Economic and Welfare Impacts of the EU-Africa Economic Partnership Agreements

The Analytical Methodology – the GTAP and SMART Models and related Databases

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Introduction

This section discusses in details the methodology applied for the empirical analysis. The GTAP modelling and data framework is outlined. As much as possible, the initial conditions in the RECs as can be deduced from the GTAP database before simulation experiments are highlighted. The GTAP model analysis is complemented in the study with a partial equilibrium analysis model. This is the SMART model developed jointly by The World Bank and UNCTAD. The SMART methodology is also described in this section. The partial equilibrium model is aimed to help surmount some of the shortcomings of the GTAP methodology given that the majority of African countries are not included in the database.

Rationale for a General Equilibrium Methodology

Trade policy analysis largely involves analysing implications of trade policy instruments on the production structure in economies at the national and global level. Trade policy instruments such as tariffs and quotas have direct and indirect effects on the relative prices of commodities produced in a given country. As the mix of goods and services produced change, the demands for factors of production also change. Consequently, in any given economy, it is difficult to conceive a situation where the change in trade policy would affect only one sector. Due to the forward and backward linkages and their related strengths existing in a particular economy, the result is always one in which the relative mix of sectoral outputs change. This by extension affects the relative mix of the different factors of production in the different sectors.

The country-level effects on output mix and demands for factors of production can in the context of international trade be extended to the global economy. Changes in relative prices of outputs and inputs resulting in a given country's change in trade policy are transmitted to the industries and input markets of other economies that the country trades with. Therefore, for trade policy analysis to be meaningful and for robust results to be produced, the interactions that prevail among different sectors as a result of a change in a given or group of countries trade policy instruments must be taken into account. The general equilibrium methodology provides an analytical framework that allows these inter- and intra-sectoral changes in output mix and by extension the demand for different factors of production to be captured.

Kehoe and Kehoe (1994) captures succinctly what general equilibrium models are. General equilibrium models are an abstraction that is complex enough to capture the essential features of the economy, yet simple enough to be tractable. These models are popular over their partial equilibrium counterparts because they stress the interactions among different sectors. However, they are not perfect, especially the static ones. This is because they fail to take account of the dynamic effects that accompany changes taking place in a given economy as a result of policy change. The Global Trade Analysis Project (GTAP) model is in this class of general equilibrium models. GTAP is a multi-region computable general equilibrium (CGE) model designed for comparative-static analysis of trade policy issues (Adams et al. 1997). It can be used to capture effects on output mix, factor usage, trade effects and resultant welfare distribution between countries as a result of changing trade policies at the country, bilateral, regional and multilateral levels. Since the GTAP model puts emphasis on resource

reallocation across economic sectors, it is a good instrument for identifying the winning and losing countries and sectors under policy changes involving the trade aspects of the EPAs.

The Theoretical Framework of the GTAP Model

There is abundant literature discussing the underlying theory of the GTAP modelling framework. The theory of the GTAP model is documented in Hertel (1997). Brockmeier (2001) provides a simplified graphical exposition of the model. The GTAP model is essentially a multi-country multi-commodity model. The theory of the GTAP model resembles that underlying the standard multi-regional CGE models. The origins of GTAP can be traced to the ORANI model, a single country general equilibrium model[1] first developed for the Australian economy (see Dixon et al. 1997). The modelling of each region in GTAP is based on ORANI model. The theory of the ORANI model has been extended to allow international trade to take place between the different countries in the global economy through introduction of a global transport sector and savings institution.

Essentially, the underlying theory of GTAP is captured in two types of equations. The key drivers of the model are the behavioural equations, which are based on microeconomic theory. These equations capture the behaviour of agents in the economy. Accordingly there are behavioural equations for the consumers and also for the international trade (exports and imports). The behavioural equations capture the behaviour of the optimising agents such as the consumers that allows the derivation of the demand functions. The second type of the equations are the accounting relationships. These are essential in order to ensure that the behavioural equations solution occurs within a consistent macroeconomic framework. Thus, the accounting relationships ensure that the receipts and the expenditures of all the agents (consumers, producers, government, rest-of-the-world) are balanced. Chapter 2 of the GTAP book (Hertel 1997) covers in details the theory behind the model and the derivations of the behavioural equations. For the purposes of this study, these derivations are taken as given and the study simply provides just the broad outline of what the GTAP model is like.

The GTAP model allows international mobility of capital, multiple trading regions, multiple goods and primary factors, empirically based differences in production technology and consumer preferences across regions and explicit recognition of a global transport sector (Siriwardana 2001). In each region there are five types of factors of production. First, the model recognises two types of labour (skilled and unskilled) and a single, homogenous capital good. Then there is land and other natural resources that also form part of the set of the factors of production. In the typical closure of the model, total supplies of labour and land are fixed for each region, but capital can cross regional borders to equalise changes in rates of return. In other words, there is clear distinction between those factors that are perfectly mobile and those that are sluggish to adjust. In the case of the mobile factors, they earn the same market return regardless of the use location. As for the sluggish factors, returns in equilibrium may be different across sectors.

[1] The ORANI model is one of the early general equilibrium models that have come to be known as Computable General Equilibrium (CGE) models. The CGE models have been credited with the operationalisation of the abstract Arrow-Debreu general equilibrium model. The ORANI model applied the Johansen procedure that was first applied by the Norwegian economist to find the solution for Norway's first CGE model (Johansen 1960). Since the Johansen solution procedure, other mathematical numerical methods have been integrated to the solution algorithms for general equilibrium modelling to the extent that non-linear models have become part of the wide class of CGE models.

In the derivation of factor inputs demands, the model structure uses constant returns to scale technology and nested constant elasticity of substitution (CES) production functions with three levels. Two categories of inputs to production are recognised, the intermediate inputs and the primary factors. The technology is assumed to be weakly separable between the primary and intermediate factors of production. There are two advantages of the separability assumption. First, profit maximising firms are able to select their optimal mix of primary factors independently of the prices of intermediate inputs and vice-versa. Second, it also implies that the elasticity of substitution between primary factors and that between intermediate inputs at the middle nest is equal. In each region, each sector chooses the mix of inputs to minimise total cost for a given level of output. At the highest (top) nest level, intermediate input bundles and primary factor bundles are used in fixed proportions. At the middle nest, intermediate input bundles are formed through combinations of similar imported and domestic intermediate goods. Similarly, primary factors bundles are formed through combinations of labour, capital and land at this middle nest. In both cases the aggregator function has a CES form. At the lowest level, imported bundles are formed through CES combinations of imported goods from each region.

