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Can trade liberalization serve international technology diffusion in developing countries?

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Abstract

Is trade liberalization a key to international technology diffusion in developing countries? This research continues the work done in the area of Regional Trading Agreements (RTAs) between the European Union and Southern African countries (e.g. Kerkelä et al. 2000, Lewis et al. 2002) focusing especially on industries that are prominent to international technology diffusion (Keller 2001, Mohnen 2001). Within the regional subset (EU and Africa), correlation between the income level and the share of R&D industries in the absorption is found to motivate the approach. In the simulations where different initiatives between SADC countries and individual / joint initiatives between the European Union and Southern African countries are simulated with the GTAP model, we look at the effects especially on the imports. These initiatives include: free trade area between South Africa and EU, SADC free trade area, Regional Economic Partnership agreement (REPA) between SADC countries and the EU and the optional GSP arrangement for LDC-countries in Southern Africa if REPAs as FTAs would not realize. The preliminary results reveal that the effect of RTAs on the imports and domestic production in R & D industries is marginal and rather decreasing. The Southern African countries will specialize even more in agricultural production and the increasing exports are used for importing mainly processed food. In overall the share of high-tech commodities in imports decrease slightly. Structural adjustment does not converge to industrial structures in Europe. We also discuss the role of South Africa as a growth pole from the technology diffusion perspective and question the role of the European Union as a uniform trading partner when technology diffusion is taken into account. From the development perspective the RTAs do not seem to be the key to technological development or catching up and other policy means are necessary for developing countries.

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1. Introduction

A common consensus prevails that international trade can play a major role in the promotion of economic development. Following this basic principle the actions for liberalizing global trade within WTO or by regional trade liberalization initiatives are seen as a main policy tool for successful development and poverty alleviation. Especially in many African countries, the openness strategy is even more dominant for their previous import-substitution policies which are claimed to be one reason for Africa's poor performance in the past (Wang and Winters 1998).

Most of the countries in Southern Africa have engaged in a variety of trade liberalization initiatives and the European Union plays a dominant role in most of these. African countries have their role in EU's preferential trade arrangements and are included either in free trade areas, ACP Preferences or Generalized System of Preferences (Panagariya 2002). Although the multilateral way for global liberalization would result in a better outcome from a global perspective, the regional approach within Africa is justified purely by its realism when effects of trade liberalization are to be considered.

In this work we utilize the GTAP model and database, for analysing the effects of trade liberalization schemes in Southern Africa. More than looking at the aggregate effects we focus on those effects that are suggested to be crucial for international technology diffusion which is a an important issue when looking at growth and development opportunities in developing countries.

The question of technology adoption has been gathered around the steps of integration in Southern Africa. In the prevailing situation the ACP tariffs are prevailing and almost all exports is entering duty-free to the European Union. The already signed free trade area between EU and South Africa is a starting point in integration. From there we have different paths to follow: to build on deeper integration in Southern Africa in the form of SADC or rely on single countries' integration solely to the European Union in the form of Economic Partnership Agreement (EPA's) in the framework of the Cotonou Agreement. At a later stage the SADC could also integrate as a unit to the European Union to build a Regional Economic Partnership Agreement (REPA) together with the European Union. And if any contractual arrangements will not succeed, the least developed countries have a market access to the European markets in the GSP system. In the scenario building we rely largely on Lewis et al. (2002).

If trade liberalization is supposed to help technology adoption and growth we first need to identify the channels through which the technology diffuses. The empirical research on technology diffusion and international technology spillovers has been very active in the recent years (see surveys Mohnen (2001), Keller (2001). The crucial question is to find mechanisms that drive productivity growth through trade. We study the issue through industries that are shown to be conducting most of the research and development. These industries are chemical products (including drugs), electrical and non-electrical machinery (including computers and telecommunication equipment) and transportation equipment. We call them high-tech products (HT-products).

The very few attempts to include spillovers in structural cge-models are van Mejl and van Tongeren (1998a, 199b) where they have added an add-on component to the GTAP-model to cover the spillover effects but as such the version can not be used for our case.[4] First, it needs an exogenous shock in productivity to accrue any spillovers, information on absorptive capacity as well as the R&D input in the technologically leading country to estimate the spillover effect.

In this study we do not include spillovers into the GTAP model as such but rather use the results in interpreting the possible effects that by technology could add for the productivity growth in relevant industries. We ask following questions:

1) Which different liberalization schemes promote the technology diffusion?
2) In different liberalization regimes, how are the trade creation / diversion effects in industries that are most prominent to technology diffusion?
3) How the role of South Africa as a growth pole in Southern Africa is seen in different liberalization schemes?
4) Can European Union be treated as a single trader when spillovers in technology are taken into account?

The work is organized as follows. The chapter 2 sets out the institutional framework and the trade liberalization initiatives in Southern Africa. In chapter 3 the empirical findings relevant for our study from research in international spillovers are reviewed. In chapter 4 we study the trade and protection patterns in trade of Southern African countries and especially their imports of High tech-commodities. In chapter 5 we present the model, data and simulations. In chapter 6 the results are analyzed. Chapter 7 concludes and suggests the work continuing from here which will be including productivity shock through increased trade into the basic GTAP model following the recent working paper by Itakura et. al (2003).

2.Trade liberalization initiatives in Southern Africa

Most of the countries in Southern Africa have engaged in a variety of trade liberalization initiatives and the European Union plays a dominant role in most of these. Even though the African countries are involved also in multilateral trade negotiations and are entitled to preferences by other developed countries as well, the long historical

[4] Other cge-models that simulate international spillovers are Eaton and Kortum 1996, 1997a, 1997b and Bayoumi, Coe and Helpman 1996 but these models are aggregate and do not have the sectors included.

ties and the current preference system with the European Union and its member countries naturally implies deeper integration in Africa to happen through the European Union.

In this study we focus on the following countries: Angola, Botswana, SACU[5] (South Africa, Lesotho, Swaziland), Namibia, Malawi, Mauritius, Mozambique, Tanzania, Zambia, Zimbabwe. The choice of countries is partly based on the availability of data but also on the opportunities that can be seen as available for Southern African countries in trade policy. All these countries belong to Southern African Development Community SADC[6] that aims in deeper regional integration and harmonization of policies in Southern Africa. Despite of very different regimes and the level of development between countries, one of the goals is a free trade area between the countries.[7] South Africa is the prominent economy in the region. [8]

In EU dimension, African countries have their role in EU's preferential trade arrangements and are included either in free trade areas, ACP Preferences or Generalised System of Preferences (Panagariya 2002). Of the free trade areas there is one negotiated between South Africa and European Union in 1999. The realisation of the free trade will have several implications to South Africa, even more to other SACU countries as well as to other SADC countries.

All SADC countries are also ACP (African, Caribbean and Pacific) countries. Based on their colonial ties with European countries they have been entitled to development funding as well as tariff preferences from the European Community. Preferences have guaranteed almost duty-free entry for most of the commodities entering the common market from ACP countries. Special protocols have governed the trade in sugar, bananas, and beef and veal. Protocols have allowed imports within quotas under sugar protocol so that quota rents have accrued to ACP producers. Of Southern African countries Mauritius is one of the beneficiaries. Under the beef protocol, the EC refunds most of the tax revenue of imports to producers. This has been very useful for Southern African producers like South Africa and Botswana.

Since 2000 these relations have been governed by the Cotonou Agreement which has replaced the previous Lomé Agreement. Renewed relationships between EU and ACP countries will be built around EPAs, Economic Partnership Agreements, which are not

[5] GTAP database treats SACU as one region and we also mostly ignore Swaziland and Lesotho and treat SACU as South Africa. GTAP database has Angola and Mauriutus as a composite region (OSA).
[6] Angola, Botswana, Democratic Republic of the Congo, Lesotho, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe.
[7] http://www.sadcreview.com/
[8] There are also other regional initiatives related to trade in Africa where part of the SADC countries are included. Among them are COMESA (Common Market for Eastern and Southern Africa, which is made up of twenty African member states and SACU (Southern African Customs Union) which is made up of South Africa, Botswana, Lesotho, Namibia and Swaziland. Common collection of customs duties within SACU has guaranteed customs revenue for all of the SACU countries and this situation is about to change due to other initiatives. Finally, to mention about African wide co-operation initiatives in sectors other than trade, NEPAD (New Partnership for Economic Development) was built for aiming to raise Africa from poverty. Comesa = (Egypt, Ethiopia, Eritrea, Sudan, Djibouti, Kenya, Rwanda, Burundi, Comoros, Uganda, Seychelles, Malawi, Angola, Democratic Republic of Congo (DRC), Zambia, Zimbabwe, Namibia, Mauritius, Madagascar and Swaziland)

only trade policy arrangements but include also development aid and different kind of price stabilization programs inherited from the Lomé system.[9] [10] A detailed description of the current situation and future challenges is also in Stevens et al. (1999) and McQueen et al. (1998). To diminish the amount of agreements EU prefers them with groups of countries. (REPA vs. EPA). During 2000-07, which is the preparatory period, the current regime with its protocols are to be maintained in some modified form. In parallel, the EPAs are negotiated with countries other than the least developed ones. The new arrangements are to enter into force at the latest by 1 January, 2008, with transition to a full FTA spread over at least 12 years (Panagariya 2002).

When building the new kind of co-operation programs, the EC was looking after arrangements that would not be in contrast with WTO regulations that allow special treatment and preferences under the Enabling Clause only for the least developed countries. GATT Article XXIV allows this kind of bilateral free trade areas. Table 1 describes the classification of countries. Of SADC countries, only Angola, Mozambique, Tanzania and Zambia are classified as the least developed countries. All the others need new arrangements in their preferences with the European Union. These countries are Botswana, DRC, Lesotho, Malawi, Mauritius, Namibia, Seychelles, South Africa, Swaziland and Zimbabwe.

Within the multilateral framework, many Southern African countries are entitled to Special and Differential Treatment (SDT) in the form of unilateral access to markets in developed countries. This treatment is governed by GSP systems (Generalized System of Preferences) that also EU has. The latest renovation in European GSP system was named to be EBA (Everything but Arms) which would ensure in market access even an improved position compared to the Cotonou Agreement. All the protocols will be abolished by 2009 but with the loss of quota rents and tariff refunds which for some producers would be a loss.

For Southern African countries, the crucial question in these liberalization schemes is the opening of markets to the European Union imports with the loss of tariff revenues but the gain in efficiency and access to technology as well. The role of South Africa in the future is also in a centrepiece. If the reciprocal EU integration in Southern Africa remains at the level of the free trade area between EU and South Africa and SADC countries proceed in their regional integration initiatives, South Africa is the hub in ´hub and spoke´ approach. On the other hand, if free trade areas are to be build either between individual African countries and the EU, the EU will be the hub. If SADC was the negotiating partner in Cotonou Agreement instead of South Africa, the role of South Africa would be relatively smaller. This angle was also recognised by Lewis et al. (2001) and can be extended beyond the actual tariffs to trade practices and governance.

Discussion on the threats and merits of regional vs. multilateral trade liberalization has been discussed lately. Different opinions prevail on whether regional and multilateral

[9] A comprehensive description of the Cotonou Agreement can be found in the Cotonou Toolkit at the webpages of the European Centre for Development Policy Management, http://www.ecdpm.org/en/cotonou/index.htm.
[10] The Cotonou Agreement, Art. 1, available at http://europa.eu.int/comm/development/cotonou/agreement_en.htm

actions are working against each other or are the regional trade agreements a preceding step for multilateral trade liberalization. Ethier (1988) argues that regional integration may be a direct consequence of the success of past multilateralism and an added guarantee for its survival. Panagariya (2000) together with Bhagwati et al. (1998) are worried about the effects of Preferential trading areas (PTAs) to form a discriminating system for countries in the form of tariffs and the rules of origin that vary across FTA agreements. These free trade intentions are thus creating a chaos in the tariff regimes where the best solution is to speed up MFN liberalization. The concern is raised also against GSP tariffs which actually prevent developing countries to grow because the system is loaded with procedures of graduation. The achieved degree of competitiveness or increase in development may lead to the exclusion of a developing country from the GSP system (more on the critics, see Panagariya (2002)).

The loss of preferences has often been raised as a reason for developing countries' resistance to multilateral trade liberalization. Behind these concerns is always the question of market access to be the crucial way for development. In this study we want to open the way to the discussion where the imports and its structure is the essential element for growth.

2.1. Research on the effects of trade liberalization in Southern Africa

Effects of African trade liberalization initiatives with cge-models have been studied in several drafts. In our previous working papers Kerkelä et al. (2000) and Kerkelä et Niemi (2002)[11] we studied the general effects of Cotonou and GSP initiatives. Ianchovichina et al. (2001) compare the effects of EU's, USA's and Japan's potential preference improvements on SubSaharan Africa. Andriamananjara and Hillberry study the effects of EU- South Africa free trade agreement when tariffs are abolished sequentially. McDonald and Walmsley (2001) extend the EU-South Africa agreement to Botswana. Also done with GTAP model Karingi et al. (2002) study the effects of COMESA. Evans (2001) and Eskola (2002) integrate poverty case studies to GTAP simulations, in global trade reform and the Cotonou Agreement. Other studies include McDonald and Punt (2001) Arndt and Lewis, Hertel et al (1998), Lewis et al. (2002) and Lewis (2001)

Studies on these initiatives by Lewis et al. (2002) and Lewis (2001) in World Bank have evaluated the impacts of different trade liberalization patterns on countries, sectors and factors. Different scenarios in their studies apart from FTA between South Africa and EU are 1) implementing a SADC FTA 2) exploiting a unilateral access to the EU in addition to a SADC FTA (EBA) and 3) entering an FTA with the EU and other SADC countries. The last scenario mostly resembles the spirit of the Cotonou Agreement. The authors find, inter alia, that unilateral access to the EU is more beneficial to Southern African countries, than a SADC FTA. However, reciprocal reforms under an EU-SADC FTA dominate unilateral access to the EU because they generate more welfare

[11]Note on correction of Lomé –tariffs – all have been set to zero, because also in those items that previously we regarded as to have trade barriers, imports is allowed in quotas.

enhancing structural adjustment. Finally, they find that South Africa is not a viable growth pole for the region and access to EU markets provide substantially bigger gains for the other SADC countries than access to South Africa.

We question these claims by once more looking at the trade diversion effects of the EU-option, or EU hub-and-spoke with Southern African countries, with an opportunity cost of losing trading possibilities with technological leaders in Asia, the United States and Japan. Also for the possibilities of technology transfer from South Africa to other Southern African countries, we ask whether South Africa still would not be the best possible trading partner when speaking about spillovers in knowledge or rent.

Other studies on Lome and Cotonou impacts are most often partial equilibrium studies focusing more in single products and their market access e.g. McQueen et al. (1998), McQueen (1998, 1999)

3. Technology adoption through imports

Market access is the dominant issue in the liberalization rounds within WTO. The issue has its tradition in GATT in a so-called request and offer system (as described by Zhen and Winters (1998)) whereby one country makes a specific request of another to reduce a particular tariff in return for a reciprocal concession. The system gives a dominant negotiating position for a principal supplier of a particular good and is based on a mercantilist view that export is the final aim of trade and imports is the necessary evil that has to paid for getting an access to export market. This approach fades the idea that the purpose of trading is the increase in welfare and consumption possibilities by improving global inefficiency and potentially also improving the prerequisites for growth.

The latest trade round within WTO started in 2001 is called Doha Development Round with the main purpose to improve the possibilities of developing countries in integrating the global trading system. This brings the structure of imports also into the front and the role of technology transfer into the discussion. (Article 66.2)

Technology as a commodity has an important role in growth and when technology is seen as instructions or a code, it is partly a public good in nature. Copying a technology does not involve extra costs. As technology's role is so important in a modern growth, it is evident that its role has been emphasized in the development goals in the ongoing trade rounds. EU, which has an active role in the trade negotiations, has also emphasized this aspect. (See the Communication from the European Communities and their Member States to the TRIPs Council: Reflection Paper on Transfer of Technology to Developing and Least Developed Countries).

Technology, for example in the form of computers, software skills, use of internet, improved level of communication, diffuses between countries. Different channels for diffusion of technology are 1) international trade in final goods, intermediate inputs, capital goods and particularly in IT (information technology) products; 2) foreign direct investment (FDI) 3) migration of educated works, 4) publications in technical journals,

5) international research collaborations and 6) royalties on copyrights and trademarks. (Classification by Mohnen 2001). These channels transmit the technology by transferring it as well as by technological spillovers. Both means are diffusing technology but their difference lies in whether the technology moves by exchange (transfer) or without counter payments more in an uncontrollable way (spillovers).

Our simulations below produce results on trade flows in different industries. As we are focusing on industries that are most R&D intensive, we do not actually specify the form of technology diffusion but have a look at on those industries. Implicitly we can assume that trading in those industries involves spillovers also, but the adaptation of those spillovers depends also on the domestic capacity.

Trade liberalization affects the final consumption pattern, through structural changes in production and the pattern of trade, i.e. exports by imports. If all the domestic production goes to export we might question its usefulness for domestic capacity building.

The connection between trade and knowledge diffusion in the aggregate level has been confirmed by Coe and Helpman (1995) and Coe, Helpman and Hoffmaister (1997). Their papers did not however give answer of the links how technology is moving between countries, only that there exist spillovers from one country's R&D to other countries tfp growth.

Keller (2001, 2002) identifies four three-digit ISIC industries to perform 80 % of all manufacturing Research and Development. These industries are: chemical products (including drugs), electrical and non-electrical machinery (including computers and telecommunication equipment) and transportation equipment. As Keller states, it is a priori plausible that international technology diffusion is most important in industries that account for a substantial part of all R&D. We follow the convention to restrict the analysis to those high-technology-industries. (Bernstein and Mohnen 1998). These industries can also be identified separately in the GTAP database.

Technology diffusion issues can also be addressed by who are the traders. It can be shown that diffusion from technological leaders is more influential than from lagging countries. This paper addresses the question of EU's new agreements and how they carry their responsibility of improving developing countries' access to technology. If new agreements and initiatives divert imports from other countries, such as newly developed Asian countries or United States or Japan, they role in improving development is not most efficient.

In tables 3-5 we have correlated the utilization and domestic production of HT-products against the per capita income level against a subset of countries (Source United Nations, Statistical Yearbook 2001). HT-products are defined as above and calculated from the GTAP data to be the sum of four HT-intensive products (crp, ome, transeq, ele to be chemical products, machinery, transportation equipment and electronical equipment). The utilization is measured by summing up the domestic production allocated to domestic consumption and imports of the products. These values are defined as shares of total consumption and they vary between 0.06 (Mozambique) and Ireland (0.25). The

subset of countries under focus has been limited to the Southern African countries under focus, the European Union countries as individual and the USA and Japan.

The first table correlates the total utilization against the income level, the second the domestic production against the income level and the third as the imports against the income level. The imports shares have been calculated simply by subtracting from the total utilization share the domestic production. Clear positive correlation can be found, which does not give reason to make any too profound conclusions but rather strengthens the motivation to use the GTAP data also for this type of analysis. the total utilization are positively correlated with income / capita. [12] Also it shows that pure imports is not correlated with high gdp alone which is quite intuitive. If no domestic production complements the adoption of technology, no growth can be achieved.

4. Trade and protection patterns in Southern Africa

The above mentioned trade liberalization initiatives have their impacts especially on imports as the current preferences submitted by the European Union allow duty-free access to most of the products from Southern Africa to the European Union. In the simulations we have modified the current protection rates presented in GTAP data base so that all tariffs to imports from Southern Africa to the European Union are set zero. The procedure has been applied also to the products under protocols as their quota rents at the moment are accruing to the African producers.

In table 4 the exports from Southern African countries is described. For many countries, like Botswana, Malawi and Tanzania, the exports is concentrated on few primary goods products. Zimbabwe, as the second largest country in the area exports also metal and manufacturing products but in every sense, not only in size, The South Africa is an exception. It exports is more diversified than any of its neighbors, it is also the prominent exporter in metal products and in some high-tech commodities, namely chemical products and other manufacturing. The destination of this exports is mainly the European Union and Zimbabwe.

In table 5 we have presented the average tariffs for imports sourcing from the European Union, the United States, Japan and Newly Industrialized Asian countries. What the liberalization schemes do bring along, are the preferences granted to the European Union in manufacturing products, including high-tech products. This naturally diverts imports from the other high-tech producing countries.

In figures 1 and 2 we have described especially the sources of imports of high-tech commodities to Southern African countries. As South Africa is so large compared to the other countries, the first table in practice describes its imports pattern. The role of EU in R&D imports is important but also Japan, the United States and Asian countries have an important role. The figure 2 describes the same imports without including South Africa. It shows clearly the transmitting role of South Africa to other Southern Africa

[12] The correlation does not hold when all the countries from GTAP data base are included. Especially we suspect that Asian countries are behind this as there are a lot of poor countries that produce technological devices.

countries. 40 percent of the imports in these products to other Southern Africa comes from South Africa where, apart from imports, is also own production.

5. Model and simulations

The simulations are performed with a global computable general equilibrium (CGE) model and related database, GTAP (Hertel, 1997), which is a product of the Global Trade Analysis Project (GTAP, 2002). The GTAP database (version 5; see Dimaranan and McDougall 2002) covers 66 regions and 55 sectors, which in this study have been aggregated to 14 regions and 21 sectors (Table 2 and Table 3).

In the country aggregation we have left all SADC countries as single as possible. As we are looking at EU as the policy maker here, all 15 EU countries are aggregated together. Other possible exporters are USA and Japan and ASIAD which calls for Dynamic Asian countries (8). (China, Honkong, Indonesia, Korea, Malaysia, Singapore, Taiwan and Thailand). In aggregating these countries we follow Coe et al. who also notice that aggregating other industrial OECD countries would not give very good picture of alternative manufacturing countries, as to these countries belong many such countries that are already lagging in income the newly developed countries.

In the simulations performed the driving forces for the results are naturally the base data in the form of values in production and trade as well as the protection rates which in different experiments are shocked to be removed. The larger the shock, the greater the impacts are (see table 5). When the current trade flows are marginal, no large impacts can be borne from even large shocks in removing the tariffs. As the European Union is the largest trading partner to the Southern African countries, the impacts are supposed to be greatest of any other possible liberalization initiatives.

The underlying model and parameters behind them naturally define the behavior of the agents in the market. In this draft directed to experts in the field we do not review the model but rely on the original sources (Hertel 1997, McDougall et al.)

The current Lome tradition guarantees almost complete duty-free access for most of the Lome-countries. GTAP data base does not take into account preferential rates but for not overestimating the effects of possible free trade areas we have abolished all duties in imports from African countries to EU. This of course diminishes the possible effects of EPAs.[13]

Following experiments have been conducted:
1) SAEU – The Free trade area between South Africa and EU
2) SAHUB – 1) + the SADC free trade area
3) EUHