting identities

1. Y + M = C + G + I + E (GNP)
2. C + T + Sh = Y (Income)
3. I = Sh + Sg + Sf (Saving – Investment)
4. E + Sf = M (Trade balance)

Modified from Reinert and Roland-Holst (1997), Table 4.2.

The first identity equals the aggregate demand with aggregate supply. Demand by commodities[2] is divided into private consumption, public consumption, investments and exports. Supply of commodities is provided by domestic production *Y* and imports *M*. The use of inputs producing outputs is measured in the cell in the upper left corner but in national accounting it does not produce value added. National income, or the value added in the economy raised as compensation for the use of factors of production, is spent on private and public consumption, taxes and savings. The public sector enters the economy through expenditures *G* and public savings *Sg* as well as a source of tax income *T* but the balance of budget is not a constraint here. Savings and trade deficit together form an identity so that trade deficit can be financed by foreign liabilities.

Combining identities 3 and 4 we get a familiar relationship between the current account and capital account, i.e the balance of payments.

$$X - M = S - I$$

Extending the identities to a global SAM starts from a notion that global exports need to sum to global imports.

$$\sum X_r = \sum M_r$$

which implies a link between global investments and savings as well.

Accounting identities in trade, in both exports and imports, form an essential element of the trade data base and also drive the modelling solutions. In GTAP both the imports and exports are tracked by commodity, source and destination. Imports are also tracked by commodity, use (private consumption, government, firms) and destination (see Hertel et al. 1997 for other tracking possibilities).

[2] Throughout this volume, terms commodity, sector and industry are used intertwinedly.

For building a global model around these identities, actors, their decision variables and functional forms for the model need to be defined. Often these solutions are based on the availability of data and parameters as described by Francois and Reinert (1997). An important feature, the possibility to aggregate data and the model, has also guided the choice of functional forms. This motivates the wide use of CES functions (Constant Elasticity of Substitution) in CGE models which are most sparse in the information needed.

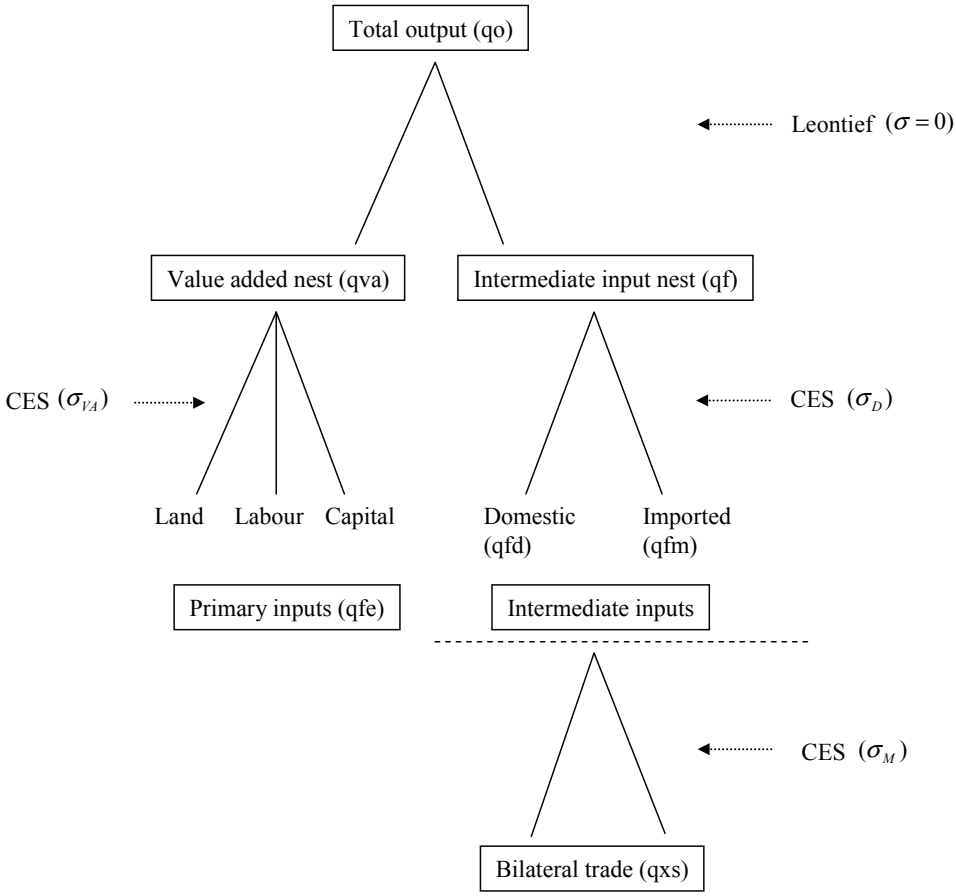
Consumer behaviour

The expenditure side of the economy is modelled by a representative household whose Cobb-Douglas utility function allocates expenditures between private, government and savings expenditures. Savings decisions do not present any life cycle properties but are instead a fixed share of income. The same applies for public expenditure. Private expenditures are further modelled as non-homothetic CDE (Constant Difference in Elasticity) form as a subutility function following the tradition of Hanoch (1975). Problems with the non-homotheticity and expansion parameters with the two levels of utility function have been taken into account in the final treatment of the utility approach and welfare evaluations (McDougall 2000).

Producer behaviour

The producer behaviour is a two-nested CES function where the upper-level part of the function combines primary inputs with intermediate inputs with fixed coefficients. The value added nest itself is a CES function with the same elasticities among all factors of production. The intermediate inputs are formed of domestic products and the imported composite and imported composite is a further composite of products imported from different sources. The base data defines the original shares that in simulations adjust to new prices finding the magnitude of changes from the parameters.

Figure 1.1 The production technology tree in the GTAP model



Source: Adapted from Hertel and Tsigas (1997, p. 56).

Factor markets

GTAP data base includes five factors of production: land, unskilled labour, skilled labour, capital and natural resources. All factors are fully utilised. Also the factors of production can be aggregated. Some of the factors are utilised only in few sectors, like land in agricultural production or natural resources in extracting sectors. This implies some properties of the Specific Factor Model of trade are included in the GTAP model. Modelling the factor inputs in the value

added function of the industries as a CES composite makes all factors substitutes for each other.

Government sector and taxes

Tax income, as well as all factor income, belongs to the representative household. There is no constraint with respect to the government's budget balance. The role of taxes and subsidies is to measure the distortions within the economy. Taxes and subsidies are implicitly defined as the difference between valuation at different levels, e.g. import duties are the difference between imports at market prices VIMS(i,r,s) and world market prices VIWS(i,r,s). The terms in brackets describe the dimension of the matrix; imports are defined over commodity *i*, from source *r* to destination *s*. It follows that all the trade flows can be aggregated and summed over commodities or source /destination countries. The essential feature of the protection data is also that they are modified to ad valorem form, this applies to specific tariffs, for example.

Modelling of trade

As explained above, trade flows are tracked by agents in the model, firms, private demand and public demand. GTAP utilises the commonly used Armington structure in modelling trade (Armington 1969). The justification for this modelling solution in a perfectly competitive trade model is to assume that consumers differentiate between commodities from different countries. The accounting identities defined above determine the starting point of a simulation. The limits of the variation in the behaviour of actors are defined through a functional form that is a nested CES Armington structure. The nested structure assumes the composite good C_i to be a function of the domestic good and the composite imports to be sourced from other regions in the model:

(1) $C_i = g[D_i, h(M_{ir}, M_{is}, ...)]$

where g is the top level nest and the function h the bottom level nest. Both functions are assumed to be CES functions and common practice assumes the elasticity between the bottom nest to be twice the size of the bottom nest. The explicit demand function is formed of shares, parameters and relative prices at a given expenditure level.

Some critical discussion has been raised against the role of base data in determining the outcome of simulations. If protection has prevented the existence of trade altogether, liberalization cannot change the situation as simulation results are dependent on the starting point. Solution to this problem of small shares in initial trade data has been suggested by van Tongeren and Kuiper (2006).

Closure of the model

Closure of the model defines the split between endogenous and exogenous variables. In the standard (GE) closure of the GTAP model prices, the quantities of all nonendowment commodities and regional incomes are endogenous variables, and endowments (land, labour, capital) as well as policy variables, technical change variables and population are exogenous to the model. In the standard closure, global savings should be equivalent to global investment, which can be utilised as a consistency check of the model closure.

As the shocks to be modelled are applied to exogenous variables, it is possible to modify the model closure by swapping a set of endogenous vs. exogenous variables. The consistency of these swaps can be studied by the general equilibrium nature of the model. Walras' Law should hold with both the standard closure and any modifications in general equilibrium. Also, as the homogeneity of the model should hold, multiplying the numeraire of the model should imply similar changes in the model's price variables, while keeping any quantity variables as given.

By varying the closure of the model, different adaptation aspects, can be taken into account. Walmsley (1998) uses closure rules to study different time frames, by letting the capital stock adapt in the simulations. In the short run, the capital stock is given whereas in the long run, it adjusts. In applications, different variations in the adjustment processes can be taken into account by different closure rules. The chapter 2 adds some points to this discussion.

With the GEMPACK software, alternative closure rules are easy to implement. It is possible to let any variable, taxes, for example, be determined endogenously and set the respective price variable as fixed. This makes it possible to include more realistic features of current policies, in which prices or quantities produced are fixed.[3]

The structure of the data base

GTAP data base, around which the model has been built, is a cross-section data of international trade flows and national input-output tables. Distortions of the economies are built into the data base, with special attention on trade distortions. All the information in the data base is reported in values converted to US dollars. The data base 6 includes 87 regions and 57 commodities adjusted to year 2001 values. The procedures and the data sources have been documented and are available on the GTAP website.

The policy instruments of the model and data have been implemented in the ad valorem form with price wedges by measuring the value flow at different levels in the economy. For example, the difference between the value of world market prices and market prices that domestic consumers and firms pay is the extent of tariffs in the economy. Similar wedges apply to prices between domestic producers and final consumers.

[3] The standard GTAP model is implemented with a Gempack software (Harrison and Pearson 1994, http://www.monash.edu.au/policy/gempack.htm). This software utilises a modelling tradition that applies linearised behavioural equations for different actors in the economy.

Parameters

The behavioural parameters utilised in the GTAP model are described in Dimaranan et al. (2006). In short, they define the magnitude of behavioural responses to changes in relative prices. Elasticities are classified as elasticities in source substitution (Armington structure), factor substitution, factor transformation, investment flexibility and consumer demand.

Consumer demand elasticities have been calibrated to the demand system and even though they are not directly linked to empirical studies, they correspond to a well-defined demand system (see Hertel and Tsigas 1997). Other elasticities are unnecessary for the equilibrium, and this is why, good guesses have been used in most of the elasticities. Armington elasticities are based on econometric work by Hertel et al. (2004).

1.3 Interpreting the results

The experiments are carried as comparative static changes in variables that are exogenous in the closure of the experiment. Shocks have to be compatible with the data. In the case of total removal of distortions or subsidies, the base data offers simple alternatives for liberalization scenarios. With the Rungtap software, tailored especially for utilising the GTAP model, the simulations are easily performed (see GTAP webpage), producing percentage changes in values, prices and quantities. Summary variables calculate the respective changes in aggregate variables such as price indexes, gross domestic product (GDP) or welfare.

Large general equilibrium models include thousands of equations that simultaneously determine the model outcome and solutions to the experiment. In general equilibrium, all agents adapt their behaviour to external conditions. Thus, solutions cannot be determined on the basis of individual equations. In general, the model outcome is dependent on the model, the data and the parameters that define the magnitude of responsive reactions. Depending on the application and

the shock, different components have different weights. In many instances, results seem to emerge from a "black box."

GEMPACK software includes several support programmes to decompose the results of the model. This software is a standard part of the GTAP model as well. For analysing the results at least following add-on components are available:

1. Welfare decomposition

The welfare measurement is based on an equivalent variation that compares expenditures in ex ante and ex post simulation data. Popularity of the welfare measure is due to its reporting values in dollar terms, which makes different policy scenarios comparable with each other. Different procedures for decomposing the welfare measure can be utilised (Huff and Hertel 2000), the first of which has global welfare change decomposed to regional changes. Regional welfare changes can further be decomposed to welfare changes in allocative effects, terms of trade effects, investment effects and to any exogenous effects increasing productivity in any sector of the economy. If exogenous productivity changes are not assumed, the breakdown of welfare changes to allocative effects and terms of trade effect is usually adequate for quick welfare analysis.

2. Decomposing simulations in respect to exogenous shocks

The results of policy simulations represent the mutual effect of several exogenous shocks. In evaluating the relative significance of these different shocks is not a trivial question. In general form, the relationship between the endogenous variable Z and the exogenous variables $X_1, X_2, \ldots, X_n$ is

(2) $$Z = F(X_1, X_2, \ldots, X_n).$$

The change in Z relative to the exogenous shocks X_1 is represented by

(3) $$dZ = F_1 dX_1 + F_2 dX_2 + \ldots + F_n dX_n, \text{ where } F_i = \partial F / \partial X_i.$$

The magnitude of different partial derivatives depends on the reference point (the solution) where different partial derivatives are evaluated. Harrison et al. (2000) demonstrate how GEMPACK software can decompose the effects of several variables into their component parts in general situations.

3. Systematic sensitivity analysis

Often the model's principal parameters are the key to determining simulation results, and their effect on the key variables can be analysed (see Arndt and Pearson 2000). This systematic sensitivity analysis resembles a Monte Carlo analysis, where the value of variables giving rise to the uncertainty is selected at random and the reliability of the results in relation to the uncertainty is characterised with the mean values and standard deviations of the simulation results. GEMPACK includes standard software for systematic sensitivity analysis relating to parameters and shocks.

In the GTAP model, it is possible to study the sensitivity of all other parameters, that have been calibrated, with an exception of demand system. In a trade model, trade elasticities are often the characteristics that drive the results.

1.4 Implications from the composite Armington structure in trade for welfare analysis in trade liberalization

Several global studies show the negative welfare effects of trade liberalization, especially for developing countries. Some of these results are reviewed next, in essay 1 on Mozambique, where the terms of trade effects, especially in the unilateral liberalization, appear to be negative[4]. In this section, we investigate this issue in some detail by referring to the discussions raised by Gros (1987), Panagariya (2000), Panagariya and Duttagupta (2001) and Bowen et al. (1998)

[4] The result also applies to multilateral liberalization cases, but the effects can more easily be seen in unilateral liberalization.

and by utilising the decomposition techniques of the GTAP model to evaluate the effects.

With GTAP simulations it can be shown that cross-price effects, causing the negative terms of trade effects, have a stronger adverse impact on the results than the terms of trade deterioration through decreases in import prices. These effects are neglected in most analytical approaches, while in numerical simulations they can be shown to have a bigger role, as indicated in Bowen et al. (1998, Chapter 5). As many other CGE models that utilise GTAP data have a similar import demand structure, similar results may concern these as well.

The policy implication from this kind of result implies a favourable outcome in unilateral market access, i.e. increasing preferences or at least maintaining the status quo in current preferences at the cost of multilateral trade liberalization.

Approximating welfare changes arising from a change in trade policy

Assume that there are N goods, and that each good is produced domestically, but also imported. Part of the production is exported. World prices are denoted by vector $p_w = (p_{w1}, \ldots p_{wN})$, and the vectors of domestic and imported prices as $p_d = (p_{d1}, \ldots, p_{dN})$ and $p_m = (p_{m1}, \ldots, p_{mN})$, respectively.

Assume also that the behaviour of economies with existing distortions can be presented by maximised value functions where the following identity between expenditures and incomes holds:

$$S(p_d, p_m, p_w, u_0) \equiv G(p_d) + \sum (p_{mi} - p_{wi}) m_i \qquad (4)$$

S represents the expenditures with a given utility which also includes the imported commodities. Income consists of production $(G(p_d))$, given by the economy's revenue or GDP function (part of which is exported with domestic price p_d) and the tariff revenue where $\tau = p_{mi} - p_{wi}$ is the tariff rate and m_i is imports.

The money metric welfare change, called the equivalent variation, measures the expenditures after a policy implementation, as compared to the original expenditures and is defined as

(5) $$EV = S(p_d,p_m,p_w,u_1) - S(p_d,p_m,p_w,u_0)$$

An approximation of the local welfare change can be derived by assuming that the post implementation expenditures are equivalent with income [5]

(6) $$EV =(G(p_d) + \sum(p_{mi}-p_{wi})m_i) - S(p_d,p_m,p_w,u_0) = 0$$

Holding utility constant ($du_0= 0$), the equation can be totally differentiated

(7) $$dEV = \sum_{i=1}^{N}[\ \frac{\partial G}{\partial p_{di}} dp_{di} + (dp_{mi}-dp_{wi})m_i + (p_{mi}-p_{wi})dm_i -$$

$$(\frac{\partial S}{\partial p_{di}} dp_{di} + \frac{\partial S}{\partial p_{mi}} dp_{mi})]$$

With the properties of the revenue and expenditure functions we have $\partial G/\partial p_{di} = q_i$, the supply of the commodity i, $\partial S/\partial p_{di} = d_i$, the demand for domestic commodity i and $\partial S/\partial p_{mi}=m_i$ is the demand for imports. Inserting these to the previous equation we get

(8) $$dEV = \sum_{i=1}^{N}\ [(q_i-d_i)dp_{di}-m_i dp_{wi})+(p_{mi}-p_{wi})dm_i)]$$

where q_i-d_i measures exports, domestic production minus consumption and dp_{di} is the change in the price of the domestic commodity. The first term in brackets measures the sum with respect to the terms of trade change when both exports and imports are taken into account. The last effect is the trade volume impact which measures the change in tariff revenue as import volume fluctuates. The

[5] Adapted from Bowen et al. (1998), p. 197.

last term can be perceived to constitute the general deadweight loss due to tariffs.[6]

To make the case more comparable with the GTAP results, the equation can be divided by $d\tau$ to recognise the substitutability between domestic and imported commodities $\partial p_{di}/\partial p_{mi}<0$.

$$(9) \qquad dEV/d\tau = \sum_{i=1}^{N} [(q_i-d_i)dp_{di}/dp_{mi}(dp_{mi}/d\tau) - m_i dp_{wi}/d\tau + (p_{mi}-p_{wi})dm_i/d\tau]$$

The result of tariff changes on welfare can be decomposed into its effects on exports markets, on world market prices and its allocative effect through increased imports (in case of tariff reductions). The latter outcome is usually positive, as increased cheaper imports improve efficiency when domestic productions with distortions are replaced.

Numerical example

To show these effects with a numerical example we use a 3x3 aggregation with three countries (EU, Mozambique, Row) and three commodities (food, manufactures, services) and analyse a scenario in which a ten percent reduction in tariffs is applied to food exports from EU to Mozambique. As such, it implies a unilateral trade liberalization by Mozambique.[7] In the base data the bilateral tariff for food imports from EU to Mozambique is 30%.

[6] For graphical exposition in one commodity case, see Bowen et al. (1998), figure 5.3.

[7] This as considerable resemblance to the GTAP book's first example, where EU unilaterally reduces import tariffs by 10%. All the results are analogous and approximately the same magnitude. The only difference and the mutual gains in the GTAP example come from the positive allocation effects. The terms of trade effects are of the same magnitude. In the book example the EU food tariff for imports from USA is 36.9%.

Table 1.2 Welfare decomposition in a simple simulation

Aggregation for EU, Mozambique and ROW

Welfare, in millions USD, 10% cut in Moz tariff on food from EU	Allocative effect	Terms of trade	Investment effect	Total
1 EU	-0.48	1.03	0	0.55
2 Mozambique	0.41	**-0.52**	-0.03	-0.14
3 ROW	0.01	-0.51	0.04	-0.46
Total	-0.05	0	0	-0.05

Terms of trade decomposed into price effects (world market price, export prices, import prices)

Terms of trade Moz	1 pworld	2 pexport	3 pimport	Total
1 Food	0	-0.18	0	-0.18
2 Mnfcs	0	-0.14	0	-0.14
3 Svces	0	-0.19	0	-0.19
Total	0	-0.52	0	**-0.52**

The table 1.2 reports the welfare results (EV measured in millions of USD) decomposed into its effects in allocation, terms of trade and investments. The last effect is caused by the behaviour of global bank which we ignore here. The positive allocative effects are the results of increased imports that replace domestic production (where distortions have existed) and are positive, whereas the terms of trade variable is negative and dominates the total welfare effect. A further decomposition extending beyond the terms of trade effects to world market prices (pworld), export prices (pexport) and imports prices (pimport) reveals that the negative effects are due to the influence of export price (Terms of trade -decomposition developed by Robert McDougall, see the Model code of GTAP). Mozambique is such a small country that its imports have no effect on EU's export prices, nor on world market prices. In the GTAP Book example EU is a major player, so that its unilateral liberalization policy has repercussions on both exports, import prices as well as world market prices (Price changes are reported as changes in in value of millions of USD, for comparison with the EV measures). In both cases the cross-substitution effect from import prices to export prices dominates the terms of trade effects.

Optimal tariff argument

The effect of tariffs on world market prices (middle effect in formula (9)) measures how much of the tariff changes are passed through to world market prices. In homogenous goods models, a small country takes the world market prices as given, but a larger country can pass a part of the tariff increase in order to decrease world market price, which implies positive optimal tariffs for the larger country. As is well known and has been noted by Gros (1987), Panagariya (2000), the Armington type of model implies positive market power for all exporters. Increasing exports through tariff cuts generates positive terms of trade gains even for small countries.

Armington structure implies that export demand function for every trading country is elastic. The import supply curve that responds to changes in tariffs is still flat for each of the countries. This observation has been raised explicitly at least in Horridge and Zhai (2006). This explains why import prices do not respond to tariff cuts even though export prices in exporting countries simultaneously do so.

Discussion

The change in terms of trade for a liberalizing country through its export prices, rather than import prices, raises the question of the role played here by the aggregation. The aggregation has an impact on the substitution structure within one economy. Let us consider a case where the EU imports wheat and exports oranges. If the tariff for wheat is reduced, how does this affect the price of oranges? If the goods are disaggregated, the effect comes from demand, but if they are aggregated, apart from demand the effect also comes from the production and import composites. Increasing demand for imported wheat reduces the price of domestic composite and exports, thus the price of oranges.

A clearer conclusion of the Armington structure rises from the policy implications it entails. Unilateral market access is the most beneficial policy for any country in the model. In contrast, the increase of imports is always harmful in the terms of trade sense. Imports are beneficial only in cases where they replace production with large distortions, as in the EU.

1.5 Summaries of the essays and main findings

This study includes four essays in which the standard GTAP model has been applied. On the other hand, with small alterations and flexible utilization the studies contribute to the application of the standard model in its various forms. They also demonstrate the usefulness of numerical policy analysis in these issues. This section describes the main contributions and results of the essays. The more technical section describes the changes made in each of the essays to the basic structure of the model and the simulations. The essays are presented in the reverse order when they were written, starting from the most recent one in 2008 to the oldest published in 2003.

All the essays, except the last which has been published in the refereed journal, are edited for this volume here. In two first essays, on Mozambique and Russia, major changes have been made. The studies published as working papers, have been revised to better complement this essay collection and to fulfil the requirements imposed by the Ph.d. thesis. Numerous descriptions of the GTAP model have been eliminated and descriptions of the changes made as well as of the experiments have been added. The last essay is presented here in its published form.

A thorough analysis of the policy environment is set out in all of the essays. This makes it possible also to evaluate the suitability of the framework for the analysis.

1.5.1 Essay 1: Trade and aid policies: Their impact on economic development in Mozambique

Recently aid for trade has become the focus of international development policies. International trade works as a catalyst for growth and poverty reduction but its success depends on underlying factors from the supply-side as well as development aid for building the necessary infrastructure. Trade alone cannot be the target but rather an instrument, like development aid. Thus, the market access and international trade negotiations cannot solve the development challenge as has been pointed out by the critics of globalization.

This study approaches the coherence of trade and aid policies from the aspects of both trade liberalization, macroeconomics of aid policies as well as the prospects of trade facilitation. The study deals with specific institutional conditions in Mozambique. This part of the work was conducted during a visit and subsequent interviews with local actors in the country. The study questions the benefits of trade agreements and multilateral trade negotiations for Mozambique. It also examines how development aid is directed to private sector development. The analysis takes into account several aspects of international discussion, like the dutch-disease aspects of aid, preference erosion, aid and trade equivalence and tied aid with respect to the sugar sector.

These issues are characterised by means of simple GTAP simulations with the standard model. The model simulations do not make a contribution in their novelty but rather the new elements they bring to this multidimensional problem. The results of the simulations indicate the differentiating industry effects that are apparent in different scenarios. In the trade liberalization scenarios the industry effects can be traced back to the extent of tariff cuts. In the simple aid scenarios, the effects are due to the general demand structure of the economy. Furthermore, the industry effects from the trade facilitation scenarios deviate from the two earlier sets of scenarios. These industry effects are then compared to the index of

revealed comparative advantage. Sugar industry shows a lot of potential, and it has a special role in Mozambique. A separate case study is conducted for sugar in Africa. The main results show small potential gains in multilateral round for Mozambique and greater potential from trade facilitation targeted as a means of development aid.

The study, originally co-authored with Pertti Haaparanta, was prepared as a background paper for OECD Development Centre's research on coherence between aid and trade (Haaparanta and Kerkelä 2006). Major revisions have been made to the original conference paper.

1.5.2 Essay 2: Distortion costs and effects of price liberalization in the Russian energy markets: A CGE analysis

Domestic policies can have international impact. The motivation for the paper is based on the dominance of Russia in the global energy markets, which means that the influence of domestic actions has global consequences as well. In 2003, the Russian government proposed an initiative to increase energy production and to promote efficient energy use. One of the means was partial price liberalization.

Russian energy markets can be described as a dual system in the sense that domestic supply is quaranteed through regulated subsidised prices, which were to be increased. One contribution of the paper was to introduce these implicit subsidies into the GTAP data base and then to estimate their significance at the economy-wide level. According to the simulation results, these subsidies estimated to cover about 2.8% of GDP. The result is very sensitive to the assumption on elasticities used in the simulation, implying that the current subsidy structure has implications for both domestic output as well as internationally. Most of the effects appear to be generated indirectly through fuel industries, but also through manufacturing industries in some neighboring countries. In Russia, the effects are derived mainly from the gas sector.

The effects of partial liberalization in the form of increased domestic prices for gas and electricity increased the export supply and had a positive effect on GDP. Effects on GDP and welfare vary according to how the subsidies are modelled in the economy and this has been highlighted in the essay.

Recently, there have been arguments in favour of maintaining the dual pricing system (Tarr and Thomson 2004) but also for increasing liberalization (Alho 2008). The chapter 2 is based on research conducted during my visit to the the Bank of Finland Institute for Economies in Transition (BOFIT).

1.5.3 Essay 3: Trade preferences in the EU sugar sector: Winners and losers

The role of sugar in trade volumes is marginal, but in the political debate the issue has been explosive. In trade liberalization dialogue it was critical because of its high protection in the developed countries and potentially large supply from the developing countries. The European sugar regime is characterised by regulated prices and quotas in production and imports. This paper analyses the changes in preferences that altered the position of developing countries because of the EBA Agreement. Since the policy reform in 2001, the gradual reduction in internal quotas and intervention price have already been introduced in internal markets partly as a gradual response to increasing imports (Europa 2008).

The chapter 4 is based on the joint work with Ellen Huan-Niemi at the MTT Agrifood Research Finland and focuses on EU's import quotas for sugar. The regime is currently under reform that would lead under the EBA Agreement for total liberalization of sugar imports to the EU for the least developed countries (LDC). If the whole market were liberalized, sugar production could decrease by 80 percent in the EU. This effect has been simulated by changing the elasticity of import demand and it accentuates the dependence of simulation results on underlying assumptions. Supply responses from the actual producers are

discussed in the essay. If the potential and factual supply reactions are not taken into account, the demand-based simulation may give the wrong picture.

This essay contributes to the GTAP studies in that it collects considerable data on sugar markets that are compatible with the GTAP data base and model. External data on quotas and quota rents have been implemented into the data base. Data on costs collected from different sources have been added to ensure realistic reactions in liberalised sugar markets.

The current approach has meant that the alternative of full liberalization is not lucrative for the developing countries. According to their webpage, "The options of total liberalization [of the EU sugar regime] and the price fall option would ultimately torpedo EBA. Without a managed market which gives remunerative prices, we would have great difficulty to reap the benefits of EBA in the sugar sector." (LCD Sugar Group, http://www.acpsugar.org/ldc/) Thus, they have applied for a ten year postponement in reducing prices and full implementation of EBA with regard to sugar.

1.5.4 Essay 4: Credited forst carbon sinks: How the cost reduction is allocated among countries and sectors

The Kyoto Protocol is an agreement where member countries of UNFCCC (United Nations Framework Convention on Climate Change, http://www.unfccc.org), agreed to rules for addressing climate change. Of the nations that have signed the Protocol, there are the 36 industrialised countries and Economies in Transition listed in Annex I of the UNFCCC. These signatories have accepted emission caps – a regulatory device that sets a ceiling on emissions released into the atmosphere by any one country within a designated timeframe.

Forest carbon sinks contribute on the global GHG balance and thus were included in the Kyoto Protocol as one of the mechanisms for mitigating climate

change. Studies on the mitigation of greenhouse gases have often focused on issues such as competitiveness and the role of trade. This link between the climate and economy is a controversial but an important subject.

The last paper is a joint research effort with Johanna Pohjola and Raisa Mäkipää. The costs of mitigation, i.e. complying the Kyoto commitment have been studied by several authors also using global trade models. The study here focuses on forest carbon sinks which absorb carbon dioxide instead of emitting it into the atmosphere. The sinks were included into the Kyoto Protocol to decrease the economic burden of implementation and also to facilitate the ratification process. The sinks in the study are included with an adjustment to orginal emission limit. It does not explicitly model the role of sinks on the economy. The results show that the facilitation is not in line with the economic burden. The role of forest sinks was shown to be modest compared to the holding back of the US from the Kyoto Protocol.

1.5.5 Technical part

Table 1.3 summarizes some technical notes on the simulations and how they have been performed. The results are analysed in each of the chapter and summarised above. Most of the papers here utilised the standard model. The choice of the data base version was based on the availability of data when the study was initated. The data base 4E in the last paper was tailored in order to take advantage of the GTAP-E model, which had additional nesting for energy inputs. This was especially useful for the analysis of emission reductions.

Additional software for utilising non-linearities in the supply function was adapted in the study on sugar markets. This tariff rate quota implementation was used mainly for adjusting the data base to new tariffs. A similar adjustment was applied to the last essay on sinks where the 1992 base data was projected to the year 2010 by exogenous assumptions on the yearly growth in aggregate (GDP),

labour and productivity. To close the equations, the growth in capital (investments) was allowed to be determined endogenously.

These projections produced the emissions for each country. External sources for necessary emission cuts were used. The GTAP emissions from the projections deviated considerably from emissions observed in other sources.

The standard closure of GTAP model has been utilized as a starting point in every essay. In chapter 2 on Mozambique, results were tested with an alternative macroeconomic closure. In the paper on Russia, the closure called altertax has been used to modify the base data subsidies. Changing the subsidies still keeps the cost shares of industries fixed (Malcolm 1998). This is a readily available tool e.g. in Rungtap software.

The general equilibrium closure is utilised in all of the simulations. Within the general equilibrium framework, with standard closure, additional swaps have been made between tax and price variables in the chapter on Russia. Small closure swaps were made as new variables were added to the model.

In all of the essays, the static version with perfect competition was used. A dynamic version of the model was available but was not utilised here. Imperfect competition, especially in the case of the Russian energy markets would have been preferred. The static version complicates the interpretation of results in cases where policies are tied to a certain future year. In comparative statics there is no time dimension.

Data from external sources has been added to the simulations. In the case of Mozambique, however, where the entire essay is based on a field survey, the simulations are based purely on GTAP data base and model. The only external figure added to the simulations was the size of development aid. Trade liberalization shocks were derived from the data base, while the productivity shock was ad hoc. In the Russian case study, we evaluated the extent of subsidies

from other sources. The information for price shocks was based on announcements by the Russian government. For sugar, outside information on the allocation of quotas was aggregated to match the aggregation used. This was actually the basis for building the data base, which uses as detailed information on quota allocations as possible. The quota prices versus world market prices were interpreted as tariffs in the simulations. Cost data was collected from different sources and was reported as relative difference between costs. The sinks data and cuts in emissions were updated from public sources.

Sensitivity of the results can be examined by modifying the shocks, parameters or the closure. All these elements have been utilised in some of the essays, in the hope to introduce additional information and to improve the analysis. In the optimal case the sensitivity analysis is relevant for the study, but not an aim in itself. In the first essay on Mozambique, the results of different macroeconomic closures on the welfare and industry effects were studied. In the study on Russia, the different assumptions on Armington elasticities were examined. The next study on sugar analysed the effects of various elasticities used for trade flows, while in the last study, the implemented shocks, comparison of emission cuts with and without sinks, can be interpreted as a sensitivity analysis.

Table 1.3 Description of simulations in the study

	Mozambique / Chapter 2	Russia / Chapter 3	Sugar / Chapter 4	Sinks / Chapter 5
Aggregation	8 regions 10 sectors	7 regions 15 sectors	20 regions 4 sectors	13 regions 14 sectors
Data base	6	5.4.	5.4.	4.0
Model	Standard	Standard	TRQ Standard	GTAP-E
Closure	Standard	Altertax Standard	TRQ Standard	Projections Standard
Modifications	Formulation of aid	Formulation of subsidies	TRQ implementation	
External data in the analysis		Power of subsidies	TRQ tariffs Quotas Cost data	Data on emission cuts Data on sinks adjusted to emission cuts
Parameters	Default Sugar analysis (see ch. 4)	Default	Armington elasticities modified	Default
Sensitivity analysis	Macroeconomic closure rules SSA with shocks	SSA with Armington elasticities Alternative closure rules	SSA with Armington elasticities	

1.6 Conclusions

Foundation of the World Trade Organisation (WTO) in 1995 after the successful Uruguay round of negotiations has brought discipline in trade policies in all member countries as well as those planning to join. Along with the increasing awareness of globalization, the rules agreed under the auspices of WTO have steered the general principles in trade agreements, both multilaterally and bilaterally. WTO's development has generated much of the discussion on the effects of globalization.

The development in internationally binding agreements is in the background of all the studies here. The general development has made evaluation of the effects of global policies important. International policies on trade, development, agriculture, energy as well as climate change have global outcomes that affect domestic welfare. Mozambique, as a developing country, has to strive to achieve its advantages during the Doha negotiation round. For Russia, the membership in WTO is still an open question and its domestic policies have implications internationally. For the EU, as a largest trader in the world, trade is an important policy arena for consumer and producer welfare. Developing countries have also indicated an increasing interest in trade negotiations. Numerical analysis of the effectiveness of policies is needed also in the future and new questions rise continuously.

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2 Trade and Aid Policies: Their Impact on Economic Development in Mozambique

Abstract

In this paper we study the impacts of various trade agreements on the Mozambican economy. We also estimate the impacts of aid and trade facilitation on the production patterns in Mozambique. Finally, we conduct an in-depth study of one sector, sugar production which our analysis shows to be potentially important for the country in the future. Sugar is also important for EU because of its current plans to liberalise the sector.

These issues are with a case study in Mozambique that includes interviews and surveys of the current situation. Donor activities to private sector are given special emphasis. The issues are also analysed with the aid of GTAP model with simple simulations.

Both aid and trade are considered to contribute to development. The development can be either seen as economic growth or structural changes that precondition growth. The simulation results from the trade liberalization scenarios are ambiguous and in some cases controversial. At the same time, trade facilitation has beneficial effects. Adverse impacts of aid (e.g. loss of competitiveness due real appreciation of the currency) are estimated to be very small, or perhaps even non-existent. Trade facilitation has a large impact on the production structure, with new sectors grow and important existing sectors (except sugar) contract. The results imply that aid-for-trade programs have large potential but must be planned carefully.

Keywords: trade liberalization, aid, trade facilitation, tied aid

2.1 Introduction

Aid for trade has become to the focus of international development policies in recent times. International trade is a catalyst to growth and poverty reduction but its success depends on underlying factors from the supply-side as well as on development aid for building the necessary infrastructure. Trade alone cannot be the only target but should be a tool for progress similarly to development aid. In Haaparanta and Kerkelä (2006a) we identified the cost and availability of credit to firms that are expanding and the lack of business capacities to be the major growth bottleneck in Mozambique. Thus, the market access and international trade negotiations alone cannot solve the development challenge.

This study approaches the coherence of trade and aid policies both from trade liberalization aspect, macroeconomic aspects of aid policies and prospects of trade facilitation. The study deals with specific institutional conditions in Mozambique. The study has reference to some recent coherence studies (Suwa-Eisenmann and Verdier 2007) but also to trade liberalization studies (reviewed below). A thorough description of Mozambique's institutional conditions is given in Removing Obstacles to Trade – A Diagnostic Trade Integration Study (DTIS), research carried out by USAID (USAID 2004). There are very few studies on joint impacts of trade and aid in CGE framework; Bourguignon, Levin and Rosenblatt (2006) as an exception. One reason for the lack of studies may be that monetary allocations are not directly transferable to resources and an exact mechanism of how aid affects the economy is needed if a comprehensive analysis is to be undertaken.

The background work for the study carried out with a visit and interviews with local actors in Mozambique in August 2005. That work is reported here. The study examines the benefits of trade agreements and multilateral trade negotiations for Mozambique. It also analyses how development aid is directed to private sector development, taking into account several aspects of international

discussion, such as dutch-disease of aid, preference erosion, aid and trade equivalence and tied aid. The sugar industry shows a lot of potential in Mozambique, and has a special role in Mozambique. A separate case study is made for sugar in the context of Africa.

The questions are analysed by simple GTAP simulations with the standard model. The results of the simulations highlight the differentiating industry effects in different scenarios. In the trade liberalization scenarios, the industry effects can be traced back to the level of the tariff cuts. In the simple aid scenarios, the effects are the result of the general demand structure of the economy. When aid is specifically targeted towards productivity improvements, like trade facilitation, very different industry effects are noted. In aid for trade the optimal targetting for industry could perhaps be revealed by the current trade orientation of a country, i.e. the index of revealed comparative advantage.

The exercise lays the ground for evaluating the potential of aid-for-trade programs. The main result from the analysis is that Mozambique does not seem to gain much, if at all from trade agreements (except from some agreements with EU). The same holds for the Doha round. At the same time, trade facilitation (modelled here as reduced transactions costs for Mozambican exports both at home and for countries importing Mozambican goods) has beneficial effects. As our analysis suggests that the adverse impact of aid (e.g. loss of competitiveness due real appreciation of the currency) is very small at worst, aid-for-trade programs seem offer considerable potential. The results also indicate, however, that trade facilitation has a larger impact on the production structure, as new sectors grow and important existing sectors (except sugar) contract.

The study, originally co-authored with Pertti Haaparanta, was prepared as a background paper for OECD Development Centre's work on coherence between aid and trade (Haaparanta and Kerkelä 2006a, 2006b). Major revisions have been made to the papers.

The paper is organised as follows. We first describe actual trade regime practices in Mozambique as well as aid allocation, especially to private sector development. The description is based on the prevailing situation in 2005. We then turn to the more conceptual issues of how these practices have been studied in economic research, particularly with CGE models. Next the GTAP simulations on the presented issues are given. The next section analyses the results with a sensitivity analysis with the implementations. Finally, some conclusions and their implications are offered.

2.2 Mozambique's position in trade regimes

Mozambique is a member of World Trade Organisation (WTO). In addition, it enjoys preferential access to key export markets under trade arrangements that reduce duty rates on its exports absolutely and relative to suppliers without such preferences. Mozambique is also accorded preferential access to certain markets, including those of some of its neighbours, under reciprocal and binding trade agreements between countries or groups of countries. Among these, perhaps the most significant is the Southern Africa Development Community (SADC) (DTIS 2004).

Apart from an improvement in internal constraints to help Mozambique better exploit market access within these agreements, market access could be advanced through changes or the full implementation of these agreements. For instance, the implementation of SADC as a free trade area is only in its initial phase. Within the WTO, the current Doha Development Round aims to improve the market access of the poorest countries. AGOA, the American Contract, is being developed. With the EU, the Economic Partnership Agreements (EPAs) are being negotiated.

Preference erosion, adverse development in market access, may happen when negotiations in other fields are advanced at the expense of Mozambique market

access. One example is the free trade area between SADC and USA which may deteriorate the position of Mozambique. The preference erosion, triggered through these contracts is similar to those negotiated in WTO when the relative position of preferences is reduced through decreases in MFN tariffs.

For Mozambique, main access to developed-country markets are organised through preferential GSP arrangements by the European Union and the United States. In GSP arrangements, the development perspective is a starting point of the preferences so the coherence aspect there is even more relevant than in regional trading blocs like free trade areas.

The Everything But Arms agreement (EBA) is an extended GSP arrangement by the EU towards LDC countries. EBA has a wide coverage for the elimination of tariffs and is at first glance a very generous agreement. However, based on the evaluation by Castel-Branco (2004), the development prospects for expanding exports will be limited by non-tariff barriers including rules of origin (ROOs), sanitary and phytosanitary measures (SPSMs) and safeguards. Critics of ROOs in particular point to rules that prevent developing countries from participating in effective supply chains and the use of imported inputs. SPSMs are an obstacle that can be overcome by development aid, e.g. by offering technical assistance for testing laboratories. Safeguard measures and graduation mechanisms, in contrast, offer the EU a way to prevent and limit the expanding export industries on very short notice. According to Castel-Branco (2004), of current Mozambican export items citrus and sugar are included in the EBA but sugar is under a special regime. Of potential exports items, three products could benefit from the EBA: oil cakes, maize and some milling products (brans and sharps and other residues).

The African Growth and Opportunity Act (AGOA), the GSP arrangement by the United States, offers a very wide coverage in tariff free access for the Mozambican exports to the American markets. Similarly to the EBA, the principal problems for realising growth opportunities through exports are linked

to ROOs, SPS and safeguards rules. With regard to ROOs the problems appear to be particularly big for the textile sector but the LDCs have been granted a "special waiver". The fear of preferences being temporary and unilaterally withdrawn reduces the prospects for growth as offered by the concession.

The AGOA offers generous conditions on textile trade, whereas the benefits in the EBA are concentrated to be more in agricultural trade. Problems with the safeguards in agricultural products, the graduation in largely expanding production and rules of origins in processing industries make it difficult to envisage clear profitable export opportunities.

In regional trading blocs, reciprocity and a mutual agreement for market access are the starting point. In practice, all free trade areas include sensitive products that are not included in the agreement. The Economic Partnership Agreements "EPAs" that the EU is negotiating with African, Caribbean and Pacific (ACP) and LDC countries, including SADC and Mozambique, are no exception. The Southern African Development Community (SADC) formed in 2000, is intended to be fully trade liberalised by 2008. Although some harmonization in trade practices has been evolving, there have also been difficulties in integration processes. The most difficult question seems to be the rules of origin. These for some SADC, especially SACU countries, favour imports from outside countries rather than from other SADC member states. Southern African Customs Union (SACU), which includes the wealthiest part of Southern Africa, seems to favour agreements in which their competitive position is protected against the poorer SADC countries (see Removing Obstacles to Trade also).

Table 2.1 summarized the average agricultural bilateral tariffs between Mozambique and its trading partners. It is clear that not much is to be gained for Mozambique at the aggregate industry level in EU and US markets, as the tariffs are already so low. Highest tariffs exist among the African regions; Mozambique, SACU and Rest of SADC countries. Moreover, the tariffs are also quite

asymmetric. For example, Table 2.1 shows that Mozambique is faced a 21.3 percent tariff on its agricultural exports to other SADC countries, while the tariffs on the agricultural exports of these countries to Mozambique are only 0.1 percent. In respect, the largest gains should be achieved from regional integration with Sub-Saharan Africa. Proximity also makes the Southern African markets easier to access than those in Europe.[8]

Table 2.1 Average tariffs in agriculture between Mozambique and its main trading partners

Exporter	Importer Mozambique	SACU	Rest of SADC	Sub-Saharan Africa	EU-25	USA	Rest of OECD	ROW
Mozambique	0	1.8	21.3	0	0.4	0	0	13.3
SACU	12.8	0	12.1	23.5	8.7	2.8	7.4	28.3
Rest of SADC	0.1	7.1	6.2	9.8	2.4	11.4	3.7	14.2
Sub-Saharan Africa	0	8.1	6.8	9.2	3.0	0.2	7.3	13.7
EU-25	14.0	4.7	14.7	9.6	1.0	1.8	26.4	11.8
USA	2.5	13.0	11.4	8.1	5.2	0	1.9	32.4
Rest of OECD	3.3	5.4	9.2	11.0	3.0	0.1	6.6	18.8
ROW	3.3	14.2	11.3	15.2	9.6	1.3	11.3	24.1

Source: GTAP Data base VERSION 5.0.

2.3 Aid, aid dependency, and donor behaviour

2.3.1 Aid allocation

Empirical analysis on the growth of Mozambique generally supports the positive contribution of foreign aid (Haaparanta and Kerkelä 2006a) to growth. Aid has also had a very positive role in poverty reduction (Massuanganhe 2005).[9] In terms of average aid/GDP ratios, Mozambique has been very favourably treated by donors, even though aid has been volatile and its share in GDP has been

[8] Detailed single tariff lines proposed by SACU for Mozambique are reported and analysed USAID (2004, Tables 5–4 and 5–5).

[9] Effectiveness of aid is a widely discussed and disputed issue but is beyond the scope of this paper. See e.g. Hansen and Tarp (2000), Burnside and Dollar (2000), Collier and Dollar (2002) and Virta (2008).

slowly declining in recent years.[10] Furthermore, donors have made serious attempts to coordinate their activities through Program Aid Partners (PAP) group, and the Integrated Framework (IF) to help with trade-capacity building. PAP donor behaviour is monitored annually, according to the guidelines set up in Killick, Castel-Branco, and Gerster (2005). In addition, there has been extensive coordination of aid to agriculture through ProAgri, a government program.

Mozambique is one of the countries where donors are prepared to allocate more aid to government budget support (GBS). And with good reason. It is harder to increase the government ownership of aid if less aid is given to government budget support. The transaction costs of aid delivery associated with project aid are high, and aid coordination becomes difficult if assistance is given as project aid. There is some very preliminary evidence that direct budget support has helped to increase aid efficiency through improved government ownership, and has promoted poverty reduction (Batley et al. 2004, 2006).

Despite the positive impacts of aid in Mozambique, one can seriously ask whether aid is really doing as much as it could. First, the allocation of aid between its various forms is still very much biased toward project aid and its share in total aid has increased from 31.8% in 2004 to 36.3% in 2005. This is projected to grow further in 2006 (Ernst&Young 2006, Table 3). The share of project aid in total aid to Government of Mozambique has also increased (ibid.). Thus, the shares of aid going to government budget support (including the balance of payments support) and of sector aid are in decline, though the share of sector aid in total aid to the government has increased. At the same time, naturally, the aid allocations to the Government of Mozambique are high, and seem to remain relatively constant, at around 88% (ibid.). The remainder is private sector support and non-governmental (NGO) aid.

[10] As shown in Ernst&Young (2006), this may exaggerate the donor role, as it appears that a large share of aid is composed of recycled debt service, paid initially by the Government of Mozambique to certain creditors.

Naturally, there are transactions costs associated with direct budget support. The most notable of these may be governance and the capacity of the government to handle increased aid flows. Also, direct budget support may give the central government more power over the local authorities that could limit the efficient use of aid (Massuanganhe 2005), especially with respect to poverty reduction. Batley et al. (2006) find that all these problems still exist but overall GBS has been a success.

The fundamental issue is that government accountability cannot be increased unless the government's possibilities to act are simultaneously improved. The "new aid architecture" (Birdsall and Williamson 2002) advocating a shift from ex ante conditionality to ex post evaluation of country performance cannot be achieved without increasing the authorities' possibilities to implement policies that are consistent with overall policy goals.

As a consequence, one must discuss future donor activities in greater depth, as donors are currently financing and supporting activities that are normally carried out by the public sector. What are the mechanisms that prevent the efficient delivery of these services through the government budget? The larger issue behind this question is whether the current aid allocation is good for the long-term development of Mozambique and what is the role of government in promoting that development.

2.3.2 Donor approaches to private sector development

As identified by Batley et al. (2006) one of the problems in GBS is that it has not yet led to deep reforms that would sufficiently support private sector development, even though the first steps have been taken. The role of the private sector in promoting development and growth has clearly been recognised and identified among donors. Switzerland is a large bilateral donor for which economic development is one of six priority areas (others are health, water and

sanitation, rural development, governance and peace promotion). Donor activities in promoting economic reform take the following forms: general budget support, debt relief, capacity building and technical assistance, support to civil society in dialogue on economic policies, and private sector promotion. The program objective in private sector promotion is to contribute to the internationalization of small and medium enterprises (SMEs) by combining investment and trade promotion instruments. On the investment side, the program provides finance and technical assistance to micro-finance banks. On the trade side, the program aims at promoting agricultural exports by addressing quality issues at the enterprise level, institutional weaknesses for better quality management and trade policy formulation. Main partners are the Ministry of Industry and Commerce, TechnoServe, UNIDO and SOCREMO. Both problems of the lack of finance and support to build business capabilities are being addressed.

One example to cite for resolving the shortcomings in small projects where partial solutions may induce other problems in building business capabilities, Sweden has launched project called Malonda ("business"). The project is focused primarily on agriculture and agriculture-related businesses in the northern Niassa province. The pilot phase has supported several initiatives in the area to improve business capabilities like microfinance, an agricultural growers' scheme, a business centre, legal services, an ombudsman, etc. To mention one success of the project, surplus maize from more than 6 000 farmers was exported to Malawi, Zimbabwe and Zambia. The project has also proposed an initiative to collect savings through the Post Bank. The program can be said to have identified well the intertwined problems in building business capabilities where creating trust between different agents is an important element.

A Danish example of a private sector development program is the support to a long-term cooperation between Danish and Mozambican companies. So far, support has been given to five long-term business partnerships in the following areas: leather bag production, juice production, printing industry, dried fruit

production, and fibre glass production. However, costs related to information and searching may prevent profitable projects from being realised. Moreover, the stipulation that both Danish and Mozambican firms express mutual interest as a necessary condition for program support probably provides insufficient incentives for the general internationalization of Mozambican firms.

In the development program of the United States for the private sector (USAID Mozambique), the role of trade and export-orientation is clearly a priority. Under the Trade for African Development and Enterprise (TRADE) Initiative, USAID is using funds to increase the capacity of small and medium-sized Mozambican companies to compete regionally and internationally. A $400,000 Global Development Alliance with TechnoServe links Mozambican businesses with typically larger and more established South African companies in tourism, wood products, nuts, and horticulture. The South African partner companies provide hands-on assistance in improving quality, introducing best practices, and developing products that can compete in world markets.

USAID's program to increase labour-intensive exports will remove constraints to investment and trade by providing technical assistance, training, and capacity building to the Government of Mozambique and the private sector to: (1) increase international markets access for Mozambican products; (2) enhance Mozambique's competitiveness by reducing the cost of doing business; and (3) increase exports in specific sectors such as tourism, garments, and horticulture. Activities will focus on improving the country's trade policies; creating a more supportive enabling environment; and directly increasing exports in target sectors.

Clearly, building business capacities and trust requires specific agents and institutions to work with local firms in the area. To be independent, these agents cannot be linked too closely to any donor or company, so that new firms can

enter the market as well. Technoserve is an example of non-profit organisation that operates outside funding parties to help firms to improve their technologies.

For multilateral donors, the possibilities for large-scale investments are naturally better. The World Bank Group's Country Assistance Strategy (CAS) for Mozambique is aligned with the government priorities set forth in the PARPA, and has three main areas of focus: (a) strengthening governance; (b) spurring broad-based economic growth by improving the business environment; and (c) improving the provision of services, particularly to the poor. Strengthening the investment climate is reflected both in IDA (International Development Association) lending to infrastructure (54%) and private sector and industrial development (7%) of the total 1ending of 20 on-going projects totalling $1,038 billion.

As part of the World Bank Group, IFC's (International Finance Corporations) committed portfolio in Mozambique totals $154 million. It consists of fourteen projects in agribusiness, the hotel industry, banking, and general manufacturing. Six of these projects are in the small and medium-sized enterprise (SME) sector, 80 % of its funding goes to SMEs. IFC's largest initiative in Mozambique has been the Mozal aluminum smelter. IFC support – $120 million for the first phase in 1997 – was crucial for financing the US$1.3 billion project and was IFC's largest single investment globally at the time. IFC provided $25 million for the second phase in 2001. IFC has further supported Mozal's HIV/AIDS programs and is assisting the company with a SME linkage program to expand its sourcing to local firms.

IFC has a special SME initiative in Mozambique. The initiative combines funding with technical assistance, an approach now also used by other donors, e.g. World Bank. Ex ante, the majority of investments (80–90%) in SMEs are failures. IFC (along with other donors) acknowledges the problem. The solution has been "handholding", close supervision of the investment project. Funds are

given only on the basis of an investment plan, the preparation of which is supported. The terms of funds to be lent are soft: interest rates are low and the funding is partly in "equity-form". Repayment is mandatory and repayment rates have been satisfactory.

The main problem in private sector development identified by many donors is getting on a sustainable path, i.e. how to get firms to grow. In addition to technical assistance, many donors propose mentors to the firms they are funding to learn how to cope with challenges posed by expansion. Mentors can also come from donor countries to help Mozambican firms in their export efforts.

Like the IFC programs, the World Bank has a program on private sector development that tries e.g. to build linkages between Mozal and Mozambican firms helping firms both in financing their activities and in building their business capacities. Especially important in this particular case is to organise quality control. Thus, "handholding" is frequently used by donors in their private sector activities.

As pointed out by Haaparanta and Kerkelä (2006a), bank credit in Mozambique is very costly, and many firms are rationed in the credit market. But also in inter-firm transactions, credit is not provided and transactions are carried on cash-only basis. Thus, working capital is an obstacle for firms, and is usually a question of credit guarantees. IFC has provided guarantees e.g. for cashew-processors.

The tariffs on imported raw materials not produced in Mozambique are another problem faced by growing firms. Given our time and data constraints, it has not been possible to calculate effective rates of protection for different sectors, but clearly tariffs on imported raw materials are a tax exerted on local production.

The danger of donor programs is that they can be very fragmented. Some donors have partially solved the problem by pooling funds with IFC and by working with NGOs like Technoserve. Yet, difficulties of coordination remain. The

biggest coordination problem still is matching donor activities with the government's development plans.

2.4 Measuring trade and aid in CGE framework

2.4.1 Trade agreements and welfare in Mozambique

Applied general equilibrium models have become a standard tool for analysing the effects of multilateral trade liberalization, and GTAP data base has been utilised in almost all related studies in the field. As few examples we can mention Anderson and Martin (2006) and Bouët et al. (2005) (see also the references). The effects of regional agreements like SADC or EPA, when analysed in the same framework, emphasize similar patterns of effects in production, trade and relative prices.

One of the outcomes in the model simulations are the negative welfare effects for small developing countries, like Mozambique. In the introduction of this volume the issue is studied in some extent. Still, the aggregate effect is not the only motivation for studying trade liberalization scenarios but we also examine the structural changes that would follow the agreements and how they might contribute to development.

In Haaparanta and Kerkelä (2006a, 2006b) we estimate the impacts of different trade liberalization scenarios. These scenarios are the following: EBA unilaterally by the EU for Mozambique, EPA as a free trade area between EU and Mozambique, SADC, joint effects of SADC and EPA and further SADC and EPAs extended to whole Sub-Saharan Africa. Based on that analysis and the analysis in Mozambique as well as other related studies, the following conclusions can be derived:

1. In the current trading arrangements, preferences extended to LDC countries like Mozambique, work as a channel between aid and trade.

That is, these trading arrangements provide development benefits (the traditional objective of aid policies). Problems with the details of the preferences still prevent countries from fully exploiting them and their temporary, unilateral nature diminishes their lucrativity. This is especially the case for sugar.

2. The evidence is weak that the Doha Development Round, even if it is renewed, will substantially promote growth in developing countries. This view is raised in several CGE studies in the field.

3. Even though there is less opportunity in regional integration for large trade volume increases than with EU access, Southern African integration is potentially more promising for Mozambique as its commodity variety is larger and existing mutual trade barriers are high. Surprisingly, it seems that Mozambique would not gain but rather lose from SADC integration even though SADC countries as a whole would benefit.

4. Deeper integration with the EU is an advantage for Mozambique only in the case of unilateral (not reciprocal) tariff cuts.

5. Regional trade agreements, even with wide coverage in commodities and deep cuts in tariffs, necessarily produces a less favourable outcome than that achieved through substantial rounds of trade liberalization. This is a feature inherent in CGE models; larger markets and better market access to several markets always increase trade and production more than trade liberalization within a smaller set of countries. This is in line with the conclusion by Lewis et al. (2002) who argue that access to the EU markets provides substantially bigger gains for SADC countries excluding South Africa than access to South Africa. South Africa would not be a viable “growth pole” for the region.

6. The simulations show that Mozambique may be faced with adverse impacts from preference erosion. While Mozambique would not benefit from an EPA excluding other SADC countries nor from SADC liberalization, the losses would be much larger if SADC liberalization were to be carried out and simultaneously all SADC negotiated an EPA with EU. The preference erosion seems to be associated with SADC countries, as the extension of EPAs to other Sub-Saharan countries mitigates the losses to Mozambique. The observation is the same when the impacts of EU-Mozambique EBA and EPA agreements are compared: EBA offers better access to EU markets by excluding countries like South Africa.

2.4.2 Measuring the welfare gain from aid

Aid is a transfer of income to a country, and excluding cases of transfer paradoxes (see e.g. Haaparanta 1987), it can be expected to improve welfare in the recipient country. But there are several reasons why aid can slow development. Aid can lead to the problem of moral hazard, in the redistribution of income between individuals/households. Aid dependency may have been created in part by these moral hazard problems.

The other possibility is to consider aid as comparable to the receiving country gaining access to certain natural resources[11]. The interaction between aid and trade can, thus, be similar to the "Dutch Disease". If foreign aid increases the demand for non-traded domestic goods, the real exchange rate appreciates and the tradable goods sector shrinks relative to the non-tradable sector (see Adam 2005 for discussion and evidence).

[11] Collier (2006) studies how far this analogy can be applied to in African context. He argues that, although there are similarities, most of the impacts of aid cannot be understood with this analogy.

But consideration of aid as merely an exogenous increase in income overlooks the uses of aid. In fact, proper use of aid can mitigate the "Dutch disease" or even reverse the impact, and magnify aid's positive effects. This can occur if aid contributes to capacity building and the supply side of the economy (see further Adam 2005).

According to Haaparanta and Kerkelä (2006a), there is no indication that aid has caused an appreciation of the real exchange rate or reduced growth in Mozambique. Instead according to IMF (2005), there are signs of a currency depreciation in the face of surging aid inflows in Mozambique.

Effects of aid in CGE framework, and models like GTAP, are not easily captured but the comparison of the ratio of aid to GDP can indicate direct effects. A direct monetary transfer does not increase resources but will have a price effect. Comparable approaches include monetary transfers between countries for instance when remittances by foreign labour force are sent back to home country (see Walmsley 2002).

Bourguignon et al. (2006) have studied the issue to some extent.[12] According to these authors, in addition to the direct effect of aid increasing Gross National Income (GNI), the beneficial impact on welfare gains depends on the shares of tradables vs. non-tradables when the Purchasing Power Parity Index (PPP) is evaluated. They also examine aid in a model with a representative household as an increase in its total consumption basket. Another alternative could be to model the aid allocation through the government budget.

If aid were modelled as an investment or mechanism that increases resources of the economy, the approach should be very different from that taken here. The

[12] Bourguignon et al (2006) do not explicitly analyse aid in an AGE model but its role in aggregate welfare evaluations is discussed. They although take the trade liberalization scenarios together with aid analysis to study the income distribution effects of aid and trade policies.

first starting point is to think of aid as improving the productivity of any sector or factor of production. Productivity increases can happen in any step of the production process and their general equilibrium effects may vary. We suggest that trade facilitation is such a mechanism. In the international discussion on aid-for-trade, trade facilitation has gained a lot of emphasis. Measurement of trade facilitation has developed recently and seems to have a lot of potential (Persson 2007).

2.5 Structural effects of trade and aid

Changes in aid and trade have both an effect on the production structure in the economy. In the simulations below these production effects are illustrated with GTAP model simulations. The simulations are performed with standard GTAP model, version 6. The data base has been aggregated to 8 regions and 10 industries (Table 2.7 and Table 2.8). The effects on the production structure and exports in Mozambique have been examined. The aggregate effects of trade scenarios were summarized above.

2.5.1 Aid, trade and development – description of simulations

Based on the previous analysis, we select two trade liberalization scenarios. The first is SADC and the second is SADC and EPA between EU and all SADC countries. In the current situation, these alternatives are the most realistic ones. EPAs are negotiated by the EU with different groups of countries, SADC being one of them. [13] Both of the scenarios are studied as free trade areas where all the tariffs between the countries have been removed.

We study the impact of aid by looking at aid as an income transfer only. Currently the extent of aid in Mozambique amounts to $700 million annually,

[13] Shocks are implemented with Rungtap commands shock tms(TRAD_COMM,"MOZ","EU") =target0% in EPA, shock tms(TRAD_COMM,"EU","MOZ") = target0% and the previous one in EPA etc.

fluctuating around 10 percent of GDP. In 2001 the share of grants in GDP was 14.8% (DTIS 2004). We apply a 10% shock to GDP, i.e. 700 million USD. To keep the global balance between demand and supply, a similar reduction in aid is projected for EU-25.[14]

When this amount is added to the economy, it does not increase welfare by the same amount. We have approached the aid issue by adding an exogenous variable (AID(r))to the equation of regional income and given it a shock comparable to current aid figures.

The implementation of aid is thus limited to the analysis of aid in total regional income, whose aggregate consumption in GTAP model is treated by the representative household that allocates its expenditure to private consumption, public consumption and savings. The role of aid in public funding and the budget balance is thus not explicitly modelled.

Finally, we analyse the impacts of improved market access overall. We do this by using a feature of the GTAP model: it includes a variable that attempts to capture transactions costs in international transactions, a cost on exports from a given country and from a given sector (a kind of "iceberg cost on exports"). This cost can be interpreted as containing both administrative costs imposed by importing countries and by the exporting country.[15]

We look at the effects of a general 10 percent increase in productivity for Mozambican trade flows in all sectors and to all destinations. The increase will produce an improvement in terms of trade and change in trade patterns from agriculture to manufacturing. When comparing these results with an increase in

[14] The question of which donor gives the money to Mozambique, does not have an effect on industry results.

[15] Trade facilitation has been implemented in GTAP model in a form comparable to the improvements achieved through market access, i.e. better terms of trade for the exporter, but also with greater imports value to the importer.

aid, it is clear that aid allocated to trade facilitation can promote changes in production and trading structure. [16]

2.5.2 Results of the simulations

Before proceeding to the production and trade figures, we look at the aggregate effects of the simulations. The aggregate effects of trade liberalization scenarios relative to other cases were described above. In the scenarios here, the GDP changes vary from 0.01 percent (SADC) to 0.07 (SADC+EPA). The aggregate welfare effects are negative in both cases, from -0.22 to -0.41, respectively when measured as a utility.

The increase in aid was implemented in the GTAP model as additional regional income which based on current expenditures, has an effect on demand for both domestic and imported consumption. The real exchange rate, characterized in the model by the terms of trade, appreciates by 0.06 percent, i.e. there is a Dutch disease effect, although the impact, given the change in aid, is very small. The same holds for aggregate welfare changes. Even though the simulated increase in aid implies a remarkable growth of disposable income, the real net welfare gain is about $8.25 Million. The increasing aid decreases the orientation of exports and spurs imports.

When interpreted in terms of the analysis by Bourguignon et al. (2006), the measure takes here the indirect effect of transfer, not the direct effect of aid to GNI. This is because aid, as modelled here, does not cumulate to resources; it has only an effect on prices. The welfare effect is generated through increases in factor and product prices. Factor prices increase from 0.07 (labour, capital) to 0.8 (price of resources). At GDP level, the effects in the model outcome are insignificant because once the resources are fully utilised in all cases, GDP increases by 0.01%.

[16] Shock ams(TRAD_COMM,"MOZ",REG) = uniform 10;

Compared to the trade facilitation experiment, the implementation of aid here as a monetary transfer maximises the potential for adverse effects from aid and serves as a useful background. The other extreme scenario studies the impacts of a reduction in trading costs (costs of trading in international markets). In this case one can think of using aid (trade facilitation, improvements in infrastructure etc) to achieve such a reduction. Between the two extremes there could be an option according to which aid is allocated to any one sector to improve its productivity. In that case, the aid could be introduced as a exogenous shock to one industry, e.g. sugar by improving its overall productivity (Hicks-neutral) or factor-augmenting way.

The results for production and exports are reported from all simulations as percentage changes in table 2.2.

Table 2.2 Changes in production (percentages) in different scenarios

	SADC	SADC + EPA	AID	TRADE FACILITATION
Agriculture	-0.2	0.2	0.0	-1.7
Fishery	-1.2	-1.6	0.2	2.0
Minerals, Forestry	-1.1	-1.5	0.0	1.3
Sugar	31.3	21.6	-0.2	1.4
Beverages and Tobacco	-10.3	-11.4	0.1	-2.4
Other food industries	-5.9	-7.3	0.0	-2.6
Textile industries	26.4	16.0	-0.1	-13.5
Other manufacturing	-1.2	-2.3	-0.3	4.4
Trade and transport	-0.2	-0.4	0.1	0.4
Services	0.6	0.9	-0.0	0.1
Investment goods	1.8	2.1	0.0	3.6

Source: GTAP Data Base 6 and authors's simulations.

In the first two scenarios, trade liberalization scenarios, the largest increases are evident when the tariffs are the largest, in sugar and in textile production. The results can also be interpreted to indicate that current protection prevents the sugar and textile industry from growing. The main difference between the

integration encompassing Africa (SADC) and Europe (SADC + EPA) is in the agricultural sector. Integration with Europe would imply that Mozambique would become more specialized in agriculture than in the case of African integration.

From the perspective of European Development Aid, sectoral support programmes might have more potential in supporting agriculture and agribusiness in Mozambique. Similar experiences were promoted by Sweden and Denmark, but also by U.S. (horticulture)

Aid, as implemented here, prevents the expansion of sugar and other manufacturing sector. Instead it favours domestically-oriented sectors; fishery, beverages and tobacco and trade and transport. The effects are still very marginal.

Trade facilitation favours fishery, other manufacturing and sugar. The main observation from the results is that a policy of aid-for-trade, as implemented above, would shift resources to non-traditional sectors.

Ex ante, it would be natural to think that increasing production is correlated with increasing exports. With the general equilibrium nature of the model, this is not the case. Table 2.3 presents the export orientation of the different scenarios.

In trade liberalization scenarios, unlike in the production figures, also agriculture and fishery industries shift more to trade. The aid scenario shows clear decrease in exports in all sectors. Through the effects on terms of trade (interpreted here as the exchange rate), aid dampen most trading in fishery and minerals, other food industries and finally to textile industries.

Trade facilitation increases exports of sugar, textile industries and other manufacturing. In these industries, the increasing global demand counterbalances the reduction in prices.

Table 2.3 Changes in exports (percentages) in different scenarios

	SADC	SADC + EPA	AID	TRADE FACILITATION
Agriculture	22.1	22.4	-0.4	-2.1
Fishery	12.3	19.9	-0.8	-11.5
Minerals, Forestry	-0.8	-1.7	-0.9	-0.8
Sugar	43.3	29.7	-0.3	5.9
Beverages and Tobacco	2.5	2.1	-0.1	-3.2
Other food industries	5.0	-0.3	-0.4	2.4
Textile industries	219.4	181.8	-0.4	4.8
Other manufacturing	2.9	2.6	-0.3	11.9
Trade and transport	-0.6	-0.7	-0.2	-4.4
Services	1.1	3.0	-0.2	-3.7

Source: GTAP Data Base 6 and authors' simulations.

In trade facilitation, both the scale of exports and their price increase and the productivity gain accrues to the importer. Trade facilitation is really a win-win situation for both trading partners. Reductions in real costs of exporting have the potential of generating large structural impacts, even if costs are reduced in the same proportion for all sectors.

From current trading patterns the results can be compared according to a rough measure built on the revealed comparative advantage. This can be measured as the ratio of Mozambique's exports of commodity *i* in the world's export of *i* to its total exports in total global exports. Countries tend to produce and export commodities in which they are superior in comparison to other countries. From GTAP Data 6 and the aggregation used here, the revealed comparative advantage is shown to be in sugar industry, agriculture and agriprocessing industries (the role of services is neglected) (Table 2.4).

In the simulations, resources are shifted away (except in the case of sugar) from the sectors in which Mozambique currently has a revealed comparative advantage. This is a challenge for policy makers and donors, and highlights the

importance of solving the problem of insufficient business capacity and lack of coordination between donor activities and the government's development strategies.

Table 2.4 Revealed comparative advantage in Mozambican exports

	Exports from Mozambique	Global exports	Revealed Comp. Advantage
	$ Millions		
Agriculture	64.9	167814	2.06
Fishery	1.7	7727	1.20
Minerals, Forestry	31.0	358828	0.46
Sugar	8.1	8450	5.10
Beverages and Tobacco	0.4	52327	0.04
Other food industries	115.8	238183	2.59
Textile industries	6.1	447632	0.07
Other manufacturing	477.2	4381428	0.58
Trade and transport	106.4	541368	1.05
Services	486.3	706474	3.66
Total	1297.9	6910229	1

Source: GTAP Data Base 5.0, base year 2001.

Despite the belief that major productivity gains can be achieved in industries in which trade orientation is already the most advanced, it is difficult to anticipate how large these gains might be and how responsive the gains in productivity will be to aid. The revealed comparative advantage measures rest on shaky theoretical foundations, and even more so for the developing countries. Thus, it may not be very illustrative to base the analysis of potential productivity improvements to which aid can contribute on these measures.

2.5.3 Sensitivity of aid and trade facilitation shocks

The standard GTAP closure, used as the default in all of the simulations here, lets the trade balance to be determined endogenously and adjusted. This makes it necessary to define the share of savings or investments exogenously. In GTAP, the trade account needs not to be in balance or fixed in simulations, as decisions

with respect to exports and imports are separate. Also the investment decisions, made by firms are different from the savings decisions of households. In GTAP, a global bank adjusts regional investments to balance the global equation (see further Hertel et al. (1997) on global closures of the trade models). How the external balance is determined is an important issue, especially for developing countries.[17]

We have studied the sensitivity of macroeconomic results in the aid-increae scenario by considering the trade balance as fixed. This resembles the trade constraints of the developing countries, even though it does not capture the real financial problems in these countries. Financing for trade is assumed to be available from domestic sources, which is not a possibility in many developing countries. The results show that GDP effects are smaller, mainly due to decreasing investments.

[17] In the developing country studies, the amount of labour is often used to describe the adaptation of factor markets. The flexible, endogenous labour force is used to describe the elastic supply of labour.

Table 2.5 The sensitivity of production and exports in Mozambique to the exogenous uniform trade facilitation shock

	Agriculture	Fishery	Minerals, Forestry	Sugar	Beverages and Tobacco	Other food industries	Textile industries	Other manufacturing	Trade and transport	Services
Production										
%-change	-1.71	1.96	1.3	1.43	-2.42	-2.59	-13.53	4.38	0.38	0.12
Median	-1.72	1.97	1.58	1.98	-2.45	-2.61	-13.46	4.24	0.37	0.11
Standard Deviation	0.68	0.47	1.69	10.58	0.57	0.96	3.41	6.7	0.23	0.65
Exports										
%-change	-2.1	-11.5	-0.8	5.9	-3.2	2.4	4.8	11.9	-4.4	-3.7
Median	-2.0	-11.7	1.0	6.7	-3.4	2.4	5.5	11.7	-4.4	-3.7
Standard Deviation	**4.1**	2.5	**11.6**	**12.9**	1.0	2.5	4.0	10.2	**4.4**	**6.3**

Another nonspecified issue is the potential of trade facilitation. In the simulations above, we have assumed a 10 percent increase in all exports. Obviously, this would be realised only in few sectors but also the extent an unknown variable. We have made a sensitivity check by varying the shock of the change with a scale 10, so that the extent could range between any amount 0.1 to 100. The results are reported in table 2.5, and show that even if the production changes are not as sensitive, trading flows can vary from positive to negative in some industries when the standard deviation of the simulations is taken into account (agriculture, minerals, sugar and trade and transport).

2.5.4 Special case study – sugar exports to the EU

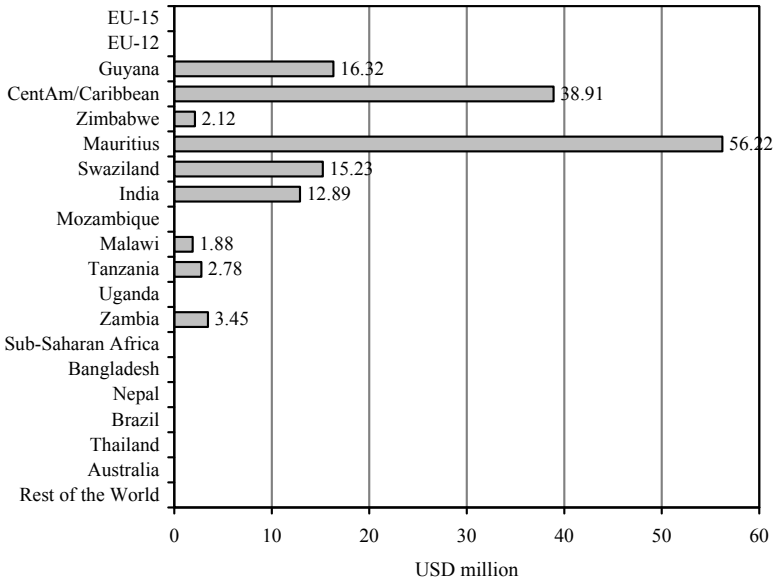
The EU Sugar Policy towards the developing countries exemplies a trade agreement where an aid component is tied to the guaranteed price exceeding the global price. Current quotas extended to different ACP and LDC countries constitute a direct transfer to sugar producers in those countries and the guaranteed intervention price for sugar that the EU is paying currently these producers, is more than double the present global rate. The high price is a result of the domestic sugar regime. This duty-free access applies to 19 ACP countries under the ACP/EU Sugar Protocol prior to the full EBA agreement but since then, new quotas have been extended to LDC countries. The quota rents are evaluated from 1997 trade data in the figure below.

The quota rents Mozambique earns are very small.

For the US market, sugar imports are also regulated by quotas, but the price paid is the world market rate. As such, no subsidy element is present in sugar exports except to the EU. In 2003, Mozambique exported 10,400 tons of sugar to the EU

at $526 per ton (valued at $5.47 Million) and 13,000 tons to the USA at $302 per ton (valued at $3.93 Million)[18]

Figure 2.1 Quota rents in the EU sugar regime for the 20 regions totalling $149.8 million [19]



Source: Kerkelä and Huan-Niemi (2005) (original source: Authors' simulations and GTAP Data base 5).

Largely because of WTO commitments, the EU has been obliged to renovate its domestic sugar regime, which poses a challenge to the current preferences within the EBA Agreement. In the EBA Agreement, full liberalization of sugar is scheduled to start from 2009, which makes the price paid of sugar an interesting question. It is quite obvious that the current intervention price is no longer affordable for the EU and may shift close to the world rate. Nevertheless, opposite effect for world sugar prices can be expected to result from the removal

[18] Source: A Sweeter Future, Oxfam Briefing Paper No. 70 (2004).

[19] Figures not given imply zero, as there was no sugar trade in 1997 between EU and these countries.

of export subsidies. Due to EU's commitments to eliminate all export subsidies, the world market price of sugar can be expected to increase.

In a simulation study by Kerkelä and Huan-Niemi (2005), the liberalization scenarios for sugar imports to the EU are analysed from the developing-country perspective. The experiment assumes that EBA countries have free access to EU markets but EU sugar imports from other countries are subject to the current level of tariffs. Mozambique is an exporting country whose position in the outcome of the liberalization scenarios depends very much on which EU country markets are opened. The best outcome would be achieved by extending the EBA agreement only for LDC countries. It is still plausible to assume that the previous relations with ACP countries will generate free imports within the EPAs.

In the simulations it was assumed that the current quotas prevent countries from fully adapting to greater demand. So, even without the quota price countries would need to adapt to new market conditions. In table 2.6 we present the aggregate effects as well as the outcome in the sugar sector for certain African countries once the EBA Agreement is fully implemented.[20]

The production and exports of sugar could increase in Mozambique to 2–3 fold from current levels, equivalent to a 0.4 percent increase in GDP, or $65 million. These results have become magnified compared to the earlier trade agreement results because of the elasticities used. In this study, sugar is assumed to be a homogenous commodity where liberalization would result in large trade flows (Armington elasticities 10/20 vs. 2.7/5.4 default assumptions). With these assumptions, the loss of quota rents implied by the reduction in EU producer prices would be compensated by trade increases. The EU sugar reform, if implemented as planned, would clearly be beneficial to Mozambique. The result also shows strong substitutability between aid and trade for Mozambique. Under

[20] GDP results for countries like Swaziland and Mauritius are undervalued as they are aggregated regions in the GTAP Data base.

the current regime, aid is a lump sum (quota rent) paid to the Mozambican sugar producers. Its elimination and better market access for producers would increase the Mozambican aggregate income considerably. But this substitutability between aid and trade is clearly a product of the very specific nature of aid.

Table 2.6 Selected results for African countries if sugar markets are liberalised in the EU

	EBA Agreement				
	GDP (%)	Sugar production (%)	Sugar exports (%)	Aggregate exports (%)	Welfare in $ Millions
Zimbabwe	0	3.5	5.3	-0.2	-3.5
Mauritius	0	-41.2	-74.2	-0.3	-12.9
Swaziland	0	2.7	9.1	0	35.3
Mozambique	0.4	236.4	295.5	-9.1	65.1
Malawi	1.2	2124.6	3439.1	0.5	125.5
Tanzania	1.1	131.1	5472.6	13.5	252.7
Uganda	0	21.7	14221.3	0	5.9
Zambia	-0.4	890.7	3083.6	-1.1	70.5
Rest of SSA	0.2	201.1	10374.9	1.7	1552.2

	EBA and EPA				
	GDP (%)	Sugar production (%)	Sugar exports (%)	Aggregate exports (%)	Welfare in $ Mio
Zimbabwe	0.2	207.2	371	0.4	78.7
Mauritius	1.2	1191.8	2002.8	5.3	536.5
Swaziland	0.1	282	977.6	-0.1	562.4
Mozambique	0	60.1	72.2	-0.6	5.1
Malawi	0.3	781.5	1265	0.3	31.4
Tanzania	0.2	36.5	1489.4	3.2	55
Uganda	0	3.8	1876.1	0	-2.1
Zambia	-0.2	362.7	1255.5	-0.1	15.4
Rest of SSA	0	41.1	1899.5	0.2	211.6

Source: Kerkelä and Huan-Niemi (2005), authors' simulations.

Interestingly, the expansion of sugar production and sugar exports resulting from the simulated EU sugar policy reform seems to crowd out other exports. In value terms, the crowding out is much smaller as policy reform improves the terms of trade of the country.

Since the implementation of EBA agreement, the sugar industry investments were made in Mozambique especially by South Africa and Mauritius, as a gateway option to the European markets. Now the transitory nature of the current high price is obvious. In the short term, the high guaranteed price in the EU market was the only incentive for investments. Still, according to most surveys, Mozambique is one of the lowest-cost producers in the world, as are most of the Southern African countries. In freely operating sugar markets, the competitive position of Mozambique is thus largely determined by regional allocation of investments in Southern Africa.

The current sugar preferences are clearly a form of tied aid and there is no clear evidence that the sector cannot expand even in the absence of clear price subsidy once the markets are fully liberalised. Thus there is no reason why the subsidy could not be compensated by measures other than a regulated price. A subsidy to improve the sugar sector productivity would make the industry more competitive in the future as well. Thus far high prices seem not to have had the desired effect on the sector's productivity.

The sector's principal challenge is that it is largely run by South African firms. They have located in Mozambique at least partly to gain access to EU markets. If there are changes in EU policies, will they withdraw from Mozambique? The analysis above does not support such pessimism, as Mozambique is not hurt by policy change as much as some other countries. The possibility of South African firms' withdrawal, however, means that improvements in sugar sector productivity and in local know-how should be supported now. Improving the prospects of the sugar sector now in the face of EU reforms is especially pertinent, given the sector's potential for poverty-alleviation (particularly if processing activities are included).

2.5.5 Discussion

In the sugar markets, the "donor-equivalence" between aid and trade preferences is most clearly defined in the concept by Adam and Connell (2004). According to these researchers the transfer value of trade preferences is the recipient's revenue gain once tariffs are reduced. In the sugar markets, this tied aid could be replaced by an increase in trade. Measuring the equivalence exactly is complicated, though.

Different donors try to support activities of certain industries that complement agriculture, textile industry and other manufacturing. Trade agreements have an impact on some of these and aid can have similar effects but based on the simulations here, we do not want to suggest very conclusions.

2.6 Concluding comments

The Aid for Trade initiative was launched by WTO in 1995 in Hongkong with the aim to build the trading capacity of the developing countries so that they could better benefit from world trade. Both trade and aid in the context of both development policy and Mozambique, need to considered from the viewpoint of how they contribute to development. At the developed country policy level, the coherence of policies also needs to be considered.

Our first main finding is that Mozambique does not seem to gain much, if at all from Doha and the various regional trade agreements (EU and SADC) (with the exception of some agreements with EU) currently on the agenda. This is surprising since in the SADC region, for e.g. mutual trade barriers are still very high and one would have expected trade liberalization benefits within SADC to extend to Mozambique as well as to the region as a whole.

Our second main conclusion is that trade facilitation (modelled here as a reduction in transactions costs for Mozambican exports both at home and

countries importing Mozambican goods) has beneficial effects. As our analysis shows, adverse impacts of aid (e.g. real appreciation) are small and aid for trade programs seem to offer opportunities. The results indicate, however, also that trade facilitation has a larger impact on the production structure triggering new sectors in manufacturing to grow and current important sectors (except sugar) to wither.

In Haaparanta and Kerkelä (2006a) we identified the costs and availability of credit to growing firms and the lack of business capacities as the major bottleneck to growth in Mozambique. Solutions to these problems must thus be found if trade facilitation is to fulfil the promise it seems to hold for Mozambique.

The aid, as implemented here, identified the price effect only but is assumed to have production effects of the representative consumer. Production and trade effects were of opposite signs in aid and trade facilitation scenarios. Thus, there is potential for a deep structural change.

Current EU sugar policy can be seen as aid for trade policy, whereby countries are given a quota for exports and paid higher than the world market price. Thus, there are fears that the EU sugar reform, leading to reduced prices, will be very damaging. In case of Mozambique this fear may not be substantiated as the policy amendment makes it possible to expand exports. The Mozambican sugar sector is, according to the GTAP simulations, competitive relative to other producers having access to EU markets. Hence, it is in a position to capture some market share.

Finally, while we emphasise here and in Haaparanta and Kerkelä (2006a), that the limited business capacity and the lack and cost of finance are the major current growth bottlenecks, we do not want to downplay other problems with respect to governance, i.e. corruption, and excessive regulation (red tape).

Similarly, there are still problems in treatment of exports and imports. These problems, as of yet at least, have not prevented foreign investors from investing in Mozambique (partly driven by the subsidies and tax breaks available to firms, both for domestic and foreign). These factors in the future, are bound to have more weight in firms' decision making.

In general, we conclude that aid, particularly aid for trade, has a potentially positive role for increasing growth in Mozambique. Of course, realising this potential opportunity depends on the effective use of resources earmarked for trade facilitation, trade capacity building, infrastructure and institutional reform. This effort is critical in order to prepare Mozambican firms for a future in which they have greater access to external markets.

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Note: An excellent source of both documents and research on Mozambican economy is the Mozambican Trade and Investment Project website, http://www.tipmoz.com/, maintained by USAID.

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Appendices

Table 2.7 Regional aggregation in the study

No.	Code	Region	Description
1	MOZ	Mozambique	Mozambique.
2	SACU	SACU	Botswana; South Africa; Rest of South African CU.
3	RSADC	Rest of SADC	Malawi; Tanzania; Zambia; Zimbabwe; Rest of SADC.
4	XSS	Rest of Sub-Saharan Africa	Madagascar; Uganda; Rest of Sub-Saharan Africa.
5	EU25		Austria; Belgium; Denmark; Finland; France; Germany; United Kingdom; Greece; Ireland; Italy; Luxembourg; Netherlands; Portugal; Spain; Sweden; Cyprus; Czech Republic; Hungary; Malta; Poland; Romania; Slovakia; Estonia; Latvia; Lithuania.
6	USA		United States.
7	ROECD	Incomplete ROECD	Australia; New Zealand; Canada; Switzerland; Rest of EFTA.
8	ROW	All other regions	Rest of Oceania; China; Hong Kong; Japan; Korea; Taiwan; Rest of East Asia; Indonesia; Malaysia; Philippines; Singapore; Thailand; Vietnam; Rest of Southeast Asia; Bangladesh; India; Sri Lanka; Rest of South Asia; Mexico; Rest of North America; Colombia; Peru; Venezuela; Rest of Andean Pact; Argentina; Brazil; Chile; Uruguay; Rest of South America; Central America; Rest of FTAA; Rest of the Caribbean; Rest of Europe; Albania; Bulgaria; Croatia; Slovenia; Russian Federation; Rest of Former Soviet Union; Turkey; Rest of Middle East; Morocco; Tunisia; Rest of North Africa.

Table 2.8 Industry aggregation in the study

No.	Code	Sector	Description
1	Agri	Agriculture	Paddy rice; Wheat; Cereal grains nec; Vegetables, fruit, nuts; Oil seeds; Sugar cane, sugar beet; Plant-based fibers; Crops nec; Cattle,sheep,goats,horses; Animal products nec; Raw milk; Wool, silk-worm cocoons.
2	Fsh	Fishery	Fishing.
3	Minres	Minerals, Forestry	Forestry; Coal; Oil; Gas; Minerals nec.
4	Sugar	Sugar	Sugar.
5	B_T	Beverages and Tobacco	Beverages and tobacco products.
6	Ofd	Other food industries	Meat: cattle,sheep,goats,horse; Meat products nec; Vegetable oils and fats; Dairy products; Processed rice; Food products nec.
7	Tex	Textile industries	Textiles; Wearing apparel; Leather products.
8	Mnfcs	Other manufacturing	Wood products; Paper products, publishing; Petroleum, coal products; Chemical,rubber,plastic prods; Mineral products nec; Ferrous metals; Metals nec; Metal products; Motor vehicles and parts; Transport equipment nec; Electronic equipment; Machinery and equipment nec; Manufactures nec.
9	T_t	Trade and transport	Trade; Transport nec; Sea transport; Air transport; Communication.
10	Svces	Services and activities NES	Electricity; Gas manufacture, distribution; Water; Construction; Financial services nec; Insurance; Business services nec; Recreation and other services; PubAdmin/Defence/Health/Educat; Dwellings.

3 Distortion Costs and Effects of Price Liberalization in the Russian Energy Markets: A CGE Analysis

Abstract

Russia's economy is energy intense and wasteful of resources. This situation has arisen in part due to the country's ample energy supplies and regulated privileges for domestic consumers. Recently enacted and proposed reforms intended to increase the efficiency of the energy sector by raising domestic energy prices also have implications for the export levels of Russian energy commodities. In this study, we estimate the costs of the subsidized energy system in an allocative sense and then analyse recent moves of the Duma to boost gas and electricity prices to bring them into line with market-based pricing. Our analysis uses a multiregion general equilibrium model (GTAP) modified to express the global dimensions of the subsidization policy and suggested reforms. Results show that current subsidies extract around about 2.8 percent of GDP but are very sensitive to the assumption on nature of the homogeneity of energy products. With alternative elasticity assumptions the estimate is 8.3 percent of GDP. Subsidies limit the potential benefits of Russia's comparative advantage in energy commodities. Increases of 6% in electricity and 10% in the price of regulated gas improve efficiency by reducing distorting subsidies and distinctly shifting output from domestic markets to exports.

Keywords: distortions, subsidies, energy market liberalization, Russia

3.1 Introduction

Extensive energy resources in the absence of a functioning domestic market for energy products allowed the centrally planned Soviet Union to become an energy-intensive economy with excessive crude oil production and inefficient conversion of energy to secondary markets in power production. The lack of a price mechanism and state ownership of resources also allowed consumers and enterprises to exploit the country's energy resources at prices far below those prevailing in market economies. Since the collapse of the Soviet Union, the energy-intensity of the Russian economy has continued to exceed the OECD average, while rates charged for fuel and electrical power remain below long-term supply costs and well below the levels in Western Europe and North America.[21] This price structure is further distorted by the system of cross-subsidies from industry and business to residential customers found in all CIS countries (Kennedy 2002a, 2002b, 2003).

In April 2003, the Russian government approved a long-term energy strategy that seeks to increase energy production and promote efficient energy use in Russia (BOFIT 2003a, No. 22). Greater energy efficiency will surely make Russia's economy less energy intense and free up greater volumes of crude oil, gas and other energy products for export. Moreover, increasing energy exports are a channel for acceding to global commodity markets. On the other hand, boosting of exports of energy products will further narrow Russia's export mix and could even threaten stable development to the extent that it increases budgetary dependence on trends in world energy prices. For the government, budget income from these resource rents is so vital that it well justifies the aims to increase production and exports.

[21] For an overview of energy markets, see IEA 2003.

Price liberalization in energy markets, especially power production, is crucial for the market mechanism to function and generate the revenue needed for necessary investment in the sector. Russia's domestic price of gas is currently a quarter of the world market price and the price of oil on the domestic market is a third of the international price.[22] The cross-subsidization of residential power effectively raises rates charged to firms to about 1.8 times the rate charged for residential electricity and heat (EBRD 2001). Higher prices from domestic energy use are needed for sustainable business and for decreasing the energy-intensity of the economy. Efficient production frees resources for other uses and increases the costs of the energy use before the structural changes occur. Such changes, while improving the overall allocation of resources, would inevitably create winners and losers in the short run. This situation largely explains the lack of political enthusiasm for implementing such changes.

In this paper, we analyse currently planned reforms in the Russian energy markets, focusing on their potential efficiency in resource allocation. Numerical simulations support the analyses, which are performed with a global data base and a multiregion general equilibrium model (GTAP) provided with compatible data. In version 5.4, Russia is separated as a country of its own with a national input-output model. Bilateral trade flows with the rest of the world genuinely connect Russia to global trade flows. The data base includes information on energy taxes, which we modify to include implicit subsidies for regulated prices. We further attempt to survey the current tax, subsidy and market structures in the Russian energy sector.

The goals of this paper are twofold. First, we analyse the extent of Russian energy markets, especially the costs resulting from the current distortions in the

[22] Information on the export price of natural gas and the relative oil prices in domestic and international markets comes from Russian economic trends, version 2002. The domestic price of natural gas in 2003 was about $23 per thousand cubic meters; the average price of exported gas in the last three years was about $98 per thousand cubic meters.

tax and subsidy system. The analysis is performed by totally removing all taxes and subsidies in the Russian energy sector. The simulations produce results on aggregate-level effects and changes in the production and trading patterns. With somewhat realistic reforms currently on the agenda, we focus on what might happen with increases in regulated electricity and gas rates. Simulation results show that current taxes and subsidies exhaust between 3–8% of current resources. This gap is mainly the outcome of subsidized gas prices for households and industry. The range of estimates is dependent on assumptions of the nature of gas and oil as tradable commodities. In the price liberalization reform, we focus on the trade-off between domestic and international markets required by the reform. We study the effect on global trade flows in gas, electricity and manufacturing industries that are sensitive to energy prices. We also consider the impact of such changes on Russia's closest trading partners.

In the section 2 of this paper, we show the importance of Russian energy markets for the domestic economy and for global energy markets. Section 3 provides an overview of the policy landscape for energy markets and what such policy implies in the domestic field and in global trade negotiations. Section 4 presents simulations. In section 5, we analyse the costs of the distorted energy system, while in section 6 we examine the impact of price increases on domestic gas and electricity. Section 7 concludes.

3.2 The role of Russian energy in trade and the domestic economy

For the purposes of this study, we make following restrictions on our analysis of energy sector: we focus solely on Russia,[23] and we only consider primary energy production of oil and natural gas (coal, while treated as a separate sector, is not of primary interest for this discussion). Our data base also treats the distribution of gas as a distinct sector. Gazprom's monopoly on ownership and governance of

[23] For a general overview of other CIS countries, see e.g. EBRD (2001).

pipelines should justify the distribution of gas as a separate industry. However, as all sectors behave symmetrically, monopoly power is unapparent in the sector. Our data do not make it possible to study separately the market structure in Russian oil markets, where extraction is partly privatised while pipelines are operated by a state-owned company. Regarding secondary energy markets, we treat electricity and heat as a single sector and analyse their subsidies and price reform. The technology of the energy sector is inferred from the input-output data for Russia and the production technology is mainly a nested CES function.[24] In any case, we focus here on demand-based reactions to changes in relative prices, rather than technology choices in production. Our definition of the GDP produced by the energy sector includes the fuel industry (the first five industries listed in table 3.1)

Table 3.1 Sectoral composition of GDP in the Russian Federation and EU

	Value Added		Total Production	
	Russia	EU	Russia	EU
1 Electricity	0.5	1.1	4.1	1.3
2 Oil	6.3	0.2	5.9	0.2
3 Gas	9.1	0.1	6.4	0.1
4 Gas Distribution	1.0	0.1	0.8	0.1
5 Fuel Industry	0.3	0.1	3.3	0.7
6 Raw metals and coal	5.7	2.3	7.0	3.7
7 Chemicals	1.6	3.1	2.4	5.0
8 Mechanical industry, automobiles	4.2	7.5	5.2	10.8
9 Wood industries	1.4	2.6	1.7	3.4
10 Light manufacturing	2.1	4.3	2.4	6.0
11 Construction	8.5	5.7	7.9	6.7
12 Food industries	3.5	3.3	6.0	5.4
13 Agriculture	8.9	2.1	8.9	2.0
14 Trade and transport	14.5	18.3	13.0	16.6
15 Services	32.2	49.1	25.0	38.1
Total	100.0	100.0	100.0	100.0
Energy intensity	17.3	1.7	20.5	2.4

Source: GTAP data base 5.4. for 1997 and author's calculations.

[24] GTAP Data base 5.4. For a description of the GTAP model, see Hertel and Tsigas (1997).

The size of the energy sector can be measured either as the value added produced by the sector as a share of total GDP or as the sectors' output compared to total output. We take the EU for comparison in table 3.1. Measured in terms of value added, the share of energy sector from GDP in Russia is 17.3% compared to the EU's 1.7%. Measured in relation to total production, the share of energy sector in Russia is 20.5%, a share ten times larger than for the EU. The figures are modified from the original GTAP data base to include subsidies for consumers in electricity and for firms and consumers in gas industries.[25] Our corrected figures deviate somewhat from Wehrheim (2003), who reports the respective shares based on World Bank (1995) figures as 13.0% and 11.6%. Our figures are quite in line with Tabata (2002), who estimates the oil and gas industry produces 16.1% from GDP when transportation and trade margins are included in the estimation.[26]

Russia is the world's second largest producer and exporter of crude oil after Saudi Arabia. In natural gas, it is the world's leading producer and exporter. Russia even exports over 7% of total world exports of petroleum products (IEA 2003). For the EU, the importance of Russia is huge. Of total imports of oil and gas to the EU, 10% and 43%, respectively, come from Russia (GTAP 5.4).

Russia's comparative advantage in natural resources can be seen in its trading patterns. Crude oil constitutes 15% of Russian exports, natural gas 17%, oil products 8%, and other minerals and extracted materials such as aluminium and nickel about 25%. The energy sector's share of total exports is 43.4% (GTAP 5.4). As the price of oil is volatile and greatly affects the world market prices of other commodities (including gas), Russia's economy, as noted above, remains

[25] For the same data in the original GTAP data, see table 3.10.

[26] According to Tabata (2002), the share of GDP produced by the oil and gas industry varied between 15.8% and 24.3% during the period 1995–2000. Some estimation errors may result from domestic margins and whether they are included in the energy sector or trade and transport sectors.

highly vulnerable to external shocks and attempts to diversify Russia's production structure should be generally welcomed.

Throughout our analysis, we only treat taxes and subsidies in the energy sector as distortionary tools that decrease the efficiency of the economy as a traditional dead-weight loss. The role of taxes as corrective policy devices in the case of externalities or limiting the use of non-renewable resources is beyond this approach. We also abstract from the budget revenue dimension of taxes or the fact that indirect subsidies in the form of regulated prices are not actually part of the government budget.[27] International best practice dictates that multiple fiscal instruments should be employed in ways that keep distortion to a minimum as risks and returns change over time (EBRD 2001). For example, Russia's hydrocarbon tax structure includes royalties based on volume recovered varying from 6% to 16%, a 25% corporate profits tax, an excise tax based on volumes (66 roubles per metric tonne of oil, 30% for non-CIS gas exports), a 10% mineral depletion tax and a crude oil export tariff (€20 per tonne of oil). The export tariff varies with prevailing oil prices (EBRD 2001).

GTAP data base 5.4 provides the following tax and subsidy structure for the energy products in the data base (Table 3.2). Positive figures are taxes; negative figures are subsidies. All positive figures come from GTAP data base 5.4. We have modified the subsidy structure so that the data more accurately describe the structure of energy markets in Russia. In the simulations below, we refer to these tax figures and describe how we base the subsidies on information on real, regulated prices. Taxes in the GTAP data base are based on estimations on the differences between domestic and world market values of energy production.

[27] The costs of these subsidies are largely borne by Russian energy-producing firms, which in turn have the possibility to operate with costs exceeding actual revenue. Treating the subsidies described here as a tax to the primary producer of gas or electricity offers possibilities to continue the work started here.

Table 3.2 Ad valorem tax rates and subsidies on Russian Energy Commodities

	Output tax	Export tax	Import duty	Consumer subsidy	Firm subsidy (average)
1 Coal	2.0	2.8	0–5.0	5.2	2.7
2 Oil	22.9	10.0	0–5.0	0.0	2.4
3 Gas	16.1	9.6	0–5.0	***-75.0***	***-75.0***
4 Gas Distribution	16.1	4.9	0–5.0	***-75.0***	***-75.0***
5 Electricity	2.8	7.4	0–5.0	***-56.0***	0.2
6 Fuel Industry	2.1	9.5	0–5.0	17.6	4.3

Source: GTAP 5.4. data base, figures bold and in italics from EBRD (2001) and other sources (modified to the data base).

A dominant feature is the low price of gas and oil in Russia's domestic market. As mentioned, the domestic price of gas is about a quarter of the world market price and the price of oil at domestic markets is a third of the international price. The domestic price of gas in 2003 was about $23 per thousand cubic meters. The average export price over the period 2000–2002 was about $98 per thousand cubic meters (RECEP 2002).

The regulated gas price, which is well below actual cost as well as the prevailing world market price, constitutes a clear subsidy to all users of gas for power production or heating. Payment arrears, barter arrangements and non-payments in the energy sector further act to subsidize the energy markets. As estimating the real subsidy rate in the presence of other distortions is a non-trivial task, we begin our approach with rough estimates.[28]

The subsidy for consumers and firms for domestic gas is expressed as a 75% subsidy. This is inferred from a fact that currently firms and consumers pay about a quarter of the market value of gas. This assumption applies to both gas and gas

[28] Problems associated with Russian energy tax rates are acknowledged by those compiling the GTAP data base (McDougall 2003).

distribution. Altertax-software makes it possible to modify the data in this respect without changing the initial factor market shares between sectors.

We also correct for the consumer subsidy in the electricity market. Electricity markets are highly regional and there is no clear international reference for electricity rates. Russia's electricity markets have the unusual feature that residential rates for power are lower than industrial rates. According to the EBRD (2001), the ratio of industrial rates to residential rates for Russia in 2000 was 1.8. This is a form of cross-subsidization of consumers at the expense of firms. If we treat the industrial rate in the electricity market as a market price, the lower residential rate implies a 56% subsidy to residential consumers.

Although the domestic price of oil is well below the world market price, inferences on subsidies are not analogous for the gas market. Instead, the inadequate export capacity and the government's willingness to restrict exports of oil have led to an over-supply and low prices in the domestic markets.

3.3 Elements of energy market reform in Russia

Several factors suggest pressures on Russian energy markets to alter the shape of markets and price formation, but no single factor is so overriding as to assure such changes will actually happen. For this purpose, we list the main features of the reforms and explain some of the positions put forward by actors in the market.

The Russian government's most concrete signal of a desire for change was the long-term energy strategy announced in April 2003. The main goals of the strategy are to increase energy production and promote efficient energy use in Russia (BOFIT 2003a, No. 22), and thereby make the economy less energy intense and free up additional crude oil, gas and as other energy products for export.

3.3.1 Price liberalization

Energy market reform and enhanced market competitiveness typically require a move from subsidized prices for gas and electricity to freely determined prices. Russian domestic prices of gas and electricity are administratively governed and the Duma must authorise any rate hikes. The domestic oil market is regulated by export restrictions and pipeline controls.

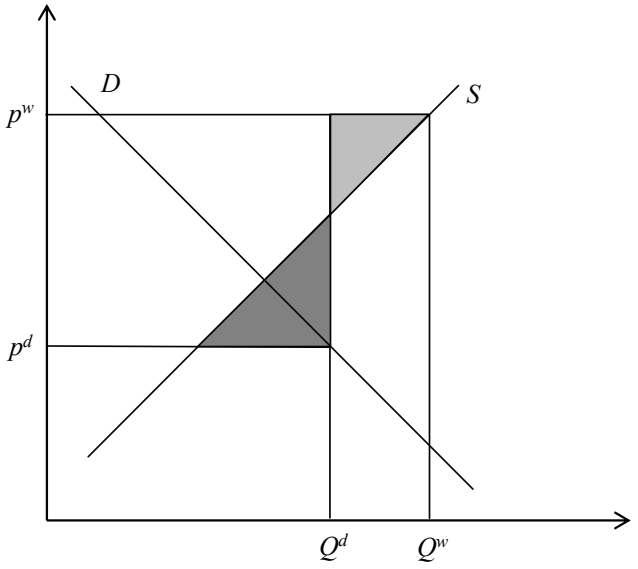
Figure 3.1 sketches a dual-track partial price liberalization resulting from domestic subsidized energy commodity prices.[29] The world price is given as exogenous to the economy. The export level in a partial equilibrium framework is the difference between supply and demand with a price level p^w. In regulated domestic markets, the price set by the government is p^d. At that price, there is excess demand for the commodity and we assume the government will impose regulations for firms to fulfil this demand, even though the firms are making losses (shaded area under the supply curve). The supply curve also measures the marginal costs of production. With the regulated domestic price, the amount available for exports reduces to $Q^w - Q^d$, where Q^w is the firms' willingness to produce at price p^w and Q^d is the domestic demand at price p^d. In a centrally planned economy, the profits from exports (shaded area above the supply curve) can be used to cover losses from domestic supply.

The rise in the domestic price in Figure 3.1 can be analysed by increasing p^d. Such an increase reduces domestic demand, increases export supply and decreases subsidies. The draft 2004 budget foresaw a 20% rise in the price of natural gas and a 16% rise in the price of electricity (BOFIT 2003b, No. 7–9). While the actual increases depend upon inflation, the budget act clearly seeks to raise the relative prices of energy commodities. Roughly estimating, an inflation

[29] "Dual track" refers to a partial price liberalization in the market where part of the market behaves competitively and part of the market is regulated to guarantee the domestic supply. The analysis here is a modified and simplified analysis of Roland (2000) where the dual-track price liberalization refers especially to China's experiences in agricultural markets.

rate of 10% results in 10% and 6% real increases in the relative prices of gas and electricity.

Figure 3.1 Dual-track partial price liberalization in energy markets



The pressures to increase domestic prices stem partly from domestic forces when firms strive to become more competitive. Reforms are also part of Russia's efforts to create a market economy. The EU has perhaps been the loudest foreign proponent of increasing Russian energy prices (see section 3.3.4). Such reforms will clearly affect consumers, the government revenue and international markets (not only in energy goods but also in manufacturing goods that use energy as an input).

3.3.2 Tax reform

Price increases are assumed to be transmitted through tax reforms to the energy sector. Tariffs on the production and export of oil and natural gas presently constitute about 35% of total federal budget revenues, which means that the budget is highly sensitive to fluctuations in world market prices for energy

(BOFIT 2003b, No. 9). In spring 2003, the Duma introduced several tax reforms affecting the energy sector. These included an increase in the oil extraction tax and introduction of a natural gas extraction tax. Another proposal would eliminate the excise tax on natural gas, while raising the export tax on gas to 20% (BOFIT 2003a, No. 26).

Shifting the tax burden towards energy commodities is partly a response to the lowering of the value-added tax (VAT). In general, the government has attempted to boost its tax take on oil income, and, in particular, windfall profits of Russian producers from high international oil prices. Extraction of natural resources from easy-access, high-profit fields should also, according to the government, carry a heavier tax burden (BOFIT 2003b, No. 12).

3.3.3 Design of market structure

To ensure restructuring to more efficient production after price liberalization so that price increases do not end up as monopoly rents, supporting reforms are also expected to ensure competitive behaviour among firms. The main features of such reforms concern the design of the market structure and a gradual abortion of regulated prices for domestic energy commodities.

Increased competition in energy markets, especially in electricity and gas production, is a main component in the reform plan. For gas production, however, the reform faces severe opposition from Gazprom, which is unwilling to share its pipelines with other companies. As a result, no plan for the reform in gas sector is likely to be implemented in the near future.

The reform plan for UES, the national electricity monopoly, strives to break up the company into ten privately independent regional power generating companies serving the wholesale market. In addition, several regional power-generating companies will be separated from UES. The power grid would remain state-

owned, while five regional power transmission companies would be partly state-owned (BOFIT 2003a, No. 23).

The plans are in concord with liberalization schemes in the OECD and the EU. Economic theory says that when a natural monopoly exploits decreasing average costs is only useful to split it up in those areas that do not benefit from increasing returns to scale. For many monopolies, there are several areas that exhibit constant returns to scale. For Russia's gas monopoly, for example, the pipelines may hold properties of natural monopoly. For electricity production, improvements in the competitive environment usually require splitting up the ownership of power generation and the ownership of the grid, and this is also suggested in Russia's case.

The energy reform includes plans for increasing the extraction of oil for exports and building up new infrastructure for this purpose. The energy intensity of the economy and consumption of energy commodities would decrease.

3.3.4 Global interest for Russian energy reform

The global interest in reforms in Russian energy sector stems partly from the general interest on how Russia moves from centrally planned economy to competitively working markets and integration with global markets. Russia's reform measures in electricity and gas supply have much in common with those of OECD countries, and especially EU countries. The convergence in market design can be seen (IEA 1995, 2002).

The EU has been highly vocal on Russia's highly subsidized energy prices. The topic has been on the agenda at the ongoing WTO negotiations for Russia, as well as in bilateral negotiations between Russia and the EU. Because Europe depends on Russian energy, and will be even more dependent on Russian gas in the future, the EU insists that Russia's domestic prices for energy resources must approach world prices and that Russia's energy sector requires significant

reform. Russia's view has been that lower energy prices are due to its comparative advantage. Raising the domestic price of energy to world-market levels would also make Russian manufacturing uncompetitive (Chowdhury 2003).

Critics earlier noted that Russia's subsidized gas and electricity prices conferred significant competitive advantage on its domestic industries. This, in turn, raised the threat of retaliation with antidumping and other countervailing measures against Russian exports. With Russia's pending WTO membership and acceptance as a market economy, Russia should gain more rights against antidumping penalties. Although energy reform should not remain a crucial question after Russia's accession to the WTO, the energy reform must still be considered from the standpoint of global economic integration.

The speed of reforms is interesting both from the standpoint of national effects and in terms of how the reforms effect export supply and thus the export price and quantity of gas and oil. Market conditions also form the basis for infrastructure investments in Russia, which impact, in turn, e.g. environmental protection measures and the investment climate in general. Russia's successful development is very much dependent on the development of its energy sector.

3.4 Analysis of Russian energy markets with the GTAP model

We now analyse the distortions in Russian energy markets and proposed price liberalization with the help of a multi-region general equilibrium model, GTAP and a data base supported by the model.[30] In recent years, such models have become standard in evaluating trade policy-related issues. In GTAP data base 5.4 an improved input-output table for Russia was published. In this study the 78

[30] Information on GTAP Project, the data base and the model, as well as several applications, are posted on the project's website at http://www.agecon.purdue.edu/gtap. Hertel and Tsigas (1997) describe the model. Dimaranan and McDougall (2002) describe GTAP data base version 5.

regions and 57 sectors are aggregated into 16 commodities and seven country groups (Appendix table 3.8 and table 3.9). In the regional aggregation, we focus on Russia, the EU and former Soviet Union countries (Baltic States and other CIS countries). The rest of the regions are Central and Eastern European countries (EEA), Northern America (NAM) and the Rest of the World (ROW). The GTAP data base includes input-output tables expressed in dollar value terms for all countries in the data.

Several single-country CGE models have recently been built for Russia (e.g. Alekseev 2003, Rutherford et al. 2004, Wehrheim 2003). While under the GTAP framework single-country data can be used to derive a single-country model (CRUSOE),[31] our goal here is to analyse Russia in the global context. While Russia is generally a minor player globally, its main export products are important in global trade and domestic measures affecting the energy sector are likely to have global implications.

Studies to date on the Russian economy in the CGE framework typically relate to WTO membership or EU integration (Sulamaa and Widgren 2003, Alekseev 2003). Wehrheim (2003) also tackles changes in agricultural production.

"Former Soviet Union" was an aggregate in the previous GTAP data base and its synthetic input-output table was unrepresentative of Russia or any other FSU country. Riipinen (2003) analyses energy market liberalization with the previous GTAP data base using GTAP data as the only source for information on Russian energy market which for the above-mentioned reasons gives a wrong description relative to the real distortions.

Clements, Jung and Gupta (2003) study the effects of petroleum price liberalization in Indonesia with a CGE model. They find that increasing prices of petroleum products by 25% reduces the output in petroleum-using sectors and

[31] Software available at the GEMPACK website http://www.monash.edu.au/policy/gempack.htm.

depresses household consumption. Consumption decreases more sharply than production and the utilities sector is most significantly affected by the reduction of the petroleum subsidy.

This study departs from previous studies in several ways. First, the more realistic subsidy structure as described above has been incorporated into the data base. Second, we estimate the burden of this subsidy structure, which by knowledge this far, has not been done widely. Results from tax and subsidy burdens are decomposed in several ways. The effects have also been interpreted on how they prevent the production structure in Russia to adapt. As such it offers a new perspective for analysing distortions. Results are shown to be very sensitive to elasticities in international trade. Third, the liberalization scenario has been incorporated in a way that it usually happens; through regulated prices. We also compare the price increase with the original structure in GTAP data base and show how effects are dependent on the base data.

The simulations proceed as follows. First we implement the information on subsidies to the data base. The following experiments are carried to this modified data base. Next, the taxes and subsidies in the energy sector have been totally removed. As it appears, the results are very sensitive to the assumption on the elasticities in international trade.[32] After that, the prices of gas and oil are fixed to be exogenous and shocked. Finally, we compare the effect of price scenarios to the original data base to judge the implementation of the subsidy data. The sensitivity of trade effects with regards to Armington elasticities is also studied.

[32] In the previous version of the paper, modified elasticities were used throughout the paper (Kerkelä 2004). In this paper, we start from the default elasticities and study the sensitivity of results with regards to the elasticity assumption.

3.5 The costs of distorted energy markets

The costs of the current tax and subsidy regime have been evaluated by simulating the total removal of output taxes, export and import taxes, as well as domestic subsidies and taxes in domestic use of energy and evaluating their relative importance. The extent of distortions was described in table 3.2. The results are reported as percentage changes of the baseline except for welfare results, which are reported in millions of dollars and decomposed to allocative effects, terms of trade effect and investment effect.

The purpose of the exercise is not to champion the total removal of the distortions, but rather to estimate their relative importance. We show which components in the system, as described here, are most important for the dead-weight losses in the economy. We also look at their effects on industries and factor markets to see which industries and factors are favoured by the current regime.

For Russia, the current distortions account for 2.8% of GDP in real terms. The effect on real income is -12.3% and on exports 29.5%. Apart from expenditures shown in GDP, the utility measure takes also into account how changes in the price index have an impact on the disposition of income of the regional household, resulting in utility decrease by -1.7%. The external balance has a large impact on the income and utility effects. The terms of trade measures external effects, i.e. changes in prices of exports and imports, and it deteriorates by -19.4% in Russia.

Table 3.3 Aggregate changes of the total removal of distortions in Russian energy sector

Percentages of baseline	EU	EEA	BALT	RUSSIA	XSU	NAM	ROW
Real GDP	0.1	0.3	0.3	2.8	0.3	0.0	0.0
Income	0.7	2.7	7.6	-12.3	10.7	0.5	0.4
Utility	0.3	1.7	5.0	-1.7	6.8	0.0	0.0
Total exports	-0.4	-3.5	-3.4	29.5	-13.0	0.0	0.0
Total imports	0.5	2.1	7.8	-24.4	18.3	0.4	0.3
Terms of trade	0.5	2.2	4.0	-19.4	16.4	0.2	0.0
Welfare in millions USD, sum of	17288.1	4551.5	638.3	-6216.3	7266.4	1308.2	-2995.0
Allocative efficiency effect	7421	896.5	42.6	11941.2	344.3	233.6	2234.7
Terms of trade effect	12149	3248	547.4	-25757.4	6575.9	1826.4	-431.5
Investment effect	-2281.9	407	48.2	7599.9	346.2	-751.8	-4798.1

Abbreviations: XSU (The rest of Former Soviet Union), NAM (USA and Canada), ROW (Rest of the World).

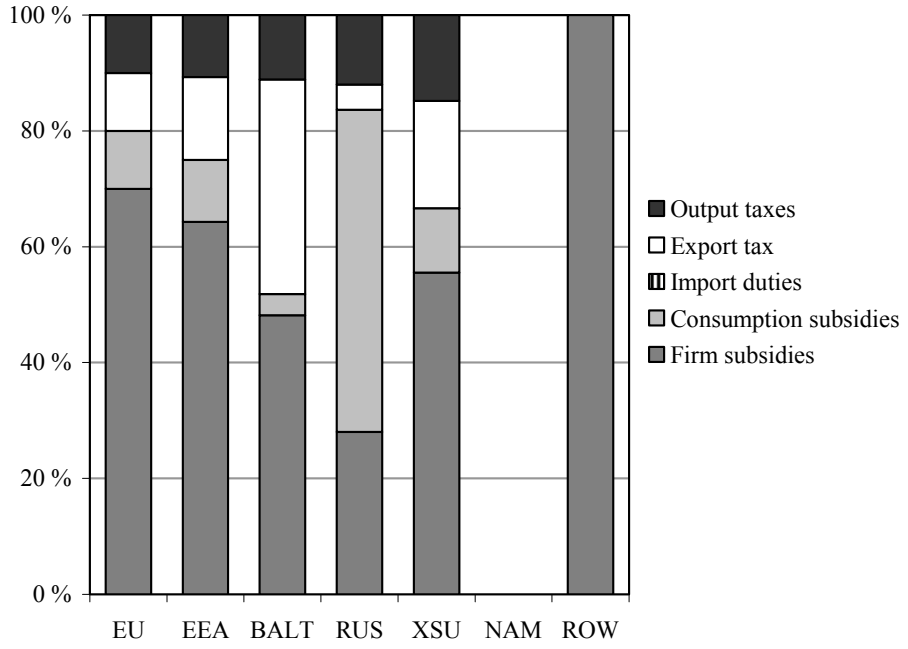
Distortions are transmitted to neighbouring countries, not only in price but also in efficiency terms. The effect on income is remarkable in neighboring countries, especially in Baltic countries (BALT) and Former Soviet Union Countries (XSU). The subsidies and taxes in Russia have an effect on the relative external position of these countries and prevent also their markets to gain a better efficiency in allocative sense. Especially for the Baltic countries, the importance of transit trade is apparent. Although the effect of aggregate distortions is only 0.3% of GDP, the effect on income is magnified (6.2%), mainly due to export taxes. Removing such taxes would likely result in greater oil and gas transit trade through Baltic countries.

Removing the current taxes and subsidies would substantially increase international trade between Russia and the rest of the world. Domestic taxes and subsidies can thus be interpreted as a trade barrier. As the current distortions apply to Russia's main export industries, removing taxes and subsidies there, would increase supply substantially. As exports would increase, the balancing trade would create more demand for imported commodities, as well.

The subsidy policy can be interpreted as a restriction for international trade and device for controlling of better terms of trade for Russia. Increasing supplies of gas and oil from Russia would decrease the world market prices of energy commodities and Russia's terms of trade would deteriorate.

To evaluate the importance of different tax means, we have decomposed the GDP and the utility (welfare) results with respect to exogenous variables (Figures 3.2 and 3.3).

Figure 3.2 *Decomposition of changes in GDP with respect to changes in taxes and subsidies, in relative terms*

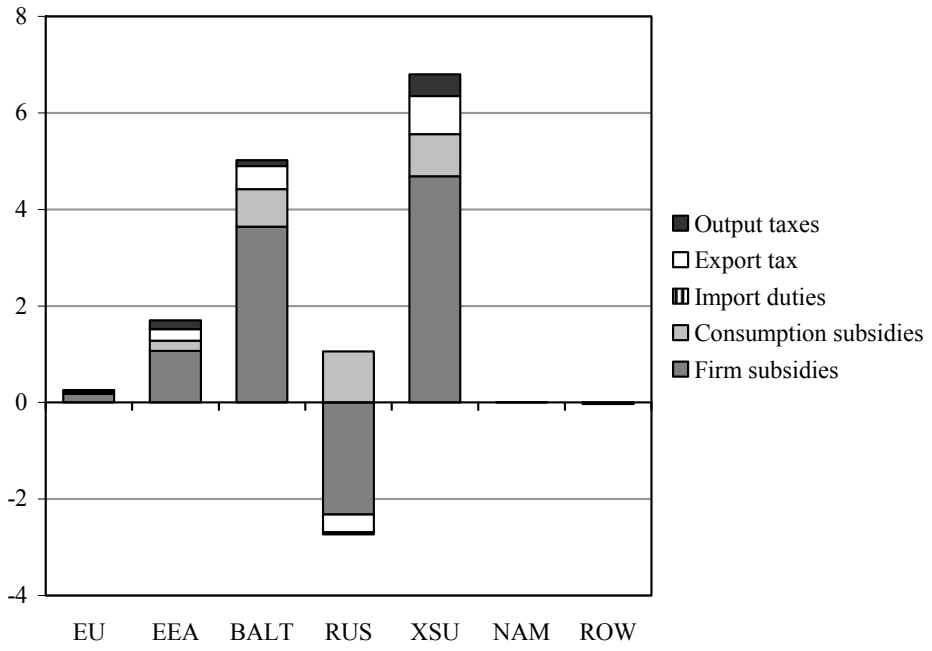


Decomposing GDP shows how different taxes and subsidies in Russia affect its own economy and trading partners. For Russia itself, the consumption subsidies contribute most to the growth, or hinder the development. For other countries, the firm subsidies and export taxes contribute relatively most. In the data, there are no import duties for energy products.

The role of different subsidies and taxes on utility varies by countries both in size and sign. For Russia, removing consumption subsidies improves welfare where as export taxes and firm subsidies decrease it. The effect results from the terms of trade effects. Firm subsidies and export taxes affect welfare through trade but consumption subsidies distort the allocation of industries. In neighboring countries, the role of firm subsidies has the greatest effect. Subsidies and taxes decrease efficiency in all the trading partners of Russia and their removal

improves it. For Northern America (NAM) and Rest of the World (ROW), the effects are insignificant.

Figure 3.3 *Decomposition of changes in utility with respect to changes in taxes and subsidies, in absolute terms*



In the figure 3.4, the allocative effects have further been decomposed by commodity to clarify the sources and channels of energy subsidies and taxes in trade. In Russia, the welfare effects in efficiency come mainly through the gas sector. Removing these subsidies increases also inefficiency in Russia as other sectors expand. In most countries, the industrial sector (Other) is the main loser of the subsidy and tax structure in Russia. Fuel industries are another industry in foreign countries, especially in Baltic countries (BALT), that are affected in efficiency by taxes and subsidies in Russian energy sector.

Figure 3.4 *Allocative efficiency effect decomposed by commodities, in relative terms*

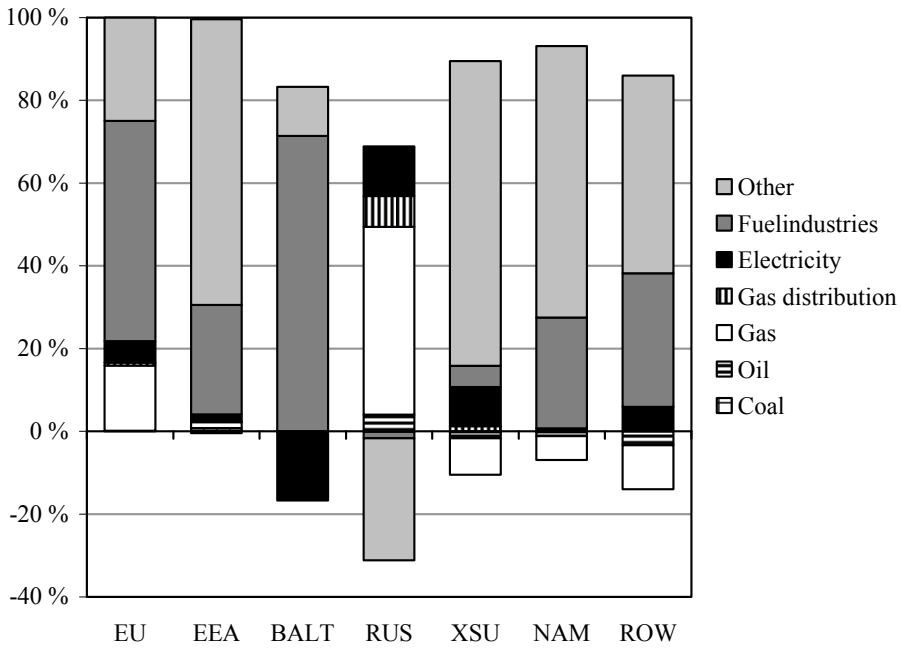


Table 3.4 presents the effects on Russian output and commodity prices from completely removing all taxes and subsidies. By and large, removing distortions decreases output and relative prices in energy sectors and energy-intensive sectors. The metal and chemical industries follow the development in energy sectors. The output in construction decreases most through the decrease in investments. The price of gas decreases but prices of oil and electricity increase. Output in non-energy-intensive industries, like wood, light industries, food and services increase most due to accompanying relative price reductions.

Table 3.4 Effect of total removal of distortions on output and prices in Russia

	Output	Price		Price
Coal	3.4	-17.9	Land	17.5
Oil	15.0	28.0	Unskilled Labour	-31.1
Gas	-9.9	-38.0	Skilled Labour	-28.3
Gasdistr	-18.7	1.0	Capital	-34.2
Electricity	-22.6	71.4	Natural Resources	-23.0
Fuelind	-5.2	-3.4		
Metal	-15.3	1.3		
Chemicals	-7.2	7.0		
Metal ind	4.9	-12.6		
Wood	23.1	-12.4		
Light	57.4	-18.7		
Construction	-57.8	-17.2		
Food	19.9	-17.5		
Agriculture	8.8	-11.6		
Tradet	5.7	-18.4		
Service	11.7	-23.4		
Investments	-68.9	-15.3		

The results can be also interpreted by asking, which industries are favoured by the current regime. Clearly, the manufacturing industries and utilities have been supported by cheap gas. The current regime also appears to restrict the potential of oil industries as well as all non-energy intensive industries and services. The current subsidy structure has distributional implications but the results are very sensitive to the assumption used on elasticities.

We study the sensitivity of key results to by looking at the effects with different elasticities in international trade. The default assumptions for Armington elasticities in gas and oil are 2.8 at the upper level of imports nesting and 5.6 at the lower level. By testing with elasticities 10 and 20 at the upper and lower level, respectively, the aggregate effect measured as GDP increases to 8.3% compared to 2.8% in the original simulation. It is realistic to assume this kind of substitutability in consumption between energy products from different sources.

On the other hand, the foreign demand does not necessarily response that easily to changes in demand due to different market imperfections.

3.6 The impact of price increases of domestic gas and electricity

As seen above, extensive implicit subsidies play a particularly significant role in distorting Russian energy markets. The prices of gas and electricity are regulated and the government sets the tariffs for them. Political realities dictate that price increases must take place incrementally. In 2004, the Duma planned to increase the price of natural gas 20% and the price of electricity 16%. If we include a plausible 10% inflation target, the relative prices of gas and electricity would rise 10% and 6%, respectively. Plans to double the gas price within a few years have been presented.

Table 3.5 Scenario plan

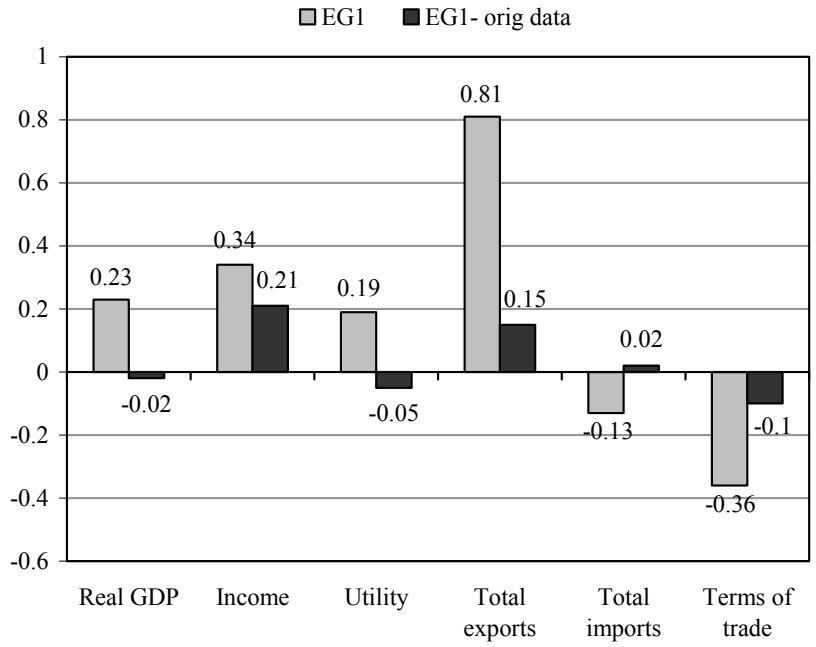
	Identification	Gas tariff hike	Electricity tariff hike
Scenario 1	EG	10%	6%
Scenario 2	EG-orig data	10%	6%

We simulate the effects of these tariff hikes in energy with the previously set data where large subsidies are present for firms and consumers in gas and gas distribution and for consumers in electricity (Table 3.5). Experiments have been implemented by modifying the closure of the standard GTAP model so that the domestic prices of gas and electricity are set fixed and their respective tax variables are allowed to settle endogenously. All the simulations have been described in the appendix. For comparison, in an alternative scenario 2, the experiments have been made to the original data base. The aggregate results are depicted in figure 3.5.

The price hikes raise GDP by 0.23%. The expenditures of households increase by 0.34%, and the rise in the aggregate utility remains in 0.19%. Most of the effects happen in the external sector. Exports increase about 0.81% and imports decrease by -0.1%. Competitiveness in foreign markets deteriorates, and despite increasing exports, imports become less affordable. This is reflected in the declining terms of trade.

The differences between price scenarios with different base data, show clearly in GDP and utility effects. With corrected data, effects are positive but with the original GTAP data reported in data base 5.4, the effects are negative. The economic effects of increasing prices thus depend on whether tariff hikes increase or decrease the efficiency of the economy. Recall that we corrected subsidies in electricity use only for consumers, not for firms.

Figure 3.5 Aggregate effects of price increases on Russia, in percentages



Increasing regulated prices and reducing underlying subsidies decreases production of energy-intense commodities, gas and electricity (Table 3.6). The other effects can be seen as secondary or adaptive effects. While output in energy-intensive industries decreases, however, it increases in non-energy-intensive sectors. This is partly due to the general-equilibrium nature of the model, where all resources are fully utilized.

In regulated energy products, gas and electricity, decreasing output results in price increases in consumer prices. However, market prices in those products decrease. In other energy commodities, notably oil, output increases while its market price falls. The higher output is clearly destined for export; domestic demand decreases. This happens even though the price of oil and its markets in principle only adapt to external shocks. The same also happens in the gas market with price regulation. Domestic demand decreases and exports clearly increase.

We have not analysed the results for consumer welfare here, because in energy commodities almost all direct production is exhausted by industry.[33] With regard to direct consumption, the share is 10% for gas, 23% for electricity and 26% for the fuel industries. We can therefore interpret the consumer viewpoint by observing the development in the price of electricity and fuels, which in Russia together account for less than 3% of total expenditures in consumption.

[33] Due to its basic assumption for the representative household, the standard GTAP model is less than ideal for analysing income distribution issues. Functional income distribution can be used to characterize income distribution.

Table 3.6 Industry effects of price increase in gas and electricity, in percentages

	Output	Market price	Domestic sales	Exports
Coal	-0.1	-0.3	-0.3	1.3
Oil	0.1	-0.1	0.0	0.2
Gas	-0.5	-1.3	-0.7	1.3
Gasdistr	-0.5	-0.5	-0.5	2.3
Electricity	-0.6	-0.8	-0.6	3.2
Fuelind	0.0	-0.1	-0.1	0.2
Metal	0.7	-0.3	0.3	1.4
Chemicals	0.5	-0.3	0.4	0.9
Metal ind	0.3	-0.2	0.2	1.2
Wood	0.4	-0.2	0.3	0.7
Light	0.4	-0.1	0.3	0.7
Construction	-0.3	-0.2	-0.3	0.6
Food	0.2	-0.1	0.2	0.4
Agriculture	0.1	0.0	0.1	0.0
Tradet	0.1	-0.1	0.1	0.4
Service	0.3	-0.1	0.3	0.5
Investments	-0.4	-0.1		

International effects

Table 3.7 presents the model results for the energy sector's bilateral exports from Russia as a result of the price reform. The increases in country-specific exports are largest in electricity between 3–4%. Largest variations happen in gas exports where gas exports grow most to the Northern America (6.4%). In the rows below the simulation results, we also report the results from the systematic sensitivity analysis. The results apply to default elasticities but assumption on larger elasticity may be grounded as the gas and oil are homogenous products. Unlike the aggregate costs of the energy reform, the results are rather stable to the assumptions on Armington elasticities.

Table 3.7 Exports of energy commodities from Russia, EG1, incl. SSA results (smaller font; median and standard deviation resp)

	EU	EEA	BALT	RUS	XSU	NAM	ROW
COAL	1,4	1,3	0,3	1,3	1,1	1,8	1,4
SSA (Median, Standard Deviation)	1,4 0,0	1,3 0,0	0,3 0,1	0,5 0,0	1,0 0,1	1,7 0,0	1,4 0,0
OIL	0,2	0,1	0,1	0,2	0,2	0,2	0,2
SSA (Median, Standard Deviation)	0,2 0,1	0,1 0,0	0,1 0,0	0,2 0,0	0,2 0,0	0,2 0,1	0,2 0,1
GAS	2,7	0,8	0,0	2,6	0,5	**6,4**	3,8
SSA (Median, Standard Deviation)	2,7 1,1	0,9 0,3	0,1 0,0	4,9 5,2	0,5 0,1	7,6 5,0	4,0 1,8
GASDISTR	2,4	2,2	2,4	6,2	2,4	2,4	2,3
SSA (Median, Standard Deviation)	2,4 0,3	2,2 0,2	2,4 0,3	6,2 0,2	2,4 0,2	2,3 0,3	2,3 0,3
ELEC	4,3	4,0	3,0	3,5	3,0	4,4	4,3
SSA (Median, Standard Deviation)	4,3 0,3	4,0 0,3	3,0 0,2	3,5 0,2	3,1 0,3	4,5 0,2	4,3 0,3
FUELIND	0,2	0,2	0,1	0,0	0,2	0,2	0,2
SSA (Median, Standard Deviation)	0,2 0,1	0,2 0,1	0,1 0,0	0,0 0,0	0,3 0,1	0,2 0,1	0,2 0,1

3.7 Conclusions

The important economic role of Russia's energy sector, both in absolute and relative terms, well justifies the examination of Russian energy markets in a general equilibrium framework. Changes in the circumstances of the energy sector have repercussions for other sectors of the economy and abroad. The foreign impact comes from the important role of Russian energy commodities in global trade. In particular, the vital role of Russian energy supplies to the EU can only be expected to grow.

The reform in the Russian energy sector is part of sectoral reforms in Russia and other transition economies. The main goals of the energy strategy accepted by the Russian Duma are to increase energy production and promote efficient energy use in Russia. Implementation of the strategy will move Russia closer to a market economy and harmonize its energy policies with other OECD economies (IEA 2003).

In this study, we have assessed Russia's energy markets and the initial reforms envisioned by the government. To highlight the global dimension of the Russian energy markets and the impending reforms, a quantitative analysis was performed using a global general equilibrium trade model (GTAP). First, we analysed the current tax structure in the form of output and production taxes and export taxes. In addition to taxes, regulated prices of energy commodities well below their real costs and world market prices constitute an equally important feature of the current regime. To evaluate the effects of the proposed reforms, both parts have to be considered in estimating their actual market effects.

We first estimated the size of the distortionary system. Our calculations show it corresponds to 2.8% of GDP with subsidies making the greatest distorting contribution. The current tax structure, in contrast, works more to inhibit trade

and exports, thus limiting the impact from any decrease in global prices of oil and gas.

To provide practical policy insights, we analysed tariff increases for regulated prices of gas and electricity. Prices were raised 10% and 6%, respectively. The effect on GDP remains modest, but positive. The results confirm the goals of the energy strategy by clearly shifting sales from domestic markets to exports.

Plans to reform the market design through increased competition has been left out of our quantitative analysis. Increasing competition in the gas and oil markets, and in particular, promoting a competitive environment for pipeline capacity, would increase production for export and depress the world market price. This would justify modelling energy markets in Russia with an assumption of imperfect competition. Moreover, efficiency improvements, which are vital for the development of the Russian energy sector, could be included to the analysis. These qualifications offer new possibilities to continue the work from here.

Another area that we have not touched on at all is the Kyoto Protocol and its possible effects should Russia decide to ratify the agreement. Implementation of the Kyoto Protocol would effect global energy prices and change the effects of Russian domestic actions in the energy markets. The demand impulse from increasing gas demand would raise the price of gas and most certainly put pressure on Russian domestic prices.

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Appendices

Table 3.8 Regional aggregation in the study

No.	Code	Region	Description
1	EU	European Union	Austria; Belgium; Denmark; Finland; France; Germany; United Kingdom; Greece; Ireland; Italy; Luxembourg; Netherlands; Portugal; Spain; Sweden.
2	EEA	Eastern European Economies	Albania; Bulgaria; Croatia; Czech Republic; Hungary; Malta; Poland; Romania; Slovakia; Slovenia.
3	BALT	Baltic countries	Estonia; Latvia; Lithuania.
4	RUS	Russia	Russian Federation.
5	XSU	Rest of Former Soviet Union	Rest of Former Soviet Union.
6	NAM	North America	Canada; United States.
7	ROW	All other regions	Australia; New Zealand; China; Hong Kong; Japan; Korea; Taiwan; Indonesia; Malaysia; Philippines; Singapore; Thailand; Vietnam; Bangladesh; India; Sri Lanka; Rest of South Asia; Mexico; Colombia; Peru; Venezuela; Rest of Andean Pact; Argentina; Brazil; Chile; Uruguay; Rest of South America; Switzerland; Rest of EFTA; Cyprus; Turkey; Rest of Middle East; Morocco; Rest of North Africa; Botswana; Rest of South African CU; Malawi; Mozambique; Tanzania; Zambia; Zimbabwe; Uganda; Rest of Sub-Saharan Africa.

Table 3.9 Commodity aggregation in the study

No.	Code	Description	Description
1	COAL		Coal
2	OIL		Oil.
3	GAS		Gas.
4	GASDISTR		Gas manufacture, distribution.
5	ELEC		Electricity.
6	FUELIND		Petroleum, coal products.
7	METAL	Metals and minerals	Minerals nec; Mineral products nec; Ferrous metals; Metals nec.
8	CHEMICALS		Chemical, rubber, plastic prods.
9	MECHE	Metal industry	Metal products; Motor vehicles and parts; Transport equipment nec; Machinery and equipment nec.
10	WOOD	Wood industry	Wood products; Paper products, publishing.
11	LIGHT	Light manufacturing	Textiles; Wearing apparel; Leather products; Electronic equipment; Manufactures nec.
12	CONSTRUCTION		Construction.
13	FOOD		Meat: cattle,sheep,goats,horse; Meat products nec; Vegetable oils and fats; Dairy products; Processed rice; Sugar; Food products nec; Beverages and tobacco products.
14	AGRICULTURE		Paddy rice; Wheat; Cereal grains nec; Vegetables, fruit, nuts; Oil seeds; Sugar cane, sugar beet; Plant-based fibers; Crops nec; Cattle,sheep,goats,horses; Animal products nec; Raw milk; Wool, silk-worm cocoons; Fishing.
15	TRADET	Trade and transport	Trade; Transport nec; Sea transport; Air transport.
16	SERVICE		Water; Communication; Financial services nec; Insurance; Business services nec; Recreation and other services; PubAdmin/Defence/Health/Educat; Dwellings.

EXPERIMENT FILES: SHOCKS, CLOSURES AND SOLUTION METHOD

Subsidy correction

Closure: altertax
Solution method: Euler 3-4-5-extrapolation(30 subintervals)
Parameter file: Altertax

Shock tpd("GAS","RUS") = target rate -75;
Shock tpd("GASDISTR","RUS") = target rate -75;
Shock tpd("ELEC","RUS") = target rate -56;

Shock tfd("GAS",PROD_COMM,"RUS") = target% -75 from file tfd.shk;
Shock tfd("GASDISTR",PROD_COMM,"RUS") = target% -75 from file tfd.shk;

Use the updated data for following scenarios

1) Full removal of taxes and subsidies in energy sector

Closure: standard
Solution method: Gragg 2-4-6 steps extrapolation (25 subintervals)
Parameter file: Default

Shock to("COAL","RUS") = Shock to("OIL","RUS") = Shock to("GAS","RUS") = Shock to("GASDISTR","RUS") = Shock to("ELEC","RUS") = target% 0;

Shock tpd("COAL","RUS") = Shock tpd("OIL","RUS") = Shock tpd("GAS","RUS") = Shock tpd("GASDISTR","RUS") = Shock tpd("ELEC","RUS") = target% 0;

Shock tfd("COAL",PROD_COMM,"RUS") = Shock tfd("OIL",PROD_COMM,"RUS") = Shock tfd("GAS",PROD_COMM,"RUS") = Shock tfd("GASDISTR",PROD_COMM,"RUS") = Shock tfd("ELEC",PROD_COMM,"RUS") =target% 0 from file tfd.shk;

Shock tms("COAL",REG,"RUS") = Shock tms("OIL",REG,"RUS") = Shock tms("GAS",REG,"RUS") = Shock tms("GASDISTR",REG,"RUS") = Shock tms("ELEC",REG,"RUS") = rate% 0 from file tms.shk;

Shock txs("COAL","RUS",REG) = Shock txs("OIL","RUS",REG) = Shock txs("GAS","RUS",REG) = Shock txs("GASDISTR","RUS",REG) = Shock txs("ELEC","RUS",REG) = target% 0 from file txs.shk;

Sensitivity analysis by changing Armington parameters from 2.8 and 5.6 in oil and gas to 10 and 20. (Parameter file modified) (Comment: SSA with the shocks failed)

2) Price liberalization scenario

2a) To the updated data
2b) To the original data

Closure: swap ppd("ELEC","RUS")=tpd("oil","RUS");
swap ppd("gas","RUS")=tpd("gas","RUS");
swap ppd("gasdistr","RUS")=tpd("gasdistr","RUS");
swap pfd("ELEC",prod_comm,"RUS")= tfd("ELEC",PROD_COMM,"RUS");
swap pfd("GAS",prod_comm,"RUS")= tfd("GAS",PROD_COMM,"RUS");
swap pfd("GASDISTR",prod_comm,"RUS")= tfd("GASDISTR",PROD_COMM,"RUS");

Shock tpd("ELEC","RUS")=6; Shock tpd("gas","RUS")=10; Shock tpd("gasdistr","RUS")=10;

Sensitivity with Armington elastcities in oil and gas,
original elasticities (2.8 at the upper level and 5.6 and lower level) are let to vary together by a scaling factor 10 resulting in in elasticity value 2.8 /28 and 0.56 / 56, respectively.

Table 3.10 Sectoral composition of GDP in the Russian Federation and EU, original GTAP data

	Value Added			Total Production		
	Rus/ GTAP	Russia	EU	Rus/ GTAP	Russia	EU
1 Electricity	0.3	0.5	1.1	6.3	4.1	1.3
2 Oil	4.2	6.3	0.2	4.1	5.9	0.2
3 Gas	6.3	9.1	0.1	4.2	6.4	0.1
4 Gas Distribution	0.8	1.0	0.1	0.6	0.8	0.1
5 Fuel Industry	0.2	0.3	0.1	2.9	3.3	0.7
6 Raw metals and coal	5.2	5.7	2.3	6.8	7.0	3.7
7 Chemicals	1.4	1.6	3.1	2.4	2.4	5.0
8 Mechanical industry, automobiles	4.7	4.2	7.5	5.7	5.2	10.8
9 Wood industries	1.5	1.4	2.6	1.8	1.7	3.4
10 Light manufacturing	2.4	2.1	4.3	2.7	2.4	6.0
11 Construction	9.0	8.5	5.7	8.0	7.9	6.7
12 Food industries	3.8	3.5	3.3	6.4	6.0	5.4
13 Agriculture	9.9	8.9	2.1	9.3	8.9	2.0
14 Trade and transport	15.1	14.5	18.3	13.1	13.0	16.6
15 Services	35.3	32.2	49.1	25.6	25.0	38.1
Total	100.1	100.0	100.0	99.9	100.0	100.0
Energy intensity	11.8	17.3	1.7	15.2	20.5	2.4

Source: GTAP data base 5.4. for 1997 and author's calculations.

4 Trade Preferences in the EU Sugar Sector: Winners and Losers

Abstract

The ongoing trade negotiations, unilateral trade concessions and obligations under the WTO have pushed the EU sugar regime to undertake reforms. These reforms will alter the positions of developing countries in the global sugar markets. This paper will describe the trade preferences granted to developing countries under the EU sugar regime. Sugar imports into the EU from the Least Developed Countries (LDCs) are expected to be totally liberalised from year 2009 onwards because of the "Everything But Arms" (EBA) concession. During the transition period until year 2009, the EBA concession is gradually granting quota preferences and partial duty-free access to sugar imports from the LDCs. Simultaneously, the temporary import quotas (Special Preferential Sugar) given to the African, Caribbean and Pacific (ACP) countries are assumed to be decreasing during the transition period. Within this background, a complete unilateral liberalization of the EU sugar sector is simulated to depict the winners and losers in the global sugar markets if no preferences are governing the imports of sugar into the EU. The supply responses, which strongly affect the outcomes, are dependent on both the nature of substitution for sugar as well as on the efficiency of sugar production in different countries. The multiregion general equilibrium framework (GTAP) is used for this analysis. The results show that total liberalization of sugar imports from the LDCs will be a major threat to the EU sugar regime. The current regime limits sugar imports from all developing countries or some efficient producers, if the cost data is a right estimate of the potential supply response from developing countries. The LDCs will be the winners under the EBA concession supported by the current regime, but a few efficient sugar producers will be the winners if the current regime is entirely liberalised.

Keywords: EU sugar regime, ACP countries, LDCs, liberalization, import quotas

4.1 Introduction

The EU's leading position in the world sugar market is a result of domestic policy, not because of having a comparative advantage in sugar production. For a group of countries, access to the European market has been granted by preferences. Current policy plans, where trade preferences may be substantially eroded or even removed, may harm current beneficiaries by weakening their export performance and thus causing further difficulties in the process of integration into the world economy. This is specially the case for small developing countries for which the sugar is the main export item and constitutes a large share of their national income. Full liberalization of the EU sugar sector will most probably improve the market access for sugar exports of both developing and developed countries, but which countries are the winners is still an open question.

This paper will analyse the EU preferential market access for sugar and how changes in the EU sugar regime will affect the developing countries that are currently under the preferential treatment. Sugar imports into the EU from the Least Developed Countries (LDCs) are expected to be totally liberalised from year 2009 onwards because of the "Everything But Arms" (EBA) concession. During the transition period until year 2009, the EBA concession is gradually granting quota preferences and partial duty-free access to sugar imports from the LDCs. Simultaneously, the temporary import quotas (Special Preferential Sugar/SPS sugar) given to the African, Caribbean and Pacific (ACP) countries are decreasing during the transition period.

The multiregion computable general equilibrium model (GTAP) is used for studying the changes in the global sugar markets. Partial equilibrium models are commonly used in the analysis of sugar policies (see e.g Devadoss and Kropf 1996; Borrell and Pearce 1999; Poonyth et al. 2000 and OECD 2003). This study is focusing on the unilateral trade liberalization of the EU sugar sector. By using

actual available data detailing the preferences granted to developing countries under the EU sugar regime, gradual changes in the tariff rate quotas are analysed in a framework that takes into account the non-linearities in the tariff rate quota regimes (see also Mensbrugghe et al. 2003). The GTAP model is also used by Frandsen et al. (2003) to analyse the production quotas under the EU sugar regime and the impact of EU sugar policy reform on the EU-15 member states.

The distortions caused by tariff and non-tariff barriers can be shown by simulating a complete unilateral liberalization of the EU sugar sector. The supply responses, which strongly affect the outcomes, are dependent on both the degree of substitution for sugar as well as on the efficiency of sugar production in different countries. This simulation will depict the winners and losers in the global sugar markets due to the complete liberalization of the EU sugar regime.

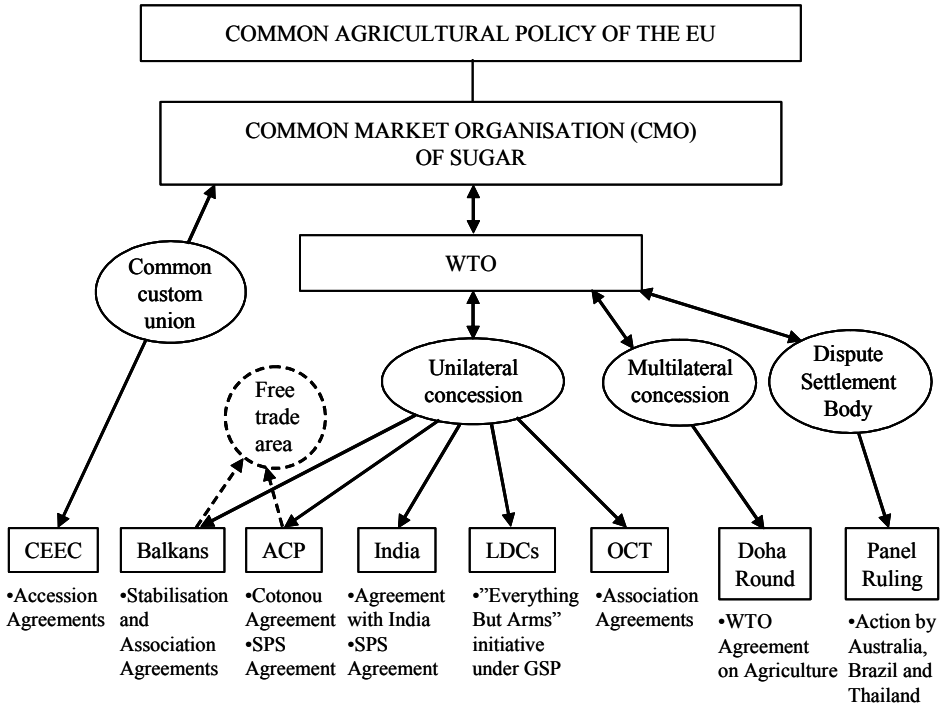
4.2 The EU sugar sector, world sugar market and trade preferences

The EU is a major trader in the world sugar market being in the top three ranking of major producers, exporters and importers in the world (Appendix table 4.5). The EU, Brazil, Australia, Thailand, and Cuba accounted for about 60% of world exports. The EU and Brazil are the dominators in the world sugar trade being the top producers and exporters in the world. However, the EU is also a major importer of sugar, but sugar imports in Brazil is negligible. The EU is unique in being both a major exporter of white sugar and importer of raw sugar in the world market.

Over the years, the EU has established a complex system of trade arrangements, which is reflected in the complex network of discriminatory tariffs through generalised and country-specific or region-specific trade preferences. The EU is applying different policies to different regions and trading blocs. The cobweb of trade arrangements in the EU sugar sector in regard to the unilateral, bilateral,

regional, and multilateral trade agreements in concurrence with the EU enlargement is illustrated in figure 4.1.

Figure 4.1 The EU sugar regime and trade agreements



While the common market organisation (CMO) of sugar exhibits a high degree of protectionism,[34] the EU has granted a whole array of trade preferences for developing countries in sugar imports. Along with forming free trade areas, the EU is granting unilateral trade concessions to the Balkan countries and African, Caribbean, & Pacific (ACP) countries. Concessions are granted also to the Overseas Countries & Territories (OCT), Least Developed Countries (LDCs) and India. The EU is also actively engaging in the enlargement process with the

[34] Sugar is categorised as a sensitive product and has the highest tariff peaks for the imports of agricultural products into the EU market.

Central and Eastern European Countries (CEEC) by forming a common custom union. The non-reciprocal trade preferences applied to the ACP countries are sanctioned by a waiver[35] obtained at the WTO during the Ministerial Conference in Doha and discrimination in favour of the LDCs is permitted. Trade preferences are at the heart of the EU sugar regime. Therefore, the EU sugar regime has been distorting the world sugar market for decades through its trade preferences and internal policies.

The EU sugar market is insulated from the world sugar market through a system of import duties and export refunds. The CMO of sugar supports producer prices at high levels above world market prices, stimulating production in the EU and resulting in exportable surpluses of sugar. Consequently, the EU has been distorting trade flows by disposing the sugar surpluses to the world market with export subsidies and indirect cross subsidies through a complex system of production quotas.

The EU is under increasing pressure and attack from low cost and efficient sugar producers for distorting world sugar trade. Australia, Brazil, and Thailand launched action in the WTO against the EU sugar regime on July 2003. These countries have claimed that EU exporters are able to export sugar partly at prices below their production cost due to the cross-subsidization.

There is also pressure coming from the on-going WTO negotiations for further reduction in export subsidies and import tariffs. The EBA concession that allows quota and duty free imports from the LDCs is considered a threat to the EU's domestic sugar production. Therefore, the EU Commission made a formal proposal[36] to reform the EU sugar sector on July 2004.

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[35] The WTO waiver will lapse by 1 January 2008.

[36] The intervention system for sugar will be abolished and replaced by a reference price set at one third lower than the prevailing intervention price. The EU production quotas for sugar will be reduced by 2.8 million tons. The A and B quotas will be merged, while existing arrangements for C sugar will remain.

4.2.1 EU preferential agreement with the African, Caribbean, and Pacific countries

In order to enhance trade's contribution to development, the ACP States and the EU decided to completely overhaul their previous trade relations. Whereas previous trade relations have been primarily based on non-reciprocal trade preferences granted by the EU to ACP exports, both parties have agreed now to enter into economic integration agreements (new WTO compatible trading arrangements), progressively remove barriers to trade between them and enhance co-operation in all areas related to trade. Thus, formal negotiations of the Economic Partnership Agreements (EPAs) started in September 2002 and the EPAs will enter into force by 1 January 2008. The unilateral trade preferences will continue to be applied during the interim period of year 2000 to 2007.

Presently, 78 ACP countries are signatories to the Cotonou Agreement signed in June 2000: 48 African states, covering all Sub-Saharan Africa, 15 states in the Caribbean and 15 states in the Pacific. Yet, only 19 ACP countries are signatories to the ACP/EU Sugar Protocol (Appendix table 4.6). In the Sugar Protocol, the EU has pledged to import 1.3 million tons of sugar based on quotas from ACP countries at guaranteed prices on a duty-free basis. In addition, further market access is given through the temporary import quotas from the Agreement on Special Preferential Sugar[37] (SPS) with 17 ACP countries.

The national quotas will be transferable between EU member states. Subsidised sugar exports will fall to 400,000 tons. Preferential imports from developing countries will continue, but the guaranteed price paid for preferential imports will drop by more than one third.

[37] The SPS agreement with ACP countries was reached on 1 June 1995, and, like the ACP/EU Sugar Protocol, it is a government-to-government agreement, but unlike the Protocol, it is of a fixed duration and the ACP countries are jointly supplying the quantities of sugar covered by the SPS agreement. The current SPS agreement is for an initial period of six years, matching the duration of the new sugar regime (ending in June 2006) and the refiners' rights to refine raw sugar. The SPS sugar imports have been ranging from 344,000 tons in 1995/1996 to 217,000 tons in 2002/2003.

4.2.2 EU preferential agreement with the Least Developed Countries (LDCs)

The "Everything But Arms" (EBA) unilateral trade concession from the EU is intended to improve trading opportunities for the LDCs. All agricultural products are included in the concession. The EBA concession took effect on March 2001. The full liberalization of sugar, rice and bananas are phased in with a transition period.[38] The "duty and quota free" market access for sugar will only begin in year 2009. Nonetheless, in order to compensate for the delay in the full liberalization of sugar, raw sugar[39] can be exported duty-free by the LDCs to the EU market within the limits of a tariff quota, which will be increased each year by 15% from 74,185 tons (white-sugar equivalent) in 2001/2002 to 197,355 tons in 2008/2009[40]. Only countries that have signed the Framework Agreement with the EU are eligible to receive these quotas during the transition period (Appendix table 4.7). Though, this is not an indication that there will be additional imports flowing into the EU sugar market. The increase in sugar imports from the LDCs through this tariff quota will simultaneously decrease the imports of Special Preferential Sugar (SPS) from the ACP countries.

The EU Commission initially estimated that 2.7 million tons of sugar exports from the LDCs may enter the EU market by year 2009 (EBA 2000). From this total, 1.4 million tons would be from the substitution of domestic consumption from world sugar imports, while the domestic production of sugar is exported to

[38] Duties on sugar will be reduced by 20% on 1 July 2006, by 50% on 1 July 2007 and by 80% on 1 July 2008 and eliminated by 1 July 2009. Duties on rice will be reduced by 20% on 1 September 2006, by 50% on 1 September 2007 and by 80% on 1 September 2008 and eliminated by 1 September 2009. Duties on fresh bananas will be reduced by 20% annually starting on 1 January 2002 and eliminated on 1 January 2006.

[39] The EU's minimum purchase price for the raw sugar from the LDCs is EUR 496.8 per ton.

[40] The current quota system guarantees both the volume imported as well as the price paid for the imported sugar to be above world market price, close to the EU intervention price.

the more lucrative EU market. Meanwhile, 1.3 million tons would come from the medium term enhancement of the LDCs production capacity in sugar. Later, the EU Commission gave a second estimation that sugar imports from the LDCs would gradually increase to 900,000 tons in the medium term (EBA 2001). The lower estimation is due to the infrastructure costs, constraints (in particular for land-locked producers), and unfavourable investment climate (including political stability) facing the LDCs at the moment. Most probably, it would take time before the LDCs would be able to overcome the existing infrastructure, logistic, marketing, quality, and other constraints, not to mention political instability (civil war or unrest) and economic mismanagement.

Preferential market access is very lucrative due to the current high price for EU domestic sugar, which is the guaranteed price paid to the LDCs sugar exporters. However, the forthcoming reforms on the EU sugar regime may have a major impact on the imports of sugar into the EU coming from the LDCs. A reduction in the price of EU domestic sugar will lead to lower export earnings for the LDCs. In the EU Commission's reform proposal for the EU sugar regime, one of the driving forces to reduce the EU domestic sugar price by one third is to curb the influx of sugar coming from the LDCs. In order to avoid a major decline in the guaranteed price, the LDCs have offered to postpone the quota and duty free concession in the sugar sector in exchange for a significant increase in the sugar preferential quotas granted to the LDCs, thus extending the transition period to year 2019.[41]

4.3 Studying the changes in the global sugar markets by using the GTAP model

The multiregion and multi-sector general equilibrium model (GTAP) is used to analyse the changes made to the EU sugar regime. Several changes have been

[41] Details of the proposal are available at the LDC Sugar Group website (http://www.ldcsugar.org).

made for the base data tariffs and elasticities and we document them here. We then describe the experiments made.

The GTAP data base 5.4[42] consists of 78 regions and 57 industries and can be aggregated to larger entities. In the simulations, the regions have been aggregated to 20 new regions by outlining the LDCs and ACP countries as detailed as possible (Appendix table 4.8). In GTAP data base there are several country groups, like Rest of South African Customs Union, where only one country, Swaziland, actually is exporting sugar to the European Union. The trade flow in the data base can be connected to the quota imports. We make a rough assumption by treating the whole country group as Swaziland. The method makes welfare evaluations very biased but as we focus on trade flows, it can be justified.

The industries are aggregated into four main groups: sugar, agriculture, manufacturing and services. Sugar is seen as a single commodity consisting of raw and white sugar. The base year for the data base is 1997. Concentrating on pure sugar neglects also the interactions of sugar industry with the rest of the economy. This can be justified by the small share of the role of sugar in economies.

For another motivation for the aggregation used, most refereed studies model sugar in a partial equilibrium framework. Poonyth et al. (2000) study removing restrictions in EU export subsidies and how this should be accommodated by reductions in quotas and intervention prices. They do not model the sources of EU imports explicitly. Devadoss and Kropf (1996) model the effects of Uruguay Round among large producers of sugar and find that low cost producers will benefit from the liberalization and the production decreases in high cost countries. They predict net exporting of EU to decline but trade is modelled by

[42] The version 5.4. increases the number of countries compared to version 5.

net trade flows. OECD (2003) models several gradual changes in the sugar regime globally. For the EU for 2009, they find 43% increase in imports of raw sugar to the EU, as a result of gradual 20% tariff rate quota expansion among other policy changes in sugar.[43]

In this study we look at the imports of sugar to the EU due to liberalization and resulting potential suppliers, especially developing countries. The main difference in this study compared to references is that quotas rents are interpreted as tariffs in the liberalization scenarios that follow. The usual assumption is that there is no in-quota tariff (OECD 2000). Changes in the quota regime have been implemented to produce a data base with differences in world market price and price of exporters in sugar. This difference is interpreted as a tariff which then is simulated to decrease in trade liberalization. In what follows are obviously too large supply reactions. This is why we have included the cost data into the analysis for adjusting the tariff cuts. The approach is meant to cover the burden exporters face in a free-trade situation. As emphasized, the simulations are not actual policy reforms but tell about the extreme supply responses EU will face due to liberalization. This is also why the elasticities used have been modified.

Before the liberalization scenarios, data detailing the preferences granted to developing countries under the EU sugar regime are incorporated to the GTAP data to simulate gradual changes in the tariff rate quotas. This has been analysed in a framework that takes into account the non-linearities in the tariff rate quota regimes. The Elbehri and Pearson (2000) special software tailored for analysing this kind of non-linearities in the supply responses is used for the simulations (TRQ software). The information needed to implement the software are: in-quota tariffs, above-quota tariffs, share accruing of quota rents to exporters and importers and finally the position of exporters in quota-regime).

[43] Other policy changes in OECD (2003) include 36% reduction in above-quota and other tariffs and reduction of export subsidy use. Also in the simulations below, export subsidies have been removed.

4.3.1 Implied tariffs from the tariff quota system of the EU sugar regime

4.3.1.1 Tariffs, quotas and tariff rate quotas

In a competitive model with a single homogenous product, any tariff has an equivalent quota and vice versa (Anderson 1988). This equivalence can be summarized in value terms by comparing the price the exporters get compared to the price importers pay. The difference in values measures either the tariff revenue collected by the government or the quota rent that accrues either to the exporters or importers with licences to import.

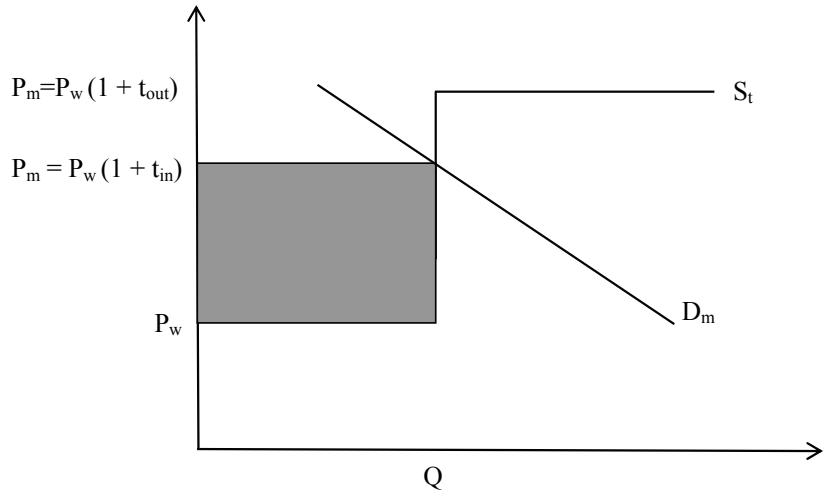
Tariff rate quota (TRQ)[44] is a two-tiered tariff where, lower in-quota tariff (t_{in}) is applied to the first Q units of imports and a higher over-quota tariff (t_{out}) to all subsequent imports (Figure 4.2). The internal market price P_m is the world market price P_w plus the imposed tariff (t_{in}/t_{out}). The supply function is shown in figure 4.2 (applied from Elbehri and Pearson 2000). The supply function S_t is a step function with two horizontal lines. The lower flat line represents the in-quota imports and extends from 0 to Q. The upper flat line represents the effective import supply function of over-quota imports and extends from Q to infinity. At the import volume Q there is a discontinuity: vertical line joins the in-quota and over-quota segments. Quota rent is the shadowed area below the demand curve (Dm). Lowering the higher over-quota tariff (t_{out}) may lead an exporting country to increase its exports beyond the given quota volume. The tariff rate quota is considered not binding when the over-quota tariff (t_{out}) is moving closer to the in-quota tariff (t_{in}). Hence, tariff rate quota is not a quantitative restriction compared to normal quotas (Skully 2001).

The supply function (S_t) in the TRQ-regime is described as a completely elastic and flat line. Normally, the supply function is upward sloping, taking into

[44] Or tariff quota, equivalently.

account the diminishing marginal revenues in production. The nature of the supply response is meaningful only when the regime is facing large changes.

Figure 4.2 *Price effects and supply responses in tariff rate quota (TRQ) regime*



The EU Sugar Protocol can be described as a tariff rate quota system. However, the exporters under the EU Sugar Protocol receive the total quota rent because there is no in-quota tariff. Therefore, there is no incentive for additional exports beyond the quota because over-quota tariffs are very prohibitive. This system is very similar to the quantitative restriction of normal quotas.

All preferential sugar imports within quotas are duty-free, but the price paid for preferential sugar is either the EU intervention price for raw sugar or somewhat below. It is assumed that this higher price is treated as a quota rent accruing to the exporter. If the EU intervention price for raw sugar is EUR 523 per ton, the ACP countries received the intervention price for their exports, but the LDCs received a somewhat lower price – EUR 497 per ton. This implies a quota rent of 523 / 200 (= 161 ad valorem tariff) and 497 / 200 (= 149 ad valorem tariff)

respectively. The over-quota tariff rate is set at 169, which would be imposed on the additional exports beyond the tariff rate quotas of the exporting countries. Exports beyond the given tariff rate quotas do not receive the quota rents.

Figure 4.3 Quota rents for the 20 regions totalling USD 149.8 million

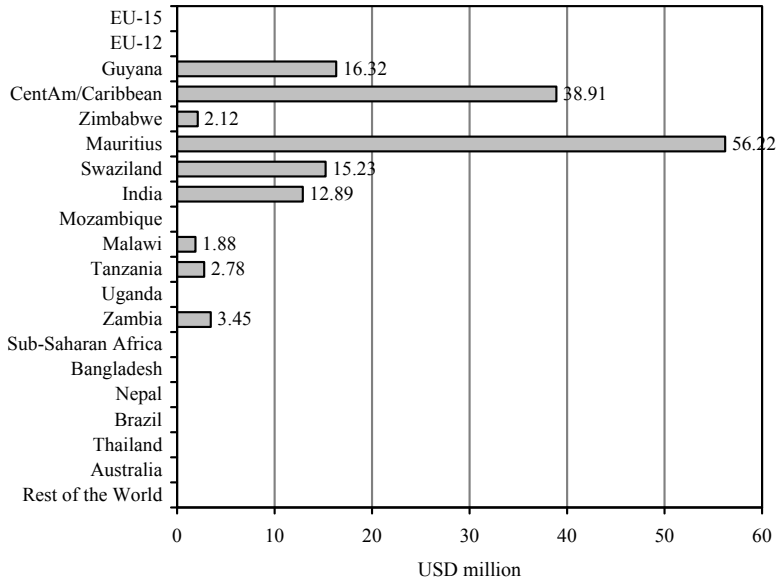


Figure 4.3 depicts the quota rents under the EU Sugar Protocol for the 20 regions exporting sugar to the EU. The results have been obtained from the GTAP simulations whereby 100% of the tariff revenues have been accrued to the ACP countries and 95% to the LDCs. The total quota rents amounted to USD 149.8 million. Under the current EU sugar regime, the largest quota rents accrued to Mauritius (USD 56 million), Central America/Caribbean (USD 39 million) and Guyana (USD 16 million). These quota rents can be regarded as an estimate of the accrued benefits due the current system or losses when the preferential system is removed. The benefits of the preferential quotas are the value differences between the high EU intervention price for the sugar exports to the EU market and the significantly lower world market.

The tariff rate quota system is applied to all preferential imports of sugar. Tariffs for non-preferential countries (Brasil, Thailand, Australia, Rest of the World) are set at 275 to include also the safeguard duties and other barriers to trade. For the new EU member states, tariffs between the EU-15 and new member states are removed and the external barriers for the new member states are adjusted to the same level as the EU-15.

4.3.1.2 Changes made within the tariff quota system of the applied EU trade preferences

Under the Everything But Arms (EBA) concession, raw sugar[45] can be exported duty-free by the LDCs to the EU market within the limits of a tariff rate quota, which will be increased each year by 15% from 74,185 tons (white-sugar equivalent) in 2001/2002 to 197,355 tons in 2008/2009.[46] The changes in quota volumes and the price difference between the guaranteed price and the world market price are implemented in the TRQ software (Elbehri and Pearson special software).[47] Only those LDCs (Appendix table 4.7) that have signed the Framework Agreement with the EU are eligible to receive the increase in quotas. These countries or regions in the data base are Mozambique, Malawi, Tanzania, Uganda, Zambia, Rest of Sub-Saharan Africa, Bangladesh, and Nepal (Rest of South Asia).

The preferential quota allocations have been described as shares in table 4.1 according to the ACP Protocol (Appendix table 4.6) & Agreement with India,

[45] The EU's minimum purchase price for raw sugar from the LDCs is EUR 496.8 per ton.

[46] The current quota system guarantees both the volume imported as well as the price paid for the imported sugar to be above world market price, close to the EU intervention price.

[47] The EBA concession includes gradual reduction in tariffs together with gradual increase in quotas. Implementing these changes within the TRQ software is technically complicated as the tariff within quotas should remain to a level that is higher than the above quota rate. This is the reason that the gradual reduction in tariffs is not implemented within the TRQ software created by Elbehri and Pearson (2000).

SPS (Special Preferential Sugar) quotas, EBA quotas (Appendix table 4.7) and MFN quotas. In the simulations, it is assumed that each of the ACP countries and India faces a 15 percent annual decrease in their preferential quotas under the SPS quotas. It is also assumed in the simulations that the increase in new quotas (EBA quotas) is simultaneously negated by the decreasing amount of SPS quotas (e.g. Malawi or Tanzania). The new exporters of sugar to the EU under the Framework Agreement are Mozambique, Bangladesh, Nepal, Uganda, Burkina Faso, Ethiopia, and Sudan. For some countries, the given shock is calculated as a percentage shock based on the existing exports to the EU.

The case for Nepal is difficult due to inaccuracy of data. The GTAP data base shows exports of sugar to the EU from the XSA region amounting to USD 10 million. Currently, none of the countries under the XSA region is exporting sugar to the EU. Under the EBA quotas, Nepal is the only preferential sugar exporter to the EU in the XSA region. The value of sugar exports under the EBA quotas is about USD 4 million. To show the increase in EBA quotas, a cumulative 15 percent shock for 8 years is given to this region.

Changes in trade flows until 2009 have been simulated based on the changes in quotas reported in table 4.1. As a result imports from ACP countries decrease and for LDC countries increase. The increases in quotas fail to be fulfilled due to data constraints as there is no imports in the original data base either. To conclude, the quota exercise serves more in defining the base data tariffs for liberalization scenarios.

Table 4.1 *EU imports of sugar classified to different types of tariff rate quotas, calculated shocks according to the increasing and decreasing level of tariff rate quotas*

		ACP Protocol	SPS	EBA	MFN	TOTAL	Calculated Shocks
XSM	Guyana	88%	12%			100%	-9
XCM	CentAm/Caribbean	78%	8%	0%	14%	100%	-6
ZWE	Zimbabwe	56%	44%			100%	-32
XSF	Mauritius	92%	8%			100%	-6
XSC	Swaziland	89%	11%			100%	-8
IND	India	51%	49%			100%	-35
MOZ	Mozambique			100%		100%	5194
MWI	Malawi	52%	24%	24%		100%	33
TZA	Tanzania	48%	11%	41%		100%	75
UGA	Uganda			100%		100%	306
ZMB	Zambia	0%	59%	41%		100%	41
XSS	Sub-Saharan Africa	35%	25%	40%		100%	64
BGD	Bangladesh			100%		100%	25066
XSA	Nepal			100%		100%	306

Source: ACP Sugar, authors' calculations.

4.3.2 Complete liberalization of sugar imports into the EU for only a set of countries or for all countries in the world

The EBA concession includes gradual reduction in tariffs together with gradual increase in quotas before the "duty and quota free" market access for sugar begins from year 2009 onwards for the LDCs. Before tariff liberalization, the current preferential quota system guarantees both the volume imported as well as the price paid for the imported sugar to be above world market price. The open question is what will be the price paid for sugar imported from the LDCs after tariff liberalization? Will it be the current high price or world market price? It is assumed in this study that due to the increasing flow of sugar after tariff liberalization, the EU cannot afford to pay the high price for sugar any more. Subsequently, the EU will be forced to pay the prevailing world market price for sugar imports after tariff liberalization. This is the reason that the standard GTAP software is used to analyse the normal tariff liberalization of sugar imports into

the EU.[48] The base data resembles the situation in 2009, after all the quota changes have been made and simulated.

There are four formulated scenarios. In the first scenario (EBA), tariffs for sugar are removed from imports coming from the LDCs to the expanded EU (EU-25). It is assumed that all the LDCs can fully adapt their production to the world market price, whereby the current quota restrictions on imports have prevented the expansion of production and exports to the EU.

In the second scenario (EBA & EPA), tariffs for sugar are removed from imports coming from both the LDCs and ACP countries to the expanded EU. This scenario is to assume that the EU would liberalise sugar imports from the ACP countries after liberalising sugar imports from the LDCs. Tariff liberalization for sugar imports coming from the ACP countries would be possible under the Economic Partnership Agreements (EPAs) to form free trade areas with the EU. It is assumed that all the LDCs and ACP countries can fully adapt their production to the world market price, whereby the current quota restrictions on imports have prevented the expansion of production and exports to the EU.

In the third scenario (PERFECT), tariffs for sugar are removed from imports coming from all countries in the world. It is assumed that all countries can fully adapt their production to the world market price. This scenario will show the potential exports of all sugar exporting countries if all countries would have access to the EU sugar market.

In the fourth scenario (REAL), tariffs for sugar are removed from imports coming from all countries in the world, but the potential supply responses are

[48] In the EBA concession and Economic Partnership Agreements, sugar is only one product out of a large class of product items. In this analysis, linkages to these other product items have been precluded. The linkages could dampen the responses for sugar production when resources are used for competing purposes. However, tariff peaks for sugar are so high that effects from sugar would anyway dominate the results.

based on the estimations of the countries' production costs for sugar. The higher the production costs, the smaller the supply response. The countries' position on the supply curve is dependent on their production costs for sugar. Countries with the lowest productions costs, but also with the highest tariff, are assumed to have the best market access when the EU sugar market is fully liberalised. The ranking of countries is portrayed in Appendix figure 4.4 according to the production costs index, based on the countries' sugar production cost (field & factory). This production costs index is adapted to the current GTAP model. The actual shocks are implemented in the form of tariffs (the higher the production costs, the higher the entry barrier). This scenario will show the potential exports of sugar exporting countries only if low cost sugar producers could adapt their sugar production and expand their sugar exports to the EU market.

4.4 Simulation results for the unilateral liberalization of the EU sugar sector

The unilateral liberalization of the EU sugar sector is divided into four scenarios: EBA scenario, EBA & EPA scenario, PERFECT scenario and REAL scenario.

Table 4.2 shows the sugar trade flows to the expanded EU (EU-15 and EU-12 together) from different countries/regions.[49] If tariff liberalization in the EU sugar regime is limited to the LDCs only under the EBA scenario, these countries would benefit the most. Duty and quota free market access for the LDCs would be at the expense of the ACP countries that do not belong to the LDCs category and other low cost sugar producing countries. However, it is assumed that all the LDCs can fully adapt their sugar production to the world market price without guaranteed market access or price. Also, necessary investments are available for these countries to expand sugar production in order to increase exports to the EU

[49] Results are reported in Millions, not in percentages, partly as they have been aggregated from the post simulation data.

market. Infrastructure improvement is especially needed in land-locked countries to facilitate the increase of sugar exports to the EU.

Table 4.2 Sugar trade flows to the EU, USD million

	Partial Liberalization		Full Liberalization	
	EBA	EBA & EPA	PERFECT	REAL*
Guyana	-22	937	579	-16
Central America/Caribbean	-50	4715	2043	-46
Zimbabwe	-2	269	142	395
Mauritius	-75	1898	1263	-65
Swaziland	-20	2077	921	64
India	-11	-11	1167	0
Mozambique	54	10	4	2
Malawi	287	106	56	37
Tanzania	562	153	71	-6
Uganda	25	3	1	0
Zambia	256	104	62	217
Sub-Saharan Africa	5027	913	369	-5
Bangladesh	19	2	1	0
Nepal	2912	853	373	-9
Brazil	-1	-2	1939	11034
Thailand	0	0	347	43
Australia	0	0	487	58
Rest of the World	-43	-48	2879	-25
Total exports to the EU	8918	11979	12703	11677

* Production cost data is incorporated into the shocks for REAL simulations.

The EBA & EPA scenario, which includes tariff liberalization for both the LDCs and ACP countries, would benefit the ACP countries the most. Countries not included in the tariff liberalization process are the main losers in this scenario. Though, it is assumed that the ACP countries could fully adapt their sugar production to the world market price and extend their current sugar production significantly. This outcome may be unrealistic because many of the ACP beneficiaries are high cost producers. These high cost sugar producers may not be able to adjust their rigid production structures and dramatically increase their exports to the EU at world market price.

In the PERFECT scenario, where the EU sugar regime is liberalised for all countries, the greatest beneficiaries would be those countries whose current market access to EU have been restricted the most. The EU's protection is at the expense of other large sugar producers or exporters like India, Brazil, Thailand and Australia. In this scenario, the ACP countries are major winners as well because the model assumes that the ACP countries could fully adapt their sugar production to the world market price and extend their current sugar production significantly.[50] Hence, the assumption here is that the ACP countries' current market share in the EU is the base for the expansion in market share after market liberalization in the EU sugar regime. Although, the current market share of the ACP countries is guaranteed by tariff rate quotas and the price paid is much higher than the world market price. It is doubtful that the ACP countries can compete at world market prices without guaranteed market access due to preferential treatment.

In the REAL scenario, the benefits from the liberalization of the EU sugar regime would accrue to a few countries like Brazil, Zimbabwe, Zambia, etc. Most of the current sugar exporters from the ACP countries like Mauritius[51] may disappear from the EU market even though Mauritius has a strong presence in the EU sugar market due to the current preferential treatment granted by the EU. Most of the LDCs are losers under this scenario. The ultimate winner would be Brazil with almost 95% of the total sugar exports to the EU from all countries in the world.

The table 4.3 collects the welfare results of the same liberalization scenarios. The results are now reported to the EU-15 and EU-12 as well, who in overall gain from the liberalization scenarios in welfare terms due to cheaper imports and

[50] The model behaves as if the current tariff quota regime had prevented a large potential of production to realize, thus curtailing the sugar exports of the ACP countries. This is not true because in reality the supply response is not perfectly elastic. Rather, the supply response is actually inelastic.

[51] The simulations do not take into account the loss of quota rents to the ACP countries. Sugar exports can be an important source of income for some of the ACP countries.

smaller tariffs. Compared to the trade effects, the welfare effects are in some cases coinciding and in other cases opposite. Guyana shows to be one of the countries suffering most from the potential changes, both in welfare and trade terms.

Table 4.3 The aggregate welfare effects in Mio USD

	Partial Liberalization		Full Liberalization	
	EBA	EBA & EPA	PERFECT	REAL
EU-15	1582	4051	5119	2886
EU-12	-156	69	497	63
Guyana	-8	492	271	-24
Central America/Caribbean	55	2447	1028	73
Zimbabwe	-4	79	38	146
Mauritius	-13	537	320	-11
Swaziland	35	562	246	23
India	-39	-17	167	-28
Mozambique	65	5	3	5
Malawi	125	31	15	9
Tanzania	253	55	24	-4
Uganda	6	-2	-3	-2
Zambia	71	15	9	55
Sub-Saharan Africa	1552	212	53	-56
Bangladesh	-2	-4	-9	-6
Nepal	1098	233	85	-11
Brazil	137	106	799	4733
Thailand	23	33	96	23
Australia	31	32	120	31
Rest of the World	-4	-470	310	-919

For some of the countries / regions the loss in export flows can be compensated by a more efficient resource allocation, i.e. Central America/Caribbean and Swaziland. It is worth noticing that these countries are also aggregates. With all measures, clear losers are also Mauritius and India.

By comparing the trade values and welfare measures, the connection between welfare and trade volume can be illustrated. For LDC countries, who gain in market access due to the EBA, much of the gains are melted to the worse terms of trade. The aggregate welfare effect is always lower than the increase in the

welfare. The same happens to the winners in the REAL case; the value of the increasing trade flow is melted away in welfare terms.

Appendix table 4.9 and 4.10 will also depict the winners and losers of EU's protection and tariff liberalization for sugar. In all the tariff liberalization scenarios, EU sugar exports would disappear from the global sugar markets. EU sugar production would decrease the most (83%) under the PERFECT scenario with a total value of USD 31.5 billion. As a result, the greatest loser would be the EU. Even under the EBA scenario, EU sugar production would decrease by over USD 22 billion. Production of sugar in the EU would still decrease by 64% even though tariff liberalization in the EU sugar regime is limited to the LDCs only.

4.4.1 The elasticity of substitution for sugar trade

The EU would not need to make a distinction between sugars coming from different regions. As a homogenous commodity, raw sugar is used as the base to estimate the elasticity between domestic production and composite imports. Consequently, in this study it is assumed in the simulations that the elasticity between domestic production and composite imports is 5.4, whereas the elasticity of substitution between different countries/regions is 10.8 in the GTAP model. The assumed elasticity is obtained by multiplying the elasticity of substitution for sugar estimated by Hertel et al. (2003) by a factor of 2. The sensitivity analysis on the variation in the elasticity of substitution is presented in table 4.4, thus showing that the assumed elasticity is compatible with the elasticity estimated by Hertel et al. (2003).[52]

[52] The GEMPACK software utilises the Systematic Sensitivity Analysis to entangle the problem with the uncertainty of parameters. Around the observed or estimated values, the modeller needs to make an approximation of the distribution of the real parameter. In this study, the assumed Armington elasticity is selected from a distribution of the estimated values. In the Systematic Sensitivity Analysis, the distribution is assumed to be biased upwards with larger values having a greater probability. The mean and standard deviation for the endogenous variable has been carried out by a Guassian Quadrature with a

Tariff liberalization in the EU sugar regime will have a dramatic impact on the trade flows into the EU. The results are particularly sensitive to the elasticity of substitution for sugar trade. Low elasticity of substitution for sugar will generate small trade flows and relatively modest efficiency gain, whereas high elasticity leads to high efficiency gains due to large trade flows. The elasticity of substitution for a commodity is typically drawn from econometric work that uses time-series price variation to identify the elasticity of substitution between domestic goods and a bundle of imported commodities (composite imports). The current EU sugar regime with its import system regulated by tariff rate quotas cannot produce a natural framework for estimating a reliable elasticity of substitution for sugar. When sugar imports are governed by tariff rate quotas and these quotas cannot be traded between countries/regions, the observable elasticity between domestic goods and composite imports approaches to zero. The observable elasticity between countries/regions also approaches to zero.

The original default elasticity of substitution for sugar in GTAP (data base 5.4.) is 2.2 and based on the SALTER Model (Jomini et al. 1994). The structure of imports in GTAP model is based on the assumption that importers first choose between the domestic commodity and a bundle of imported commodities (composite imports). Within the bundle, importers choose between commodities from different countries/regions. The standard assumption is that the elasticity of substitution between different countries/regions (4.4) is twice as high as the elasticity between domestic production and composite imports (2.2).

On the other hand, Hertel et al. (2003) estimated from the U.S. trade data that the elasticity of substitution for sugar between different countries/regions to be 5.4. The standard assumption would make the elasticity of substitution for sugar

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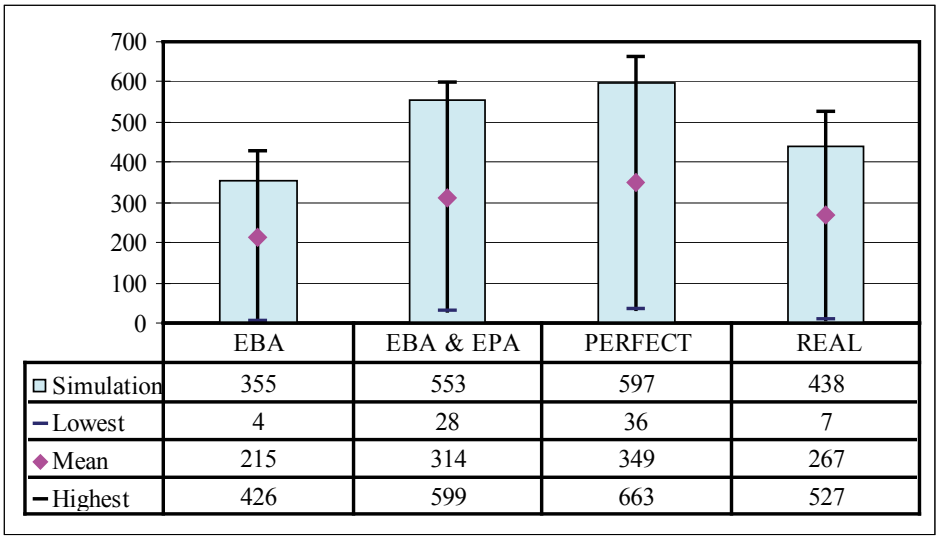
scaling factor of 4 and a uniform distribution function. The results are reported in table 4.4. The elasticity between imports from different regions is assumed to be completely correlated with the elasticity between domestic and imported commodities. The Systematic Sensitivity Analysis for a symmetrical distribution is described in Arndt and Pearson (1996).

between domestic production and composite imports to be 2.7. These elasticity figures may be too low to estimate the actual elasticity of substitution for sugar trade flows into the EU sugar market. First, the EU mainly imports raw sugar, which is a very homogenous product, even though the product category for sugar in trade statistics includes a wide variety of sugar containing products. Therefore, raw sugar imported from different regions cannot be differentiated distinctively from each other. Second, as stated above, the differences between the sugar producing countries is not distinguished from demand or tastes, but as a result of granted preferences regulated by tariff rate quotas.

Table 4.4 illustrates the distribution of percentage changes in the aggregate imports of sugar into EU (former 15 member states only) for the four assumed scenarios. The broad bars represent the simulated results with the assumed elasticity of 5.4 for substitution between domestic production and composite imports and 10.8 for between regions. The lines in the middle of the broad bars depict the distribution of the simulated results from the Systematic Sensitivity Analysis. The diamonds describe the mean of the distribution. The "Highest" value is the mean plus one standard deviation and the "Lowest" value is the mean minus one standard deviation. The broad bars are within the limit of the distribution even though the simulated results are in the upper bound of the distribution.

According to the assumed elasticity of 5.4 for substitution between domestic production and composite imports and 10.8 for between regions, sugar imports into the EU would increase between 355 to 597 percent from current imports depending on the different set of scenarios. The EBA scenario has the smallest impact and the PERFECT scenario has the largest impact on the sugar imports into the EU. The lowest figure gives a picture of the increase in imports with default elasticities.

Table 4.4 Percentage changes in the aggregate imports of sugar into EU



	EBA	EBA & EPA	PERFECT	REAL
Simulation	355	553	597	438
Lowest	4	28	36	7
Mean	215	314	349	267
Highest	426	599	663	527

4.5 Discussion and caveats

Can developing countries with high production costs currently adapt the structure of their sugar production when the preferential treatment and quotas are removed? Are these developing countries able to compete at world market prices without preferential treatment? The bias in the preferential system may have created sugar production in such countries where production is not profitable at world market prices.

The simulation results show that total liberalization of sugar imports from the LDCs will be a major threat to the EU sugar regime. The current EU sugar regime limits sugar imports from all developing countries or some efficient producers, if the cost data is a right estimate of the potential supply response from developing countries. The LDCs will be the winners under the EBA concession supported by the current regime, but a few efficient sugar producers will be the winners if the current regime is entirely liberalised for all countries.

The full liberalization of the EU sugar regime and the abolition of the preferential treatment in the EU sugar regime would change the position of the countries as winners or losers. The assumptions on the production and export possibilities of the sugar producing countries and the homogenous nature of sugar would create more losers than winners. For some of the losers, the loss of sugar exports could seriously damage their fragile economy. Therefore, the abolition or loss of preferential treatment is an important issue and hotly debated around the world.

Trade preferences have the potential of helping developing countries to promote self-sustained economic development and can substitute transfers in the form of direct financial assistance from developed countries to poor developing countries. The EU has maintained this development perspective by granting preferential access to the highly protected and subsidized EU sugar market with prices significantly above the world market prices. In the short run, any sudden changes in the EU regime and trade policies may cause severe problems for the poor currently employed in the export-oriented sugar industry of the developing countries. Compensation is needed for these affected people because of the adjustment costs due to the changes in trade policies. In the long run, the sustainable export performance and economic development based on the comparative advantage of the developing countries should be the final objective. Though, the livelihood of the poor must be protected against sudden changes in trade policies in the effort to achieve the Millennium Development Goals.

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Appendices

Table 4.5 *Major sugar producers, importers and exporters: 2000–02 average (in raw sugar equivalents*)

Main Producers Country/regions	Mil. tonnes	Main Importers Country/regions	Mil. tonnes	Main Exporters Country/regions	Mil. tonnes
Brazil	21.6	Russia	5.0	Brazil	11.9
India	20.7	European Union	1.9	European Union	6.2
European Union	17.3	Indonesia	1.8	Thailand	4.3
China	9.2	Japan	1.6	Australia	3.6
United States	7.6	Malaysia	1.5	Cuba	2.6
Thailand	6.5	Korea	1.5	India	1.5
Mexico	5.2	Nigeria	1.5	South Africa	1.3
Australia	5.1	United States	1.4	Columbia	1.3
Pakistan	3.9	Canada	1.2	Guatemala	1.1
Cuba	3.2	Algeria	1.2	Mauritius	0.5
All other	39.5	All other	27.1	All other	13.6
World	139.8	World	45.7	World	47.9

Source: F.O. Lichts International Sugar and Sweetener Report.

Table 4.6 The import quota for raw sugar under the ACP/EU Sugar Protocol (19 countries)

ACP Countries	Agreed Quantities (ton w.s.e.)
Barbados	50,312.4
Belize	40,348.8
Congo	10,186.1
Côte d'Ivoire	10,186.1
Fiji	165,348.3
Guyana	159,410.1
Jamaica	118,696.0
Kenya	0.0
Madagascar	10,760.0
Malawi	20,824.4
Mauritius	491,030.5
Saint Kitts & Nevis	15,590.9
Surinam	0.0
Swaziland	117,844.5
Tanzania	10,186.1
Trinidad & Tobago	43,751.0
Uganda	0.0
Zambia	0.0
Zimbabwe	30,224.8
Total	1,294,700.0

Source: ACP Sugar.

Table 4.7 The EBA import quota for raw sugar under the Framework Agreement (26 countries)

	2001/02	2002/03	2003/04	2004/05	2005/06
Angola	0	0	0	0	0
Bangladesh			8989	8282	6643
Benin	0	0	0	0	4238
Burkina Faso	7073	7238	7672	7374	5090
Burundi	0	0	0	0	0
Cambodia	0	0	0	0	0
Congo DRC	0	0	0	10831	8155
Ethiopia	14298	14689	15249	14264	11737
Guinea	0	0	0	0	3974
Haiti	0	0	0	0	0
Laos	0	0	0	0	0
Madagascar	0	0	0	6550	4742
Malawi	10402	10661	10959	10925	8076
Mali	0	0	0	0	4985
Mozambique	8332	8384	10117	9738	7731
Nepal	0	8970	8667	9191	7248
Niger	0	0	0	0	5118
Rwanda	0	0	0	0	0
Sierra Leone	0	0	0	0	5960
Senegal	0	0	0	0	4816
Somalia	0	0	0	0	0
Sudan	16257	17037	16979	17032	15214
Tanzania	9065	9317	9940	9493	7589
Togo	0	0	0	0	5980
Uganda	0	0	0	0	4979
Zambia	8758	9017	9538	9146	7475
Total	74185	85313	98110	112826	129750

Source: ISO 2004.

Table 4.8 Regional aggregation in the study

No.	Code	Description	Group
1	EU	EU	Austria; Belgium; Denmark; Finland; France; Germany; United Kingdom; Greece; Ireland; Italy; Luxembourg; Netherlands; Portugal; Spain; Sweden.
2	EUE	EU Accession countries	Bulgaria; Cyprus; Czech Republic; Hungary; Malta; Poland; Romania; Slovakia; Slovenia; Estonia; Latvia; Lithuania.
3	XSM	ACP SoutAm	Guyana; Paraguay; Surinam
4	XCM	ACP CentAm	Anguila; Antigua & Barbuda; Aruba; Bahamas; Barbados; Belize; Cayman Islands; Costa Rica; Cuba; Dominica; Dominican Republic; El Salvador; Guatemala; Haiti; Honduras; Jamaica; Netherlands Antilles; Nicaragua; Panama; Saint Kitts & Nevis; Saint Lucia; Saint Vincent & the Grenadines; Trinidad & Tobago; Virgin Islands
5	ZWE	ACP	Zimbabwe.
6	XSF	ACP SoutAf	Angola; Mauritius
7	XSC	ACP SACU	Rest of South African CU.
8	IND	ACP India	India.
9	MOZ	LDC	Mozambique.
10	MWI	LDC	Malawi.
11	TZA	LDC	Tanzania.
12	UGA	LDC	Uganda.
13	ZMB	LDC	Zambia.
14	XSS	LDC	Benin; Burkina Faso; Burundi; Cameroon; Cape Verde; Central African Republic; Cote d'Ivoire; Djibouti; Democratic Republic of Congo; Equatorial Guinea, Eritrea; Ethiopia; Gabon; Gambia; Ghana; Guinea; Guinea-Bissau; Kenya; Liberia; Madagascar; Mali; Mauritania; Mayotte; Niger; Nigeria; Rwanda; Sao Tome & Principe; Senegal; Seychelles; Sierra Leone; Somalia; Sudan; Togo
15	BGD	LDC	Bangladesh.
16	XSA	LDC	Nepal / Rest of South Asia.
17	BRA	Brazil	Brazil.
18	THA	Thailand	Thailand.
19	AUS	Australia	Australia.
20	ROW		New Zealand; China; Hong Kong; Japan; Korea; Taiwan; Indonesia; Malaysia; Philippines; Singapore; Vietnam; Sri Lanka; Canada; United States; Mexico; Colombia; Peru; Venezuela; Rest of Andean Pact; Argentina; Chile; Uruguay; Switzerland; Rest of EFTA; Albania; Croatia; Russian Federation; Rest of Former Soviet Union; Turkey; Rest of Middle East; Morocco; Rest of North Africa; Botswana.

Table 4.9 Changes in the production of sugar (in percent)

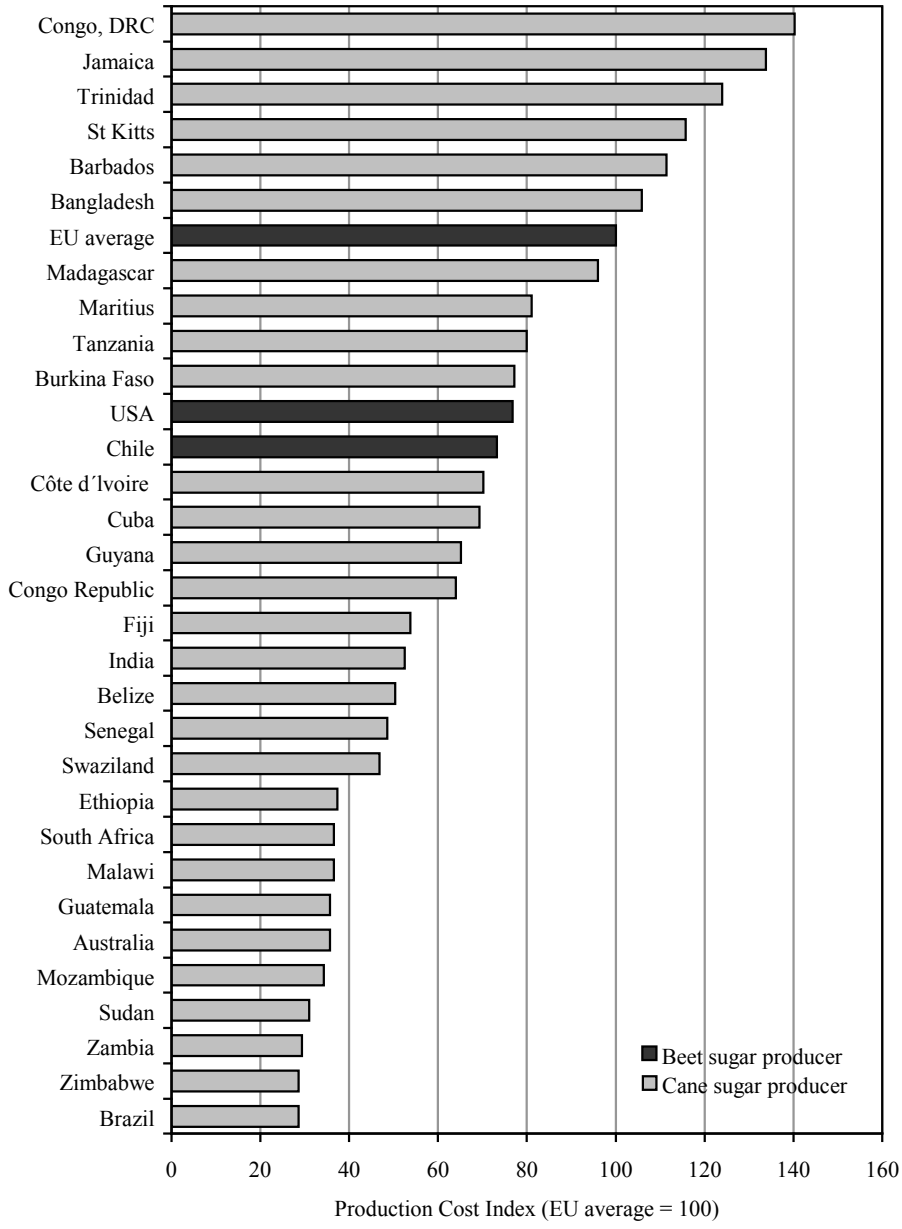
Regions	Partial Liberalization		Full Liberalization	
	EBA	EPA	PERFECT	REAL*
EU15	-63.84	-81.34	-83.31	-71.79
EUE	-22.93	-53.35	-66.54	-55.5
Guyana	-10.17	675.6	419.21	-5.31
CentAm	5.03	173.17	79.71	8.2
Zimbabwe	3.48	207.2	111.45	305.38
Mauritius	-41.22	1191.84	798.11	-32.44
Swaziland	2.71	282.02	129.04	17.88
India	0.51	0.23	5.85	0.23
Mozambique	236.36	60.14	35.87	28.43
Malawi	2124.61	781.53	416.53	272.27
Tanzania	131.07	36.5	17.56	-0.47
Uganda	21.73	3.8	2.03	1.4
Zambia	890.71	362.66	215.94	753.84
Subsahara	201.07	41.12	20.69	10.02
Bangladesh	2.53	0.51	0.59	0.75
Nepal	74.47	22.47	10.44	0.43
Brazil	3.35	3.74	18.57	90.3
Thailand	6.25	7.68	20.82	8.48
Australia	5.22	8.38	36.85	11.07
Rest of the World	2.11	3.18	8.73	2.93

* Production cost data is incorporated into the shocks for REAL simulations.

Table 4.10 Changes in the production of Sugar in Million USD

Regions	Partial Liberalization		Full Liberalization	
	EBA	EPA	PERFECT	REAL*
EU15	-20638	-26297	-26933	-23208
EUE	-1585	-3687	-4598	-3835
Guyana	-15	1027	637	-8
CentAm	141	4840	2228	229
Zimbabwe	7	389	209	573
Mauritius	-90	2613	1750	-71
Swaziland	24	2474	1132	157
India	105	47	1217	49
Mozambique	49	13	8	6
Malawi	312	115	61	40
Tanzania	595	166	80	-2
Uganda	35	6	3	2
Zambia	398	162	96	337
Subsahara	6435	1316	662	321
Bangladesh	30	6	7	9
Nepal	2790	842	391	16
Brazil	528	589	2924	14223
Thailand	157	193	524	213
Australia	110	176	775	233
Rest of the World	1316	1983	5446	1829

Figure 4.4 *The ranking of countries according to the production costs index based on the countries' sugar production cost (field & factory) from numerous sources*



5 Credited forest carbon sinks: How the cost reduction is allocated among countries and sectors

Abstract

Forest carbon sinks have been included in the Kyoto Protocol as one of the mechanisms for mitigating climate change. Consequently, credited sinks decrease the need to reduce emissions. We analyse in detail both the economy-wide and the sectoral effects of inclusion of carbon sinks as agreed upon in Bonn and Marrakesh for the first commitment period of 2008–12. The focus of our analysis is the special treatment for Canada and Japan that allows them larger sinks. The analysis is performed with the multiregion computable general equilibrium model GTAP-E.

New Zealand benefits most from the inclusion of sinks as it gains large carbon sinks from afforestation. Also in Sweden, Canada and Japan the costs of achieving the emission target are considerably reduced. Of these countries, only Canada has high costs without sinks. Thus credited sinks partly reduce the difference in economic burden of achieving the Kyoto target among countries. Even though larger sinks clearly benefit Canada and Japan, their effect on other countries, either on the economy-wide or on the sectoral level, remains marginal. Allowing larger sinks is, indeed, of relatively minor importance for world economics and emission reduction, compared to the US withdrawal from the Kyoto Protocol.

Keywords: Bonn Agreement, carbon sequestration, CGE model, global economic analysis, emission reduction, GTAP-E, Kyoto Protocol

5.1 Introduction

Forest carbon sinks were included in the Kyoto Protocol as one of the mechanisms for mitigating climate change since they contribute on the global GHG balance (UNFCCC 1997). Because sinks decrease the need to reduce emissions, they became a tool for decreasing the economic burden of implementing the Kyoto Protocol and for facilitating the ratification process (Schulze et al. 2002). However, in COP6 in Bonn 2001 (UNFCCC 2001) it was agreed that only part of the sinks resulting from forest management may be credited. In order to get Japan and Canada to ratify the Protocol, these two countries were given larger sinks.

The economy-wide and sectoral effects of implementing the Kyoto Protocol have been estimated in numerous studies (e.g. reviewed by Weyant 1999). Previous analyses tended, however, to exclude carbon sinks. Only after the COP6 in Bonn, where the rules for crediting of carbon sinks were established, were sinks included in the economic simulations for analysing the costs of the Kyoto Protocol (see e.g. Böhringer 2001, den Elzen and de Moor 2001 and 2002, Jakeman et al. 2001 and 2002, Manne and Richels 1999, Babiker et al. 2002). Böhringer, and den Elzen and de Moor estimated the costs both with and without sinks. The importance of carbon sinks was not however thoroughly discussed. In particular, no attention was paid to special treatment for Japan and Canada even though this led to a considerable decrease in their need to reduce emissions.

Relief for some countries also affects other countries through trade-induced effects and the lower price of an emission permit in the case that international emission trading is allowed. Earlier studies on the Bonn Agreement, like Böhringer (2001) and den Elzen and de Moor (2001, 2002), focused on the effects of the US withdrawal, with special attention to emission permit market, but impacts from allowing larger sinks were not analysed.

The objective of this study was to analyse in detail both the economy-wide and the sectoral effects of inclusion of carbon sinks as agreed upon Bonn and Marrakesh for the first commitment period of 2008–12. We identify the Annex I countries which may benefit from credited carbon sinks and analyse how the effects are allocated within the sectors of the economy. We focus on the larger sinks allowed for Canada and Japan by estimating their economic importance both for themselves and for other countries. Furthermore, we compare the importance of sinks agreement to the US withdrawal and ask whether the US withdrawal weakens the position of Canada. We assume in our analysis that international emission trading is not allowed. The impacts are estimated with a multiregion, multi-sector model, GTAP-E.

Section 2 presents the rules for crediting carbon sinks and describes the treatment of carbon sinks in our policy simulations. Section 3 outlines the major characteristics of the GTAP-E model. Section 4 describes the baseline and policy scenarios with estimates of the emission reductions. In section 5, the results of model simulations are presented and discussed. Section 6 presents the conclusions and indicates the deficiencies of the present research and the needs for further research.

5.2 Carbon sinks in the Kyoto Protocol and in the model simulations

5.2.1 Forest carbon sinks under Articles 3.3 and 3.4

In the 1990's, annual carbon sequestration by terrestrial ecosystems was estimated to be 8.4 Gt CO_2, while emissions from land-use change were 5.9 Gt CO_2 yr^{-1} (IPCC 2000). Globally the net terrestrial uptake of 2.6 Gt CO_2 yr^{-1} corresponded to one tenth of the emissions from combustion of fossil fuels (23.1 Gt CO_2 yr^{-1}) (IPCC 2000). The largest forest carbon sinks of the industrialized (Annex I) countries are in Russia and the USA, which reported that in the year 1990 their sinks were 587 Mt CO_2 and 272 Mt CO_2, respectively (UNFCCC

2002). Relative to CO_2 emissions, forest carbon sinks are, however, largest in New Zealand and Sweden, in the year 1990 corresponding to 70% and 60% of their emissions, respectively (UNFCCC 2002). However, carbon sinks to be credited under the Kyoto Protocol are much smaller than actual sinks on entire forested area in the Annex I countries (Liski et al. 2000).

According to the Kyoto Protocol, carbon sinks resulting from direct human-induced land-use change and forestry activities, limited to afforestation, reforestation and deforestation since 1990, are to be credited under Article 3.3. Furthermore, according to Article 3.4 of the Kyoto Protocol and the Bonn Agreement (July 2001), Annex I countries may choose to account for anthropogenic greenhouse gas emissions by sources and removals by sinks resulting from revegetation, forest management, cropland management and grazing land management.

Table 5.1 *Projections of CO_2 emissions for the year 2010, estimates of annual forest carbon sinks to be credited under Articles 3.3 and 3.4 of the Kyoto Protocol for the first commitment period (2008–2010), assigned emission target adjusted according to these sinks, and estimated emission reductions needed to achieve the Kyoto targets with and without credited sinks*

	CO_2 emissions in 2010[1)]	Credited sink		Adjusted target	Emission reduction	
		Art.3.4.[2)]	Art.3.3.[3&4)]		without sink	with sink
	Mt CO_2	Mt CO_2	Mt CO_2	Mt CO_2	%	%
Finland	77.1	0.6		54.5	-30.1	-29.3
Sweden	65.2	2.1		55.5	-18.1	-14.8
Rest of EU	3214.7	16.3	7.5	2773.4	-14.5	-13.7
Austria	46.7	2.3		42.9	-13.0	-8.0
Belgium	123.0	0.1		96.5	-21.6	-21.5
Denmark	53.6	0.2	0.4	41.2	-24.0	-23.0
France	397.1	3.2		360.9	-9.9	-9.1
Germany	858.5	4.6		784.1	-9.2	-8.7
Greece	119.0	0.3		96.9	-18.8	-18.6
Ireland	42.3	0.2	3.4	37.0	-21.0	-12.6
Italy	442.1	0.7	1.7	374.8	-15.8	-15.2
Luxembourg	10.1	0		8.8	-13.3	-12.9
Netherlands	213.1	0		149.5	-29.9	-29.8
Portugal	66.3	0.8		50.4	-25.3	-24.1
Spain	279.7	2.5		239.0	-15.4	-14.6
UK	563.2	1.4	2.1	491.4	-13.4	-12.8
EFTA	91.2	3.3	0.1	68.4	-28.8	-25.0
Iceland	2.2	0		1.8	-18.3	-14.3
Norway	35.5	1.5	0.1	28.2	-25.0	-20.7
Switzerland	53.4	1.8		38.3	-31.7	-28.3
Canada	605.7	44.0		434.8	-35.5	-28.2
Japan	1163.4	47.7		1037.5	-14.9	-10.8
New Zealand	30.2	0.7	21.7	44.8	-25.8	48.6
Australia	379.0	0		286.5	-24.4	-24.4
CEA	858.6	13.8		861.5	-1.3	0.3
Bulgaria	72.3	1.4		72.0	-2.3	-0.4
Czech Reb.	150.8	1.2		148.5	-2.3	-1.5
Hungary	64.1	1.1		65.1	-0.2	1.5
Poland	349.8	3.0		352.2	-0.2	0.7
Romania	155.7	4.0		156.2	-2.3	0.3
Slovakia	53.4	1.8		54.0	-2.3	1.1
Slovenia	12.5	1.3		13.5	-2.3	8.3
FSU	2379.8	127.8		3189.6	28.7	34.0
Estonia	35.0	0.4		34.6	-2.3	-1.3
Latvia	22.8	1.2		23.5	-2.3	3.2
Lithuania	35.1	1.0		35.3	-2.3	0.6
Russia	1769.6	121.1		2420.0	29.9	36.8
Ukraine	517.3	4.1		676.2	29.9	30.7
Total excl USA	8864.9	256.3	29.3	8806.5	-3.9	-0.7
USA	6915.8	36.7		4538.3	-34.9	-34.4
Total incl USA	15780.7	293.0	29.3	13344.8	-17.5	-15.4

1) Since only the CO2 emissions from combustion are included in the model used in the simulations, emission reduction target is set here to CO2 emissions instead of GHG emissions.
2) Maximum amounts allowed to be credited from forest management under Article 3.4 as agreed in COP6 in Bonn, 2001 (UNFCCC 2001).
3) Amount of carbon sink under Article 3.3 as reported by Parties for UNFCCC in their submission August 2000 (UNFCCC/SBSTA 2000).
4) Net carbon sources resulting from ARD activities under Article 3.3 are not shown here, since they were subtracted from the amount to be credited under Article 3.4 when the decision was made concerning maximum amounts to be credited (UNFCCC 2001).

Knowing the large potential of forest carbon sinks and the difficulties to separate human-induced sinks from those arising from climate change or former forest management practices, the countries agreed in COP6 in Bonn that for the first commitment period forest carbon sinks resulting from forest management under Article 3.4 will be only partly credited and the maximum values for a carbon sink to be credited were defined (Table 5.1, according to Appendix of UNFCCC 2001). For most countries, the maximum values shown in Appendix were calculated on the basis of the preliminary country-specific data concerning potential carbon sinks on forested land area (FAO 2000, UNFCCC/SBSTA 2000). In general, the credited amount from forest management was strictly limited to 15% of the estimated sink. Furthermore, in order to limit the role of sinks in achieving the given emission target, the amount of credited sink cannot exceed 3% of the base-year emissions.

As an outcome of political negotiations in Bonn, Canada and Japan were, however, given relatively larger carbon sinks. The maximum amount allowed for Japan is 13 Mt C (47.7 Mt CO_2) and for Canada 12 Mt C (44.0 Mt CO_2), rather than 3.9 Mt C (14.3 Mt CO_2) and 0.75 Mt C (2.8 Mt CO_2), which would have been their maximum amount if the common accounting formula had been applied. Furthermore, the maximum value calculated for Russia was not recognized by the Russian Federation; and in the COP7 in Marrakesh, that figure was revised from 17.63 to 33 Mt C yr^{-1} (121.1 Mt CO_2). The revised figure

means that the biomass of trees is expected to be increased by 807 Tg CO_2 yr^{-1}, which is consistent with assessment of forest carbon sinks based on the most recent (1998) forest inventory data (UNFCCC 2000) but which is lower than the 1578 Tg CO_2 yr^{-1} reported by FAO TBFRA 2000 (FAO 2000) and higher than that estimated in IIASA (Nilsson et al. 2000). However, quality of the current inventory data does not allow quantitative uncertainty analysis of reported forest carbon sinks.

5.2.2 Treatment of forest carbon sinks in the policy simulations

Table 5.1 gives the estimates of the carbon sinks under the Articles 3.3 and 3.4 that are used in our study. The amounts of sinks to be credited under Article 3.3 are based on the Parties' own submission in August 2000 (UNFCCC/SBSTA 2000). For carbon sinks credited under Article 3.4 only forest management, which has the greatest potential to contribute large carbon sinks in the first and subsequent commitment periods (IPCC 2000), is considered in this study. We apply in our analysis the maximum amount allowed for sinks arising from forest management. This provides all countries, including Japan and Canada, the upper limit for credits from forest management, since the sinks have to be performed and documented to get credits. Carbon sinks under Article 12 (CDM) are not considered in our analysis, since rules for forest carbon sinks are not formulated and estimates on the costs and extend of CDM projects are very uncertain. The impact of CDM sinks on the costs of achieving the emission target is likely to be small in the first commitment period since the maximum amount allowed to be credited equals only 1% of the base year GHG emissions. Also, inclusion of CDM sinks affects the relative position of countries only slightly.

The sink enhancement is assumed to be costless in our study, as also in most of the other economy-wide model simulations including carbon sinks (e.g. in Böhringer 2001, den Elzen and de Moor 2002, Manne and Richels 1999, Jakeman et al. 2001 and 2002 for carbon sinks under Articles 3.3 and 3.4).

Carbon sinks are treated exogenously by adjusting the assigned amounts of emissions with external information on carbon sinks outside the model. This implies that all direct and indirect effects from increasing sinks are excluded.

In terms of the magnitude of the sinks credited and time period considered in our analysis, this approach can be considered quite realistic. The estimates for sinks under Art. 3.3 are estimated by national authorities on the basis of previous changes in land use and countries may achieve them without new subsidies or large changes in land-use policy. Forest management practicies that are increasing forest carbon sink are e.g. improved regeneration, increased rotation length, forest conservation and reduced forest degradation. Since the maximum amount to be credited from forest management is relatively low in comparison with the carbon sinks on entire forest area, it is likely that new costs on forestry or timber market effects remain modest.

5.3 Description of the model

The simulations are performed with a global computable general equilibrium (CGE) model and related data base, GTAP-E (Burniaux and Truong 2002)[53]. GTAP-E has been extended from the basic GTAP model (Hertel 1997) for analysis of climate change policy, as part of the Global Trade Analysis Project (GTAP 2003). In order to include various energy components and implied emissions in the model, the energy volume and price information have been integrated into the original GTAP data base. The GTAP data base (version 4; see McDougall et al. 1998) covers 45 regions and 50 sectors, which in this study have been aggregated to 13 regions (Table 5.2) and 15 sectors (Table 5.3).

[53] Burniaux and Truong (2002) refer to a model derived from version 6.1 of the GTAP model and version 5 of the data instead of the version 4 that we use. The main properties of the model versions are the same and differences are explained in their paper.

Table 5.2 Regions in this study

Regions	
USA	USA
Canada	CAN
Sweden	SWE
Finland	FIN
The rest of EU countries	EU
EFTA	EFT
Central European Associates (transition countries)	CEA
Former Soviet Union	FSU
Japan	JPN
Australia	AUS
New Zealand	NZL
Non-Annex I paper and pulp exporters	NPX
Non-Annex I paper and pulp importers	NPM

Table 5.3 Sectors in this study

Sectors
Agriculture
Forestry
Paper and pulp industry
The wood products industry
Iron and steel industry
Chemical industry
Electrical equipment
Machinery and other equipment
Other industry
Services
Electricity and heat
Production of oil
Production of coal
Production of gas
Production of fossil fuel products

The assigned amounts of emissions impose the constraints to which economies adapt. In the Kyoto Protocol the assigned amounts of emissions are set as CO_2 equivalents to the total emissions of all six greenhouse gases and are allowed to be adjusted with sinks. In our study, however, we refer to CO_2 emissions from combustion only because this is consistent with the GTAP-E model, where only CO_2 emissions from combustion are reported. Furthermore, we treat the carbon

sinks exogenously as explained in Section 2. Thus these measures are not taken into account when the model chooses the least cost options to achieve the emission target optimally.

The shadow-price for emission constraint is expressed as a carbon tax. Since prices of fossil fuels raise due to carbon tax, less carbon-intensive fossil fuels are substituted for more carbon-intensive ones, and energy with other inputs. Instead of including a detailed description of existing and potential technologies, like in the bottom-up or hybrid models, the CGE models use more general functions. Production technology is described as a nested structure where fossil fuels (i.e. coal, gas, oil and petroleum products), electricity, capital and labour are substituted in several phases. Substitution possibilities depend on original input shares and substitution elasticities, both of which vary among inputs. The similar nested structure and substitution elasticities are assumed to prevail in every country. Differences in costs of emission reduction are thus determined by the input shares.

Efficiency losses due to limited substitution possibilities of energy commodities imply higher costs for industries that are emission-intensive. A contraction in these activities does not leave idle capacity, as factors of production (land, labour, capital) are assumed to be used fully, moving to other sectors and increasing their production. Adjusting prices balance the demand and supply for each commodity.

As a global model, GTAP brings forth the issues of competitiveness and the relative position of countries in changing patterns of production and trade flows. For determining the impacts on competitiveness in the international market, modelling of international trade plays a crucial role. In the GTAP framework, domestic and foreign products in the same product category are assumed to be

imperfect substitutes[54]. Increasing costs and prices, e.g. for domestic energy-intensive products, diminish their demand but are not totally displaced by foreign products. The larger the substitution, the less powerful the country is in the international market and the greater the losses of competitiveness due to cost increase. The values of Armington elasticities used in our study imply that even the smallest country has some market power in the world market.

5.4 Scenarios

5.4.1 Baseline projections

Estimates of the baseline emissions in the first commitment period strongly influence the costs of mitigation. They are especially important for evaluating the effect of including carbon sinks, as it depends on how large the carbon sink is relative to reduction in emissions. For evaluation of the first commitment period (2008–2012), we choose to obtain estimates for emission levels from other studies instead of letting the model produce them freely. Relying on energy scenarios for information on projected emissions is rather standard procedure when mitigation costs are estimated (see e.g. Böhringer et al. 2000). The percentage emission reductions needed to achieve the targets with or without adjustment with sinks (Table 5.1) are calculated outside the model and given as input to the projected data base. Thus we estimate how the inclusion of sinks affects the actual reduction in emissions needed in 2010.

Projections on the world economy for 2010 are based on the exogenous assumptions on the growth rate for the GDP, labour, capital and productivity in different sectors and are described in Haaparanta et al. (2001). The emission estimates utilised in this study for the year 2010 are from the European Union Energy Outlook to 2020 (European Commission, 1999) for EU countries and from emission scenarios provided by the ABARE Research Institute (Jakeman et

[54] I.e. the Armington assumption.

al. 2001) for other Annex I countries. The forest carbon sinks (Table 5.1) are estimated as described in Section 2.

5.4.2 Policy scenarios

The emission targets in the simulations are based on the Kyoto Protocol and on EU burden sharing (see e.g. Schulze et al. 2002). In our simulations, international emission trading is not allowed, which implies that the emission target has to be achieved by domestic actions only.

We perform the following policy scenarios:

Sink: no. Annex I countries, excluding the USA, reduce their emissions as assigned in COP3 in Kyoto 1997.

Sink: common rule. As above, but carbon sinks are credited and the amounts to be credited are calculated by common accounting rules, thus also applying to Canada and Japan (adjusted targets are shown in table 5.1, except for Canada and Japan these figures are 2.8 Mt CO_2 and 14.3 Mt CO_2, respectively).

Sink: larger. As in "Sink: common rule", but larger carbon sinks are allowed for Canada and Japan as agreed in COP6 in Bonn 2001 (see adjusted targets in table 5.1).

US in. USA ratifies the Kyoto Protocol and carbon sinks are credited according to common accounting rules as in the "Sink: common rule" scenario.

The first three scenarios are used to evaluate the importance of allowing credits from carbon sinks. In all these scenarios it is assumed that the USA does not reduce emissions. The third scenario is in line with the actual situation. The fourth scenario is used to analyse how the US withdrawal affect other countries, especially Canada and Japan.

5.5 Results and discussion

5.5.1 Which countries benefit from carbon sinks?

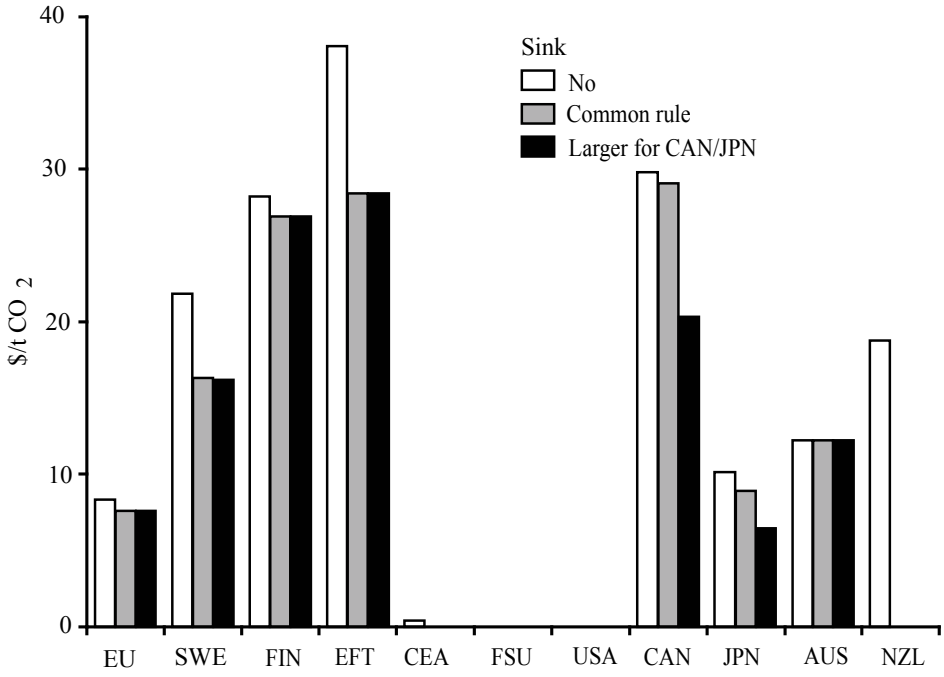
The burden on the economy of implementing the Kyoto Protocol in the year 2010 is measured with carbon tax and change in welfare[55] (Figs. 5.1 and 5.2, and Appendix). Carbon tax and change in welfare differ between countries due to differences in both the amount and the costs of reducing emissions.

New Zealand benefits most from the credited carbon sinks in terms of lower carbon tax and smaller welfare loss since it gains large carbon sinks from afforestation. Due to the positive world market effects, its welfare is actually increasing slightly compared to business-as-usual without a climate policy (Fig. 5.2). In Sweden and in EFTA (i.e. Iceland, Norway and Switzerland), the carbon tax is also considerably lower and welfare loss smaller due to the inclusion of sinks as they obtain notable amount of credits from forest management. In other countries, the forest carbon sinks have only a minor influence on the carbon tax (Fig. 5.1) or welfare (Fig. 5.2) since the credited sinks are relatively small compared with reduction in emissions.

The larger forest carbon sinks allowed for Canada and Japan in Bonn clearly benefit them, unlike the sinks calculated according to common rules. The economy-wide costs are reduced by one third in Canada and by more than one third in Japan compared to the "common rule" scenario (Fig. 5.2).

[55] In GTAP model the welfare consists of private consumption, government consumption and savings (future consumption).

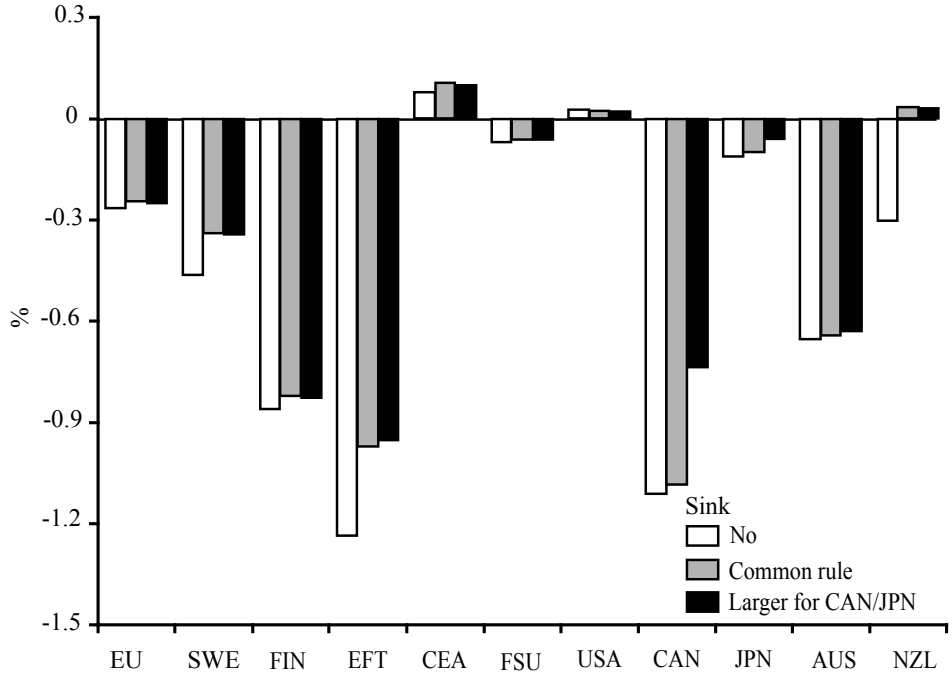
Figure 5.1 *Carbon tax needed to reach the Kyoto target without US participation in the year 2010 for Sweden, Finland, the rest of the EU, EFTA, Central European Associates (transition countries), former Soviet Union, USA, Canada, Japan, Australia and New Zealand when (i) sinks are not credited, (ii) sinks are credited according to common accounting rules, (iii) larger sinks are allowed for Canada and Japan as agreed in Bonn*



The impact of inclusion of sinks, as agreed upon in Bonn, is also illustrated by Böhringer (2001). Canada is found to benefit more and Japan less than in our study. Furthermore, the benefits for Europe are larger than those estimated here. In Böhringer's study, CDM sinks and sinks arising from agricultural activities under Article 3.4 are included. However, the difference in amounts of sinks explains the differences in results only partly.

Inclusion of sinks partly reduce the difference in economic burden of achieving the Kyoto target among Annex I countries. Some of the countries/regions with originally high costs, namely Canada and EFTA, gain from sinks since their costs are reduced. However, the inclusion of sinks also reduces costs in countries such as New Zealand, Sweden and Japan, where the costs are relatively low even without credits from sinks.

Figure 5.2 *Change in welfare in 2010 in Annex I countries without US participation. Credits of carbon sinks as in Fig.5.1*



5.5.2 What is the importance of the sinks agreement compared to the US withdrawal?

For world economics and emission reduction, the sinks agreement is of relatively minor importance compared to the US withdrawal from the Kyoto Protocol (see also den Elzen and de Moor 2002). For those countries/regions having small

sinks compared to the emission reduction, like EU and Australia, the slightly positive impact from sinks cannot compensate the negative impact due to the US withdrawal while for those countries/regions having considerable sinks, like Sweden, New Zealand and Japan, the positive impact from sinks exceeds the negative impact from the US withdrawal (Appendix). As inclusion of sinks decrease the domestic emission reduction, the positive impacts are mainly due to the smaller efficiency loss from reallocation of resources. On the other hand, the negative effects from the US withdrawal are due to the losses in terms of trade. In Canada, both sinks agreement and the US withdrawal reduce costs, of which impact of sinks is larger.

International emission trading was excluded in our analysis. With the emission trading, both the sinks agreement and the US withdrawal would have positive impact on the costs of the Kyoto Protocol. For those countries having large sinks relative to the emission reduction, the relative importance of sinks and the US withdrawal depends on the assumption on international emission trading. If the international price of emission permit would be reduced substantially due to the US withdrawal, this might reduce the costs more than credits from sinks, as can been seen in Böhringer (2001) for Japan.

5.5.3 How are other countries and different sectors affected by the larger sinks allowed for Canada and Japan?

Larger carbon sinks credited to Canada and Japan have only a minor influence on the amount of the carbon tax or the welfare of other countries (Figs. 5.1 and 5.2, and Appendix). Although the economy-wide impacts are considerable for Canada and Japan, the influence on other countries through trade impacts remains minor.

Compared to the US withdrawal, allowing larger sinks is a considerably smaller shock to world economy. Firstly, allowing larger sinks cuts emission reductions

in Canada and Japan by 20–30%, while the US withdrawal cuts its reduction in emissions to zero[56]. This implies that price adjustment in the country in question, and thus the change in competitiveness in the world market, are notably smaller in the case of larger sinks than in the case of the US withdrawal. Secondly, Canada and Japan are less important trading partners than the USA is. Japan's share of world exports does not exceed 10% of the total exports and Canada's share is less than 5%. The results indicate that these countries do not have a dominant position in the regional markets either[57]. Trade impacts are summarised in the changes in the terms of trade (the relation between export and import prices). Declining terms of trade describe deteriorating purchasing power for imports with given exports. Allowing larger sinks for Canada and Japan has a small impact on the terms of trade for other countries (Fig. 5.3a), while the US withdrawal clearly affects them (Fig. 5.3b). The terms of trade for Canada and Japan are also affected more by the US withdrawal than by allowing them larger sinks (Figs. 5.3a and 5.3b). For welfare the result is however opposite.

Impacts on production in other countries are also very small. Larger sinks decrease the producer price of fossil-fuel-intensive goods in Canada and Japan and thus production of iron and steel, and chemicals is at higher level than in the "no sinks" scenario, especially in Canada. Since changes in competitiveness in the world market and imports from Japan and Canada remain however small, the negative impact on production of fossil-fuel-intensive goods in other countries cannot be large either. On the other hand, in most of the other regions the production of machinery is at the slightly higher level than in the "common rule" scenario since larger sinks weaken the relative competitiveness of labour- and capital-intensive sectors in Japan and Canada.

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[56] Emission reduction is decreased by 75 Mt CO_2 due to allowing larger sinks while the US withdrawal lowers the need to reduce emission by 2380 Mt CO_2.

[57] Due to limited possibilities to substitute goods from different places of origin, the country may have more market power regionally than globally.

5.5.4 Can we find any basis for allowing larger sinks for Canada and Japan?

Withdrawal of the USA from the Kyoto Protocol might affect, in particular, its neighbour Canada since its competitors are not hit by the carbon tax. According to our simulations, exports of fossil-fuel-intensive goods from Canada, like iron and steel and chemicals, do indeed decrease as a result of the US withdrawal. The negative effects are, however, exceeded by the positive ones, implying that withdrawal of the USA actually benefits Canada moderately (Appendix).

Figure 5.3a *Change in terms of trade in 2010 in Annex I and non-Annex I countries under different credits for carbon sink*s

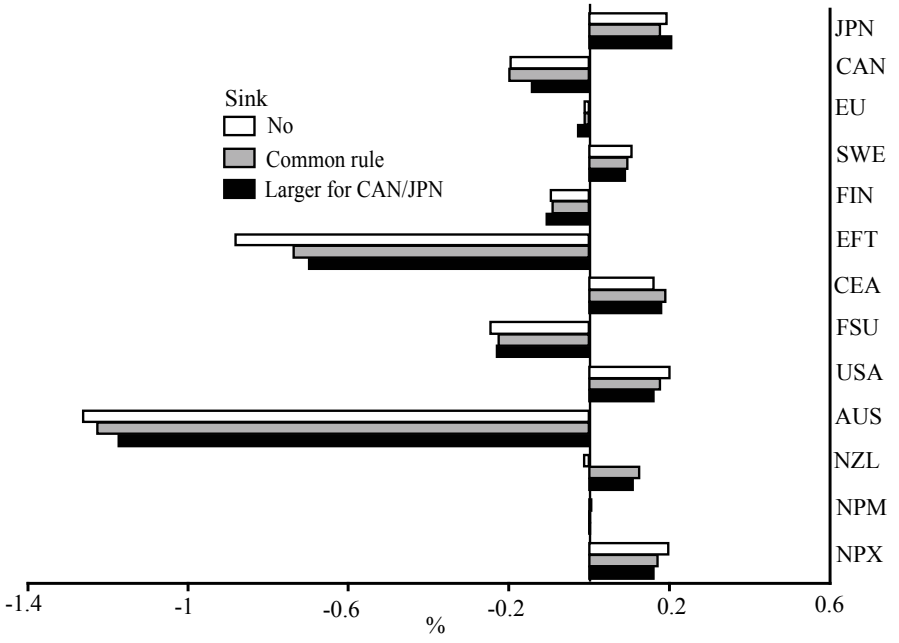
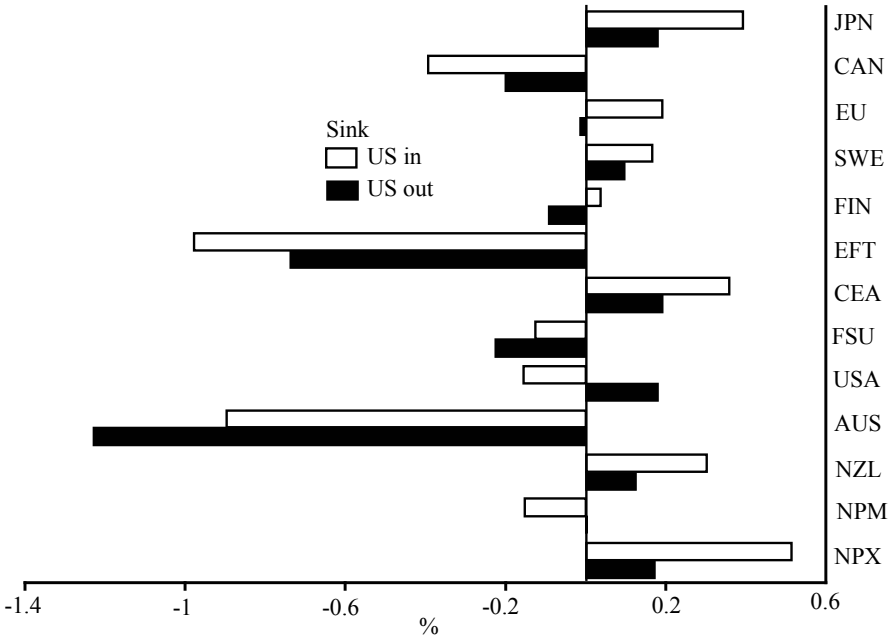


Figure 5.3b *Change in terms of trade in 2010 in Annex I and non-Annex I countries with and without US participation*



Although the US withdrawal reduces exports of fossil-fuel-intensive goods from Canada to the USA, the total exports are increased. This is mainly due to the increase in exports of fossil fuels, especially oil and gas, whose consumption remains high in the USA when it does not face the emission constraint. Export of machinery and other equipment, which is the major exporting industry in Canada, is also increasing due to the better competitiveness in labour- and capital-intensive goods[58]. In addition to these reasons, the higher real income in the USA increases the demand for both domestic and foreign goods, also benefitting exports of all goods from Canada through the income effect. The impact of the US withdrawal on the total exports of Canada was also positive,

[58] When the USA does not reduce its emissions, the prices of capital and labour are not adjusted downwards. Thus the production costs and prices of labour and capital goods remain higher than in the scenario in which the USA ratifies the Kyoto Protocol.

although exports of some goods, like machinery, to countries other than the USA were decreased.

In Böhringer (2001) Canada benefits from the US withdrawal more than in our study. The considerable impact is explained by the fact that the net exporters of fossil fuels, like Canada, gain from the fact that prices of fossil fuels do not drop so much. In our study, this effect is likely to be smaller since the treatment of fossil fuels is different. In both studies, the US withdrawal improves the terms of trade in Canada. However, in our study this is due mainly to the decrease in import prices, which consist mainly of US prices, instead of an increase in export prices of fossil fuels.

In Japan, the welfare decreases moderately due to the US withdrawal. For some other regions, like the EU, however, the negative welfare effect is greater. Thus the US withdrawal did not weaken the position of Canada or Japan.

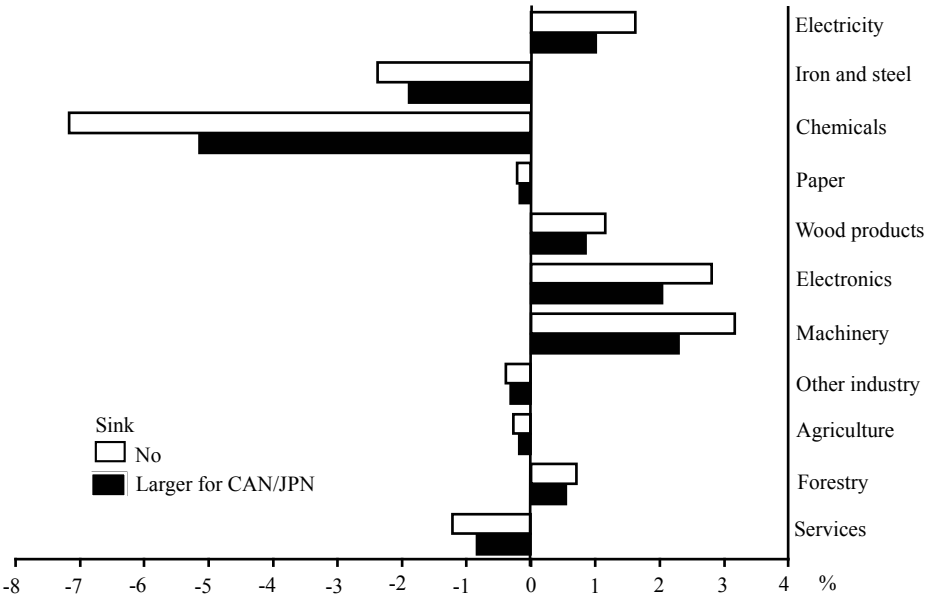
According to our simulations, Canada due largely to its high abatement task, bore one of the highest costs of implementation of the Kyoto Protocol without credits from sinks. Böhringer (2001) and Jakeman et al. (2002) support this finding. Even after allowing a larger sink, the welfare costs for Canada are among the highest. Thus larger sink does not provide an unreasonable advantage for Canada, especially since other countries are not affected. On the other hand, in Japan the costs of achieving the emission target are estimated to be very low and were made even lower by allowing a larger sink.

5.5.5 How are benefits from carbon sinks distributed within the economy?

The inclusion of carbon sinks cuts down the adjustment in industry structure by lowering the amount of emission reduction. Sectors producing fossil fuels, such as coal, oil, gas and petroleum products, or fossil-fuel-intensive goods, such as iron and steel, chemical products and services (including traffic), benefit from

inclusion of sinks in all those countries that have considerable sinks relative the emission reduction, as illustrated in Fig. 5.4 for Canada. On the other hand, the machinery and wood products industries, where the cost share of fossil fuels is negligible, suffer from inclusion of sinks in all these countries, except in Japan. For the electronic industry the effects are diverse. In those countries in which sinks are insignificant compared to reduction in emissions, the impacts may be different if the trade effects dominate.

Figure 5.4 *Changes in production levels in Canada in 2010 without US participation when (i) sinks are not credited, (ii) larger sinks are allowed for Canada and Japan*



5.6 Conclusions and caveats

The results of this study indicate that the gains from carbon sinks are not distributed evenly among countries. Within countries, New Zealand benefits most from the credited carbon sinks, as it gains large carbon sinks from

afforestation. Also in Sweden, EFTA, Canada and Japan the carbon tax is considerably lower and welfare loss smaller if credits from forest carbon sinks are allowed. In other countries, the forest carbon sinks have only a slight influence on the carbon tax or welfare, since credited sinks are relatively small compared with the reduction in emissions. Of those countries that gain the most from sinks, Canada and EFTA have originally high implementation costs while New Zealand, Sweden and Japan have low costs. Thus carbon sinks partly reduce the difference in economic burden of achieving the Kyoto target among countries.

With respect to cost differences between sectors, sinks equalise the costs to some extent, as the inclusion of sinks dampens the adjustment in the industry structure by lowering the reduction in emissions. Sectors producing fossil fuels or fossil-fuel-intensive goods, like iron and steel or chemicals, benefit from inclusion of sinks while the other sectors, like machinery, might suffer.

Those countries that had bargaining power in the negotiations manage to obtain important gains from sinks. The larger sinks allowed for Canada and Japan provide considerable benefit for these countries, while carbon sinks calculated according to common rules would have only a minor effect on their costs for implementing the Kyoto Protocol. The larger carbon sinks allowed for Canada and Japan do not, however, influence other countries either economy-wide or on the sectoral level since the trade-induced effects are small.

For world economics and emission reduction, the sinks agreement is of relative minor importance compared to the US withdrawal. In New Zealand, Japan and Sweden, the positive impact from inclusion of sinks exceeds, however, the negative impact resulting from the US withdrawal. Canada benefits both from inclusion of sinks and the US withdrawal.

In the simulations presented here, the emissions have to be reduced by domestic measures. In the case of allowing international emission trading, all countries that buy permits would benefit from carbon sinks inside the trading area, as the price of an emission permit would drop. Countries having sinks would benefit most since they could sell the credits from sinks. According to Böhringer (2001), the inclusion of sinks would drop the permit price from \$17/t CO_2 to \$11/CO_2 in the case of US participation and from \$2/CO_2 to \$0/CO_2 without the USA. However, it is likely that Russia and other sellers of emission permits will restrict the supply of such permits in order to raise their price (see e.g. Buchner et al. 2002, Böhringer 2001).

Another limitation of this study is that the costs of carbon sequestration are not considered. Although for the first commitment period this approach can be considered realistic, for the later commitment periods the possibilities to use forests actively for carbon sequestration might be expanded. Cost-efficiency would imply that, in order to choose the least-cost options to achieve the emission target, the costs of increasing the amount of carbon sequestered should be compared to the costs of reducing emissions from fossil fuels. Increasing carbon sinks would probably have direct impacts on the timber and land markets, which might in turn influence relative prices, competitiveness, production in other sectors, like agriculture, and trade flows. On the other hand, the size of sink is likely to be affected by reduction in use of fossil fuels, e.g. due to the substitution of wood for fossil fuels, and the lower demand for timber if the production of energy-intensive paper is reduced. In order to capture all the effects, the cost curve for supplying forest carbon sinks in existing and new forests, as well as land use and global timber markets, should be added into the model.

For the first commitment period, the role of carbon sinks has been found to be rather limited since only a minor proportion of the carbon sinks on forested land are to be credited. As the assigned amounts of emissions were already agreed

upon in Kyoto, it was sensible to limit the role of sinks. However, for later periods, sink enhancement might be taken into account when emission targets are set. Thus with a given cost, higher reduction targets can be achieved.

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Appendix

Table 5.4 *Change in welfare in 2010 resulting from achieving the assigned emission targets with various assumptions about crediting forest carbon sinks, %*

Regions	No credits from sinks	Sinks credited according to common rules		Larger sinks credited for Canada and Japan
		USA out[1)]	USA in[2)]	
Rest of EU	-0.27	-0.25	-0.16	-0.25
Sweden	-0.47	-0.34	-0.29	-0.35
Finland	-0.86	-0.82	-0.77	-0.83
EFTA	-1.24	-0.97	-1.08	-0.95
Central European Associates	0.08	0.11	0.19	0.10
Former Soviet Union	-0.07	-0.07	-0.04	-0.06
USA	0.03	0.02	-0.47	0.02
Canada	-1.11	-1.09	-1.17	-0.74
Japan	-0.11	-0.10	-0.09	-0.06
Australia	-0.65	-0.64	-0.56	-0.63
New Zealand	-0.30	0.03	0.09	0.03
NPM[3)]	0.02	0.02	-0.04	0.02
NPX[4)]	0.04	0.04	0.11	0.04

1) KP ratified by the other Annex I countries but not the USA.

2) KP ratified by all Annex I countries (including the USA).

3) Non-Annex I countries which are net importers of paper, pulp and publishing.

4) Non-Annex I countries which are net exporters of paper, pulp and publishing.

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