Each region or composite[2] region in GTAP has a single representative household that collects all the regional income. This representative household aggregate income is exhausted through constant shares[3] to private household consumption, government expenditures and national savings. The private household buys bundles of commodities to maximise utility subject to its expenditure constraint. The constrained optimising behaviour of the private household is represented by Constant Difference Elasticity (CDE) demand system. The CDE function is not as general as the commonly used CES and Linear Expenditure System (LES) but is more flexible and easy to calibrate with different price and income elasticities of consumption by region. The consumption bundles are CES combinations of domestic goods and import bundles, with the import bundles being CES aggregations of imports from each region.

Demand equals supply in all markets, which are, considered competitive implying equality between the price received by the producer and the producer's marginal cost. Regional governments intervene in their own markets by imposing taxes and subsidies on commodities and primary factors, thus driving wedges between prices paid by purchasers and prices received by producers. These policy interventions are modelled as ad valorem taxes, tariffs and subsidies, or quantitative restrictions in the case of textile and apparel trade. International trade is linked through Armington substitution among goods differentiated by country of origin. Therefore, in markets for traded commodities, buyers differentiate between domestically produced products and imported products with the same name. Product differentiation between imports by region of origin allows for two-way trade across regions in each tradable product.

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[2] A composite region as will be seen later is an aggregation of different countries whose individual disaggregation has not be done in the GTAP database e.g. rest of sub-Sahara Africa is an aggregation of all African countries that are not available in the database as stand-alones.

[3] As indicated in Brockmeier (2001), according to a Cobb-Douglas per capita utility function, the regional income is distributed over the three forms of final demand: private household expenditures; government expenditures; and savings. But the constancy of this proportionality between the three may sometimes not be maintained because of the endogenous nature of the private expenditure through its non-homothetic function. The price of the private household expenditure ends up depending on the quantities purchased and as a result of this endogeneity of the private household's optimisation problem; the shares in the resultant demand equations cease to be constant.

Other general features of the model are its explicit recognition of savings by regional economies. These savings are completely exhausted on investments that are savings-driven in the model. In the static form of GTAP, current investment is assumed not to affect the production capacity of the industries, as it is not yet installed. The demand for investments however affects economic activity through its effect on patterns of production in the capital goods producing sector in each region to service investment. The cost-minimising capital creator in each region combines inputs to assemble units of capital, subject to a nested production technology similar to that facing each sector for current production. The only difference is that the capital creator does not use primary factors. The use of primary factors in capital creation is recognised indirectly through inputs of commodities to capital construction. In essence, capital goods are just a Leontief combination of other goods typically. They do not require value added.

Investment in each region is financed from a global pool of savings. Each region contributes a fixed proportion of its income to the savings pool. Two alternative ways can be used to allocate the savings pool. The first way is where each region's share increases by the proportion in which aggregate pool increases. The second way is where the investment allocation is done according to the relative rates of return. Regions, which experience increases in their rate of return relative to the global average, will receive increased shares of the investment budget, whereas regions experiencing reductions in their rate of return relative to the global average will receive reduced shares.

The GTAP framework described above relies on country and regional input-output tables as its database. More specifically, the GTAP database comprises: input-output data for each region, bilateral trade data derived from United Nations trade statistics; and support and protection data derived from a number of sources. A discussion on the database follows including a description of the characteristics of the African economies already captured in the version of the database used in the study.

The GTAP Database and the Study Aggregation

Data description

The GTAP model is used together with the GTAP database. The database, like the model, captures different individual and composites of countries. For this study, we start with version 5 of the database. This version of the database has 1997 as the base year and recognizes 66 regions as well as 57 sectors and 5 factors of production. Thus, for each of the individual or composite region, there are 57 sectors whose data is captured in the overall GTAP database. As already pointed out, not all countries are individually captured in GTAP, however, all the world economies are part of the database as they could be part of a given composite region or included as part of the rest of the world. Thus, global macroeconomic consistency holds. Unfortunately, only a very small proportion of African countries are individually disaggregated in version 5 of the database. Majority of African countries are captured through one or other regional composite. Before turning to the aggregation scheme used in the study, it is useful to describe very briefly what constitutes the GTAP database.

Bilateral trade data is a critical component of the GTAP database. It is this bilateral trade flows that transmit policy and growth shocks between countries. Indeed, trade shares are important in explaining the simulation results. The bilateral trade is also important when it comes to looking at the terms of trade implications. The global bilateral data is sourced from the United Nations COMTRADE data. This is supplemented with individual countries global

trade information and trade totals or aggregate bilateral trade statistics such as from the IMF, FAO and World Bank.

Another important sub-component of the GTAP database is the protection data. This data is both explicit and implicit. Explicit in the sense that tariff revenue or export revenue by commodity is available. In addition, anti-dumping data by commodity and region is also obtainable. It is implicit in the sense that the bilateral trade data is available both in market and world prices. The key sources of the protection data vary. In the case of tariffs, the agricultural tariffs are obtained from the Economic Research Service, the EU and the applied or MFN rates. Merchandise tariffs on the other hand are available from the World Integrated Trade Solution project of the World Bank and UNCTAD (details of WITS are presented in the section discussing the SMART methodology). The domestic support protection data is obtained from the OECD's producer subsidy equivalent tables and this can be divided into output subsidies, input subsidies, land-based and capital-based payments.

Study Aggregation

Policy analysis requires an aggregation that is not only tractable but also one that gives sufficient information that would allow objective recommendations to be arrived at. In this context, it is necessary to undertake a reasonable aggregation of the global database to a level that would allow the study achieve its objectives. The main principle behind the aggregation undertaken for this study is to have a fair disaggregation of the African regions. The 66 regions have therefore been aggregated to 12 regions with the individual African and composites of African countries as stand-alones. Table 1 shows the regions' aggregation scheme.

As for the sectors, the aggregation should be at such a level that allows implications of the EPAs to be analysed at the level of primary commodities, light manufacturing, heavy industries, trade and services. Hence, the initial aggregation has an aggregation of the original 57 GTAP sectors into 13 sectors. At this stage of methodology development, the commodities aggregation can be revisited depending on the kind of information the initial aggregation allows to be derived from the policy simulations. The two aggregations are shown in the following two tables.

Table 1: Regions Aggregation Scheme of the GTAP version 5 Database

Code	Aggregated Region	GTAP Regions
1. EU[4]	European Union	Austria, Belgium, Denmark, Finland, France, Germany, United Kingdom, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, Hungary, Poland, Rest of Central European Association
2. BWA	Botswana	Botswana
3. XSC	Rest of SACU	Namibia and South Africa
4. MOZ	Mozambique	Mozambique
5. MWI	Malawi	Malawi
6. TZA	Tanzania	Tanzania
7. ZMB	Zambia	Zambia
8. ZWE	Zimbabwe	Zimbabwe
9. UGA	Uganda	Uganda
10. XSF	Rest of Southern Africa	Other Southern Africa (Angola)
11. XSS	Rest of Sub-Saharan Africa	Rest of Sub-Saharan Africa
12. ROW	All other regions	Australia, New Zealand, China, Hong-Kong, Japan, Korea, Taiwan, Indonesia, Malaysia, Philippines, Singapore, Thailand, Vietnam, Bangladesh, India, Sri Lanka and Rest of South Asia, Canada, USA, Mexico, Central American, Caribbean, Colombia, Peru, Venezuela, Rest of Andean Pact, Argentina, Brazil, Chile, Uruguay and Rest of South America, Switzerland, Rest of EFTA, Former Soviet Union, Turkey, Rest of Middle East, Morocco, Rest of North Africa, Rest of World

Table 2: Commodity Aggregation Scheme of the GTAP version 5 Database

Code	Aggregated Sector	GTAP Sectors
1. Cereals	Grains	Paddy rice, wheat, cereal grains nec
2. Vegetables	Vegetables and Fruits	Vegetables, Fruits, Nuts,
3. Oilseeds	Oil seeds	Oil seeds,
4. Sugar	Sugar	Sugar cane, Sugar beet,
5. Cotton	Cotton	Plant-based fibres
6. oCrops	Other crops	Crops nec
7. Livestock	Animals and animal products	Cattle, sheep, goat, horses, Animal products nec, Raw milk, Wool, silk-worm cocoons
8. Natresources	Natural resources	Forestry, Fishing, Coal, Oil, Gas, Minerals nec
9. Agroproc	Agro-based industries	Meat: cattle, sheep, goats, horse; Meat products nec, Vegetable oil and fats, Dairy products, Processed rice, Sugar, Food products nec, Beverages and tobacco products
10. Lightmanuf	Light industries	Textiles, Wearing apparel, Leather products, Wood products, Paper products, publishing
11. Industry	Industrial sectors	Petroleum, coal products, Mineral products nec, Chemical, rubber, plastic prods, Ferrous metals, metals nec, Metal products, Motor vehicles and parts, Transport equipment nec, Electronic equipment, Machinery and equipment nec, Manufactures nec
12. Services	Utility services	Electricity, Gas manufacture and distribution, Water, Construction, Communication, Financial services nec, Insurance, Business services nec, Recreation and other services, Dwellings, PubAdmin/Defence/Health/Education
13. Trade	Trade facilitation	Trade, Sea transport, Air transport,

[4] In the GTAP version 5 database, the recently EU acceding countries were either presently individually as in the case of Poland and Hungary or as members of the composite Rest of Central European Association. In this study's aggregation scheme, the new EU-10 is aggregated with original EU-15 to an expanded region EU.

The Characteristics of the African Economies in the GTAP Database

In this sub-section the characteristics of the African economies as captured in GTAP database on the basis of the aggregation are described. There are two aims for this discussion. The first aim is to present the stylised facts about these economies. This will be useful when it comes to making any general conclusions regarding the countries that are not individually represented[5] in the GTAP database. The second and probably the most important objective is to show the nature of bilateral trade taking place between each of the countries with the EU in the first place and with the rest of the African countries. Hand in hand with this, the prevailing level of protection even before the simulations will also be evident. The bilateral trade captured in the base data and the level of protection give the initial conditions that will be instrumental in understanding the results from the envisaged policy simulations.

Macroeconomic and Trade Characteristics of the African Economies

Table 3 gives a summary of the macroeconomic and trade characteristics of the African economies based on the 1997 base year data in the GTAP database. Clearly, the African economies are generally small in size with a GDP of less that US$10 billion. However, the size does vary. Malawi is the smallest economy with a size of US$2.8 billion. The rest of SACU (XSC), which basically represents the Republic of South Africa, is the largest economy. The distribution of this output in terms of value added shows an abundance of unskilled labour. This may have implication on the concentration and quality of goods. Capital is the most important in Botswana by nature of the structure of its economy as shown in Table 4. One important observation, which is not surprising all the same, is that the labour share of income is at least 50 per cent. With respect to trade aspects of the EPAs, allocative efficiency of these factors is likely to determine the EPA impacts on the industry structure as currently shown in Table 4.

Probably the most important feature in the context of this study is the dependence of these economies on trade depicted in Table 3. Based on the sum of exports and imports as per cent of GDP, Botswana is the most open economy with openness equivalent to 107.7 per cent of GDP. The country depends extensively on trade. The vulnerability of an economy to external terms of trade shocks would be a concern given this level of openness. However, in the case of Botswana, it is evident that the balance of payments may not be a concern given the favourable terms of trade evidenced by the positive trade balance. It is also noteworthy that besides Botswana, several other countries export more than they import. These include, rest of SACU, Malawi and Zambia. Uganda and Mozambique are the most closed economies on the basis of the sum of the shares of exports and imports to GDP. It is important to note that imports are quite suppressed for a number of the countries, as they constitute less than 30 per cent of GDP. This means that these economies are likely to be affected by trade liberalisation in the EPAs.

[5] It would be useful to reiterate that all the African countries are represented in the database as part of the rest of sub-Saharan Africa.

Table 3: Macroeconomic Characteristics of the African and non-African Countries

	EU	BOT	XSC	MWI	MOZ	TZA	ZAM	ZWE	XSA	UGA	XSS	ROW
GDP and Trade Flows (Final Demand, billion US$, 1997)												
GDP	8254.2	4.8	139.1	2.8	3.6	6.8	4.2	8.3	13.6	6.8	156.6	20381.0
Exports	2577.0	3.0	34.9	0.6	0.4	1.1	1.1	2.6	7.4	0.7	41.2	3739.2
Imports	2509.9	2.2	32.2	0.5	1.0	2.1	1.0	3.3	4.9	1.1	48.9	3802.2
Trade Dependence (shares, % GDP)												
Exports	31.2	61.8	25.1	22.6	11.7	16.6	26.2	31.6	54.4	10.8	26.3	18.3
Imports	30.4	45.9	23.2	19.0	26.5	31.6	23.0	39.7	35.9	15.9	31.2	18.7
Factor Shares (% of Value Added)												
Land	0.4	0.4	0.5	3.9	4.5	5.6	3.0	1.9	1.1	6.2	2.2	1.3
Unskilled Labour	33.4	22.2	40.7	43.2	42.4	43.5	39.8	38.6	27.4	48.3	41.7	35.8
Skilled Labour	21.8	12.2	19.6	9.5	8.1	5.4	10.3	15.0	11.4	6.6	10.7	20.9
Capital	44.1	61.7	37.3	42.6	44.1	44.3	45.6	43.7	50.2	38.0	40.6	41.1
Natural Resources	0.3	3.6	1.9	0.9	0.9	1.2	1.3	0.7	9.8	0.9	4.8	0.9

Source: GTAP Database Version 5 Aggregation

De-industrialisation hypothesis is of major concern in discussions related to trade. Even without considering the potential impacts of full reciprocity to EU by African countries under the EPAs, the issue of de-industrialisation in some countries within particular RECs have been of major concern. The rate of liberalisation in the African RECs has been checked by fears within the RECs that some economies would suffer as a result of de-industrialisation. The concern over de-industrialisation has contributed to the pursuance of liberalisation on the basis of asymmetry principle. This is likely to be an issue at the EPAs level where the asymmetry principle may be raised both in terms of the sectors to be liberalised and also the time frame for those sectors that eventually are chosen for liberalisation under full reciprocity. Table 4 provides a clear picture of the structure[6] of the African economies.

On the basis of the proportion of the value added that constitutes light manufactures and industry, the rest of SACU is the most industrialised. Zambia and Zimbabwe also have some significant industry at 15 per cent of total value output. These economies with some sizeable light manufacturing and industrial sectors are likely to be the most concerned by de-industrialisation. However, the extent to which de-industrialisation takes place should not be considered in isolation as it would also depend on the abundance or lack of factors of production as shown in Table 3 which ultimately determine comparative advantage. The picture for individual countries in terms of production structure shows Botswana as a predominantly resource-based economy at 28.8 per cent of its value of output. Malawi, Mozambique, Tanzania, and Uganda are basically agricultural economies. These economies and that of Botswana may not find reciprocity with EU on the primary commodities a major issue considering the share of labour in the value added. Agro-based industries are significant

[6] It is possible to disaggregate the sectors of industries further especially if one is concerned with more details of which sub-sectors gain or lose from trade liberalisation.

in Tanzania and in at least four other individual countries. Competitiveness of such industries Africa-wide would be a major issue under the EPAs. The picture for individual countries is mirrored to some extent in the composite rest of sub-Sahara Africa (XSS) region where the economies are predominantly primary commodities based with sizeable natural resources and light manufacturing sectors.

Table 4: Production Structure (Per cent of Total Value of Output)

	EU	BOT	XSC	MWI	MOZ	TZA	ZMB	ZWE	XSF	UGA	XSS	ROW
Cereals	0.3	0.5	0.5	6.8	4.9	8.8	3.5	1.6	1.1	4.6	4.9	0.9
Vegetables	0.5	0.2	0.6	2.3	6.0	3.4	1.0	0.7	0.6	22.2	2.3	0.9
Oilseeds	0.1	0.0	0.0	0.7	0.2	0.9	0.4	0.2	0.2	0.7	0.5	0.2
Sugar	0.1	0.0	0.1	0.1	0.0	3.6	0.4	0.8	1.0	0.9	0.5	0.1
Cotton	0.0	0.0	0.0	0.2	0.5	1.2	0.5	1.3	0.5	0.3	0.8	0.1
Other crops	0.3	0.0	0.4	15.5	6.2	7.3	4.4	6.6	1.6	4.9	3.4	0.3
Livestock	1.3	1.6	1.9	1.4	2.3	2.2	2.1	3.2	1.5	5.1	2.9	1.3
Natural Resources	0.8	28.8	5.6	2.8	4.4	5.1	5.6	3.9	21.5	3.8	11.7	2.5
Agro processing	5.7	4.9	7.0	10.9	10.9	16.1	11.3	12.2	7.5	6.3	11.4	5.2
Light Manufactures	5.5	1.8	5.8	6.3	1.7	3.9	5.3	6.2	7.8	1.4	5.0	6.0
Industry	23.9	9.6	22.9	9.6	2.3	6.3	15.1	15.7	11.4	2.8	9.9	23.2
Trade	16.4	10.8	18.6	25.1	32.2	20.1	19.1	14.9	15.1	17.6	20.8	16.9
Services	45.2	41.8	36.5	18.2	28.5	21.2	31.2	32.7	30.3	29.5	25.9	42.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: GTAP Database Version 5 Aggregation

Trade and services appear to be critical industries in all the countries. They constitute at least one-third of the economies. Given the issue of trade facilitation and trade in services under the WTO, these sectors would be areas of interest in EPAs discussions.

Trade by Sectors

Tables 5 and 6 show the export and import shares by sectors of the total exports and imports of goods and services respectively in each of the economies. In the case of Botswana, the dominating resource based sector also dominates its exports. Rest of SACU has industrial based exports dominating. In the smaller economies such as Malawi, mainly other crops exports dominate with limited exports from agro-processing and light manufactures. Other crops exports also dominate in the case of Tanzania, Zimbabwe and Uganda. Agro-processed exports are important in the case of Mozambique and as such EPAs with full reciprocity would most likely be a concern. Light manufacturing and industry constitute what can be called as the manufacturing base[7] and exports from this base are clearly important for Zimbabwe as they add up to at least 36 per cent of total exports.

[7] The proportion of industrial exports for Zambia appears overstated.

Table 5: Exports Shares by Sectors (% of Total Exports of Goods and Services)

	EU	BOT	XSC	MWI	MOZ	TZA	ZMB	ZWE	XSF	UGA	XSS	ROW
Cereals	0.3	0.0	0.7	0.2	0.8	1.1	0.1	3.1	0.1	0.2	0.1	0.7
Vegetables	0.7	0.0	2.1	0.7	7.0	7.1	0.6	1.6	0.1	1.4	1.6	0.6
Oilseeds	0.1	0.0	0.1	0.7	1.3	1.1	0.3	0.3	0.0	0.3	0.4	0.4
Sugar	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0
Cotton	0.0	0.0	0.1	1.0	5.6	12.1	1.1	5.3	0.0	2.6	2.9	0.2
Other crops	0.4	0.0	0.5	68.0	1.3	20.7	2.7	28.8	0.2	61.4	9.8	0.7
Livestock	0.4	0.3	0.6	0.1	0.1	1.3	0.2	0.4	0.1	1.2	0.3	0.4
Natural Resources	1.2	73.8	11.7	2.2	5.0	2.7	1.9	3.9	57.4	5.8	48.0	8.2
Agro Processing	5.9	2.6	4.1	3.5	27.6	10.9	2.7	7.4	7.3	4.5	5.2	3.9
Light Manufactures	10.6	2.7	7.7	8.4	3.9	5.1	4.0	9.1	12.6	0.5	3.8	10.5
Industry	61.8	13.3	57.2	1.2	9.6	7.1	61.8	27.6	7.9	3.3	13.5	56.6
Trade	7.4	2.7	8.9	5.8	12.8	21.3	7.1	5.5	7.9	8.1	6.9	8.5
Services	11.2	4.6	6.4	8.3	24.9	9.1	17.5	7.1	6.4	10.7	7.3	9.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: GTAP Database Version 5 Aggregation

The import shares are also an important starting point in understanding potential implications of the EPAs. Table 6 shows the total imports of the various commodities into each of the countries in the aggregation. However, the most important imports information would be the distribution of these imports in terms of source and type. In other words, data on the imports from the EU into each of these countries would be more informative with respect to EPAs analysis particularly on the issue of reciprocity as this would have a bearing on the revenue implications if most of the imports are from the EU. It is clear however from the aggregate imports data that in general, industrial goods dominate the rest of SACU, Zambia, and Zimbabwe. Other crops are also significant in a number of the countries, probably pointing to possible agricultural deficits. Agro-processed imports are substantial in Mozambique, Tanzania, and Zimbabwe. Generally, imports of primary commodities are not much for all the countries except for the category of other crops.

Table 6: Imports Shares by Sectors (% of Total Imports of Goods and Services)

	EU	BOT	XSC	MWI	MOZ	TZA	ZMB	ZWE	XSF	UGA	XSS	ROW
Cereals	0.4	0.0	0.9	0.2	0.9	1.3	0.1	3.8	0.1	0.3	0.1	1.0
Vegetables	0.8	0.0	2.9	0.7	7.2	7.9	0.9	2.0	0.1	1.8	2.1	0.8
Oilseeds	0.1	0.0	0.2	0.7	1.7	1.6	0.3	0.4	0.0	0.5	0.6	0.5
Sugar	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0
Cotton	0.0	0.0	0.1	0.9	5.1	11.5	1.1	5.0	0.0	2.6	2.9	0.2
Other crops	0.4	0.0	0.5	67.9	1.4	22.0	2.9	28.9	0.2	62.1	10.3	0.7
Livestock	0.4	0.3	0.6	0.1	0.1	1.4	0.2	0.4	0.1	1.4	0.3	0.4
Natural Resources	1.2	72.8	12.7	2.1	5.0	2.5	1.8	3.9	55.0	5.6	47.6	8.1
Agro Processing	6.7	3.9	5.3	5.3	33.1	13.1	4.4	10.4	11.2	5.3	6.5	5.0
Light Manufactures	10.8	2.8	8.0	9.0	4.0	5.0	4.1	9.0	13.2	0.5	3.9	11.2
Industry	61.6	13.4	55.3	1.1	9.2	6.6	61.7	25.6	7.3	3.1	12.9	55.8
Trade	7.0	2.5	7.9	5.0	11.0	18.5	6.5	4.6	7.1	7.3	6.2	7.7
Services	10.6	4.3	5.7	7.1	21.4	7.9	16.0	6.0	5.7	9.6	6.6	8.6
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: GTAP Database Version 5 Aggregation

Level and Structure of Protection: the Base for the EPAs

The level and structure of protection as captured in the GTAP database provide the initial conditions or the benchmark from which the trade liberalisation aspects of the EPAs would have to be assessed. This benchmark in respect to trade liberalisation analysis needs to be seen at two levels. The first level is the prevailing protection against imports from the European Union. The protection structure is provided in Table 7. The table shows the average applied tariffs on goods imported into the country shown at the top of the column from the EU. It can be seen from Table 7 that on average, agro-processed and light manufactures from the EU are heavily protected as evidenced by the high tariffs. This high taxation can be seen first as part of the industrial policy in these countries. It is the use of this high taxation as part of the industrial policy that has recently become an important area of discourse as pertains to policy space for developing countries. The second way that the high tariffs on EU goods should be looked at is as a source of revenue. Considering that these highly taxed EU imports are in sectors that constitute main imports imply that under the EPAs, with full reciprocity there are possibilities of significant revenue implications in addition to trade creation and diversion issues. The net effect in terms of trade expansion for the trade creation and diversion aspects will be determined at the empirical stage of the study. The protection data indicates that most countries are protective ranging from Botswana, Rest of SACU, Malawi, Mozambique, to Zimbabwe.

Table 7: Ad Valorem Tariff Rates (%) on EU Imports into African Countries

	BOT	XSC	MWI	MOZ	TZA	ZMB	ZWE	XSF	UGA	XSS
Cereals	25.8	38.8	24.9	2.5	17.5	12.4	6.4	0.5	63.7	11.1
Vegetables	25.6	25.6	33.0	18.8	9.8	11.1	15.8	5.6	27.4	18.4
Oilseeds	38.2	38.2	39.6	2.5	13.3	0.0	4.9	12.8	63.7	9.8
Sugar	17.1	0.2	0.0	7.6	0.0	0.0	0.0	8.7	15.0	0.0
Cotton	34.0	17.1	42.3	2.5	39.5	0.1	0.0	0.1	14.9	3.5
Other crops	9.2	9.2	37.3	4.1	30.1	5.2	7.8	12.9	5.2	16.6
Livestock	13.0	7.3	18.9	12.9	27.2	8.2	4.9	2.4	1.0	15.0
Natural Resources	28.7	0.1	0.3	7.8	2.5	20.1	13.0	13.4	11.4	7.6
Agro Processing	67.1	71.4	32.3	30.5	21.3	16.5	42.9	29.6	18.2	22.9
Light Manufactures	25.5	12.1	24.5	21.9	23.5	12.4	21.8	26.8	15.9	20.9
Industry	23.9	7.2	17.4	9.8	17.1	10.8	14.9	27.3	13.8	14.7
Trade	0.0	0.0	0.0	0.0	0.0	13.3	0.0	3.0	0.0	1.4
Services	0.0	0.0	0.0	0.0	0.0	8.5	5.0	6.8	0.0	4.1
Average (excl. trade & services)	28.0	20.7	24.6	11.0	18.3	8.8	12.0	12.7	22.7	12.8
Average (incl. Trade & services)	23.7	17.5	20.8	9.3	15.5	9.1	10.6	11.5	19.2	11.2

Source: GTAP Database Version 5 Aggregation

Table 8 is more specific as it gives indications on what could be expected in terms of trade creation and diversion. The table shows the average intra-Africa trade ad valorem tariffs. It can be read as follows. The average applied tariffs on goods into the country at the top of the column from each of the country in the row. For example, Botswana levies the highest import tariffs (24 per cent) on Zambian goods. The picture that emerges from the intra-African tariff protection data is one of substantial intra-African trade tariff barriers. Botswana in this case

emerges as the most protective. Overall, each of the individual countries at the top of each column has substantial tariffs towards the rest of sub-Sahara Africa. This essentially indicates that in spite of lack of disaggregated GTAP information on individual countries, the composite African country faces significant tariff barriers in the African countries. Mozambique generally levies the lowest tariffs on trade. In addition to the question of reciprocity to EU, most of these intra-African tariffs will have to be eliminated accentuating concerns regarding de-industrialisation and revenue shortfalls in majority of the countries.

Table 8: Average Intra-Africa Trade Ad Valorem Tariffs (%)

	BOT	XSC	MWI	MOZ	TZA	ZMB	ZWE	XSF	UGA	XSS
Botswana	0.0	0.0	18.7	6.2	4.4	10.1	13.5	11.6	24.6	9.7
Rest of SACU	0.0	0.0	7.6	4.3	16.9	4.7	17.2	15.4	12.3	14.3
Malawi	22.2	18.3	0.8	5.7	10.6	10.3	13.0	10.1	12.2	7.7
Mozambique	20.8	14.2	9.8	0.3	11.5	11.1	12.2	10.9	20.8	6.2
Tanzania	20.2	15.8	12.5	7.6	0.0	10.2	20.5	14.9	9.8	18.2
Zambia	24.2	13.9	4.1	6.5	15.1	0.5	11.8	11.9	17.7	9.4
Zimbabwe	23.6	17.3	16.5	5.7	12.6	9.9	1.9	13.5	16.9	13.8
Rest of Southern Africa	22.0	16.9	19.0	6.5	6.9	11.9	13.2	12.4	21.1	17.9
Uganda	20.6	16.7	18.4	5.8	15.3	10.8	12.4	11.3	4.3	19.4
Rest of sub-Sahara Africa	20.2	15.2	18.2	5.9	17.5	11.1	9.5	13.0	12.9	7.8
Average tariff rate	17.4	12.8	12.6	5.4	11.1	9.1	12.5	12.5	15.3	12.4

Source: GTAP Database Version 5 Aggregation

Most of the tariff barriers protection with respect to intra-African trade discussed above is on agro-processing and light manufactures (see Table 9).

Table 9: Average Commodity Tariffs on Intra-African Trade (%)

	BOT	XSC	MWI	MOZ	TZA	ZMB	ZWE	XSF	UGA	XSS
Cereals	31.4	30.7	3.9	1.2	19.2	4.1	19.0	3.1	32.8	7.6
Vegetables	22.8	22.8	23.3	7.3	14.6	16.4	21.5	13.4	47.9	19.9
Oilseeds	34.0	34.0	30.8	7.8	11.9	0.0	0.6	22.8	38.7	18.4
Sugar	11.4	0.1	0.0	5.9	0.0	0.0	0.0	6.8	13.3	0.0
Cotton	15.1	9.5	22.7	0.3	3.3	0.6	0.3	0.0	7.8	3.6
Other crops	8.2	8.2	22.7	9.0	19.1	13.0	32.8	23.8	13.7	37.4
Livestock	5.7	5.1	2.0	4.7	15.6	14.3	1.5	7.8	1.8	12.3
Natural Resources	20.5	0.7	2.5	5.7	8.6	20.0	8.8	10.8	7.5	10.3
Agro Processing	57.2	56.2	37.7	7.7	27.9	13.5	26.5	21.0	14.4	19.7
Light Manufactures	21.9	13.3	24.1	17.5	26.0	17.0	33.4	22.0	15.9	17.1
Industry	22.8	4.9	10.6	11.1	13.8	7.7	27.4	23.3	20.4	17.8
Trade	0.0	0.0	0.0	0.0	0.0	13.3	0.0	2.8	0.0	1.2
Services	0.0	0.0	0.0	0.0	0.0	9.3	6.3	5.2	0.0	3.0

In the absence of reciprocity with the EU, there is potential for trade creation in the African trade if these tariff barriers were to be eliminated[8]. However, with reciprocity, trade creation for most efficient African producers is not likely to be maximised because of the competitive advantage of the EU producers. In the area of primary production, vegetables and other crops are also heavily protected. Similarly, cereals are protected under the intra-African trade. Given that primary production is labour intensive, trade creation and specialisation possibilities in these sectors exist under an EPA.

The Partial Equilibrium Modelling Framework – the WITS/SMART Model

Why a Partial Equilibrium Model?

It was argued in a previous section that trade policy analysis is more robust when undertaken within a general equilibrium modelling framework. This can be seen as the first-best option as general equilibrium models, not only measure the first-round effects of simulated changes, but also the second-round effects which include inter-industry effects and macroeconomic adjustments. However, as has been indicated in the discussions on the GTAP modelling and database frameworks, majority of the African countries are not individually captured in that methodology due to lack of data disaggregation. Only a few which have been presented in the previous section as individual stand-alone countries while the rest are part of composites of countries viz. the rest of SACU, rest of Southern Africa, and Rest of sub-Saharan Africa. Consequently, the partial equilibrium modelling framework presents itself as a second-best option for those countries that are not captured individually in the GTAP database. This section therefore describes the partial equilibrium modelling methodology that will be used in the study to complement the GTAP results. The main distinction that should be noted at the outset is that as a partial equilibrium model, the inter-sectoral implications (second-round effects) of a trade policy change are not taken into account, as is the case in the general equilibrium model. Similarly, the inter-regional implications such as within a REC setting are also ignored in a partial equilibrium framework. The only point of convergence of the partial and general equilibrium models is that it is still possible within a partial equilibrium model to analyse the trade policy effects on trade creation and diversion, welfare and even on tariff revenues while holding everything else constant.

Milner et al. (2002) in providing a simple analytical framework explaining the theory behind partial equilibrium modelling, notes that to adequately capture the inter-actions between sectors and elasticities of substitution between factors, and to simulate dynamic effects in their EPA study between the EU and the East African Community, a general equilibrium model would be desirable. However, due to scarcity of individual and regional CGE models for developing countries then partial equilibrium models would be alternative choices. Milner et al. (2002) also raise a valid observation that the database for general equilibrium models lacks the commodity detail to take account of the specific sensitive and special products that are of interest to both the sub-Saharan African countries and the EU in this particular case. A partial equilibrium framework is in a better position in spite of its shortcomings to allow for the utilisation of the now widely available trade data at the appropriate level of details that would allow for the principle of special and differential treatment to be captured in the simulation analysis. It however remains true that although partial equilibrium models have

[8] As seen in the introductory part of this study, deeper regional integration through elimination of intra-African tariff and non-tariff barriers is one of the principles of the EPAs. It is therefore possible that at the negotiations that the African countries could commit to reducing tariff barriers among themselves as part of receiving non-reciprocation commitment from the EU.

drawbacks, as a modelling approach they have the advantage of working at very fine levels of details such as at tariff line level.

The WITS/SMART Model

For the purposes of this study, it is proposed that the WITS/SMART model will be the applied partial equilibrium framework. The World Integrated Trade Solution (WITS) brings together various databases ranging from bilateral trade, commodity trade flows and various levels and types of protection. WITS also integrate analytical tools that support simulation analysis. The SMART simulation model is one of the analytical tools in WITS for simulation purposes. SMART contains in-built analytical modules that support trade policy analysis such as effects of multilateral tariff cuts, preferential trade liberalisation and ad hoc tariff changes. The underlying theory behind this analytical tool is the standard partial equilibrium framework that considers dynamic effects constant. Like any partial equilibrium model, it has these strong assumptions allowing the trade policy analysis to be undertaken a country at a time. In spite of this weakness, WITS/SMART can help estimate trade creation, diversion, welfare and revenue effects for those countries whose data is available.

Trade creation

The underlying theory is summarised below for the estimation of the trade flows and revenue effects. The exposition of the WITS/SMART theory is summarised from Laird and Yeats (1986). Trade creation captures the trade expanding aspects of liberalisation that leads to the displacement of inefficient producers in a given preferential trading area (a free trade area for instance). It is assumed that there is full transmission of price changes when tariff or non-tariff distortions (ad valorem equivalents) are reduced or eliminated. Laird and Yeats (1986) derive clearly the equation that can be used to estimate the trade creation effects. The derivation begins with the following basic trade model composed of simplified import demand and export supply functions and an equilibrating identity:

A simplified import demand function for country *j* from country *k* of commodity *i*:

$$M_{ijk} = f(Y_j, P_{ij}, P_{ik}) \qquad (1)$$

The export supply function of commodity *i* of country *k* can be simplified as:

$$X_{ijk} = f(P_{ikj}) \qquad (2)$$

The equilibrium in the trade between the two countries is the standard partial equilibrium equation:

$$M_{ijk} = X_{ikj} \qquad (3)$$

In a free trade environment, the domestic price[9] of commodity *i* in country *j* from country *k* would change with the change in an ad valorem tariff as follows:

$$P_{ijk} = P_{ikj}(1 + t_{ijk}) \qquad (4)$$

[9] The transport and insurance costs are not reflected in the equation explicitly.

To derive the trade creation formula, Laird and Yeats (1986) proceed as follows. First, the price equation (4) is totally differentiated to get:

$$dP_{ijk} = P_{ikj} dt_{ijk} + (1 + t_{ijk}) dP_{ikj} \qquad (5)$$

Equations (4) and (5) are then substituted into the elasticity of import demand equation[10] to get:

$$\frac{dM_{ijk}}{M_{ijk}} = \eta_i^m \left(\frac{dt_{ijk}}{(1 + t_{ijk})} + \frac{dP_{ijk}}{P_{ikj}} \right) \qquad (6)$$

From the identity in equation (3), $\frac{dM_{ijk}}{M_{ijk}} = \frac{dX_{ikj}}{X_{ikj}}$ this can be used to derive the following expression for elasticity of export supply:

$\frac{dP_{ikj}}{P_{ikj}} = \frac{1}{\gamma_i^e} \frac{dM_{ijk}}{M_{ijk}}$ which when used in equation 6, allows the computation of the trade creation effect, which from equation (3) is equivalent to exporting country *k's* growth of exports of commodity *i* to country *j*:

$$TC_{ijk} = M_{ijk} \eta_i^m \frac{dt_{ijk}}{((1 + t_{ijk})(1 - \eta_i^m / \gamma_i^e))} \qquad (7)$$

If $\gamma_i^e \to \infty$, then equation (7) can be simplified as follows:

$$TC_{ijk} = \eta_i^m M_{ijk} \frac{(1 + t_{ijk}^1) - (1 + t_{ijk}^0)}{(1 + t_{ijk}^0)} \qquad (8)$$

where TC_{ijk} is the sum of trade created in millions of dollars over *i* commodities affected by tariff change and η_i^m is the elasticity of import demand for commodity *i* in the importing country from the relevant trading partner. M_{ijk} is the current level of import demand of the given commodity *i*. t_{ijk}^0 and t_{ijk}^1 represent tariff rates for commodity *i* at the initial and end periods respectively. Trade creation then depends on the current level of imports, the import demand elasticity and the relative tariff change.

Trade diversion

Trade diversion as opposed to trade creation can expand or contract trade globally. Trade diversion is the phenomenon that occurs in a free trade area for example whereby efficient producers from outside the free trade area are displaced by less efficient producers in the preferential area. Consider an EPA between ECOWAS and EU for instance. Trade diversion would result if as a result of the establishment of the EPA more efficient suppliers from the

[10] The elasticity of import demand is $\frac{\Delta M_{ijk}}{M_{ijk}} = \eta_i^m \frac{\Delta P_{ijk}}{P_{ijk}}$

rest of the world (ROW) into ECOWAS are displaced by inefficient producers from the EU. Assuming that such an EPA is formed which leads to reduction of tariffs facing the EU without any changes in the tariffs facing the ROW exporters; the theory underlying the measurement of trade diversion in SMART is also explained in Laird and Yeats (1986). To see the derivation clearly, first the expression for elasticity of substitution is given. The elasticity of substitution can be expressed as the percentage change in relative shares of imports from two different sources due to a one per cent change in the relative prices of the same product from these two sources:

$$\sigma_M = \frac{\Delta\left(\sum_k M_{ijk} / \sum_K M_{ijK}\right) / \left(\sum_k M_{ijk} / \sum_K M_{ijK}\right)}{\Delta\left(P_{ijk} / P_{ijK}\right) / \left(P_{ijk} / P_{ijK}\right)} \qquad (9)$$

where *k* denotes imports from EU and *K* denotes imports from the rest of the World. Equation (9) can be expanded, and through substitutions and rearrangements be used to obtain the expression for trade diversion which is expressed as:

$$TD_{ijk} = \frac{M_{ijk}}{\sum_k M_{ijk}} \frac{\sum_k M_{ijk} \sum_K M_{ijK} \frac{\Delta(P_{ijk} / P_{ijK})}{P_{ijk} / P_{ijK}} \sigma_M}{\sum_k M_{ijk} + \sum_K M_{ijK} + \sum_k M_{ijk} \frac{\Delta(P_{ijk} / P_{ijK})}{P_{ijk} / P_{ijK}} \sigma_M} \qquad (10)$$

Equation (10) can be simplified to the case of an EPA. The relative price movement terms in the equation as noted in Laird and Yeats (1986) capture the movement due to changes in tariffs or the ad valorem incidence of non-tariff distortions for the EU and the ROW. Therefore, the trade diverted to the EU in the EPA, TD^{EPA} can be captured by reducing equation (10) above as follows:

$$TD^{EPA} = \frac{M^{EU} M^{ROW} \left(\frac{1+t^1_{EU}}{1+t^0_{EU}} - 1\right) \sigma_M}{M^{EU} + M^{ROW} + M^{EU} \left(\frac{1+t^1_{EU}}{1+t^0_{EU}} - 1\right) \sigma_M} \qquad (11)$$

Equation (11) shows the additional EU imports into the African EPA configured region such as ECOWAS in addition to the increase in ECOWAS imports as a result of trade creation without necessarily resulting in a net increase in imports but being accompanied with the displacement of ROW imports into ECOWAS. M^{EU} and M^{ROW} are the current imports into the African REC configuration for EPA purposes from the EU and ROW respectively. t^1_{EU} and t^0_{EU} are respectively the end and initial periods import tariffs imposed on EU imports in the destination REC with $t^1_{EU} < t^0_{EU}$. σ_M is the elasticity of substitution between EU and ROW imports into the concerned country or REC. Trade diversion then depends on the current level of imports from the EU and ROW, the percentage change (reduction in this case) of tariffs facing EU imports with those for ROW remaining unchanged and the elasticity of substitution of the imports from the two sources. The higher the value of the elasticity of substitution, the greater will be the trade diversion effects.

Trade expansion

The total effect on trade can be derived by adding the trade creation and diversion. As indicated in Laird and Yeats (1986), the summation in equations (8) and (10) for an importing country can be done across products and/or across sources. It is also possible to sum the results across a group of importers for single or groups of products as well as for single sources of supply or groups of suppliers.

The revenue effect

The quantification of the revenue effect using WITS/SMART model is simple. In theory, the tariff revenue is given as the product of the tax rate (tariff rate in this case) and the tax base (the value of imports). Thus, before the change in the ad valorem incidence of the trade barriers, the revenue is given as:

$$R_0 = \sum_i \sum_k t^0_{ijk} P_{ijk} M_{ijk}$$

After the change in the tariff rate, the new revenue collection will be given by:

$$R_1 = \sum_i \sum_k t^1_{ijk} P_{ijk} M_{ijk}$$

The revenue loss as a result of the implementation of an EPA would then be the net between R_1 and R_0 which is the same as:

$$RL = \sum_i \sum_k \Delta t_{ijk} P_{ijk} M_{ijk} \qquad (12)$$

The welfare effect

The WITS/SMART model estimation of welfare effects is quite simple. This is unlike the equivalent variations measurement in general equilibrium models. Essentially, the welfare effect is mainly ascribed to the consumer benefits in the importing country as a result of lower import prices[11]. This allows them to substitute more expensive domestic or imported products with the cheaper imports that are affected by the relevant tariff reduction. Increased imports leads to a net welfare gain which can be thought as the increase in consumer welfare and is measured as follows:

$$w_{ijk} = 0.5(\Delta t_{ijk} \Delta M_{ijk}) \qquad (13)$$

The coefficient of 0.5 captures the average between the ad valorem incidence of the trade barriers before and after their elimination/reduction. Equation (13) assumes that the elasticity of export supply is infinite. If this is not the case, the import prices in the importing countries fall by less than the full reduction in trade barriers. Therefore, while the equation can be used to measure welfare effect, it is no longer a representation of consumer surplus alone but has some element of producer surplus (see Laird and Yeats 1986).

[11] As emphasized in Laird and Yeats (1986), in the case of pre-existing level of imports, there is no net welfare gain in the country as the tariff reduction simply means a reallocation/transfer of revenue from the government to the consumers.

The WITS Database

WITS database comes from various sources. The main ones are COMTRADE and TRAINS databases. These will be complemented by EUROSTAT data and as much as possible with country-level statistics.

References

Adams, P., M. Horridge, B. Parmenter, and X. Zhang, 1997, "Long-run Effects on China of APEC Trade Liberalisation", Unpublished paper based on a report prepared for the East Asia Analytical Unit, Department of Foreign Affairs and Trade, Canberra, Australia.

Brockmeier, M., 2001, "A Graphical Exposition of the GTAP Model", *GTAP Technical Paper No. 8*, Revised March 2001.

Dixon, P.B., B.R. Parmenter, J. Sutton, and D.P. Vincent, *ORANI: A Multisectoral Model of the Australian Economy*, North-Holland Publishing Company.

Hertel, T.W., 1997, *Global Trade Analysis: Modelling and Applications*, Cambridge University Press, New York and Cambridge.

Johansen, L., 1960, *A Multi-Sectoral Study of Economic Growth*, North-Holland Publishing Company, Amsterdam (2nd Edition 1974).

Kehoe, P.J. and T.J. Kehoe, 1994, "A Primer on Static Applied General Equilibrium Models", *Quarterly Review*, Federal Reserve Bank of Minneapolis, Spring Issue, pp. 2-16.

Laird S. and A. Yeats, 1986, "The UNCTAD Trade Policy Simulation Model: A Note on the Methodology, Data and Uses", UNCTAD Discussion Paper No. 19, Geneva.

Milner, C., O. Morrissey, and A. McKay, 2002, "Some Simple Analytics of the Trade and Welfare Effects of Economic Partnership Agreements: The Case of the EU-EAC", mimeo, CREDIT, University of Nottingham.

Siriwardana, M., 2001, "Some Trade Liberalisation Options for Sri Lanka", *East Asian Studies Review*, Volume 25 Number 4, pp 453-477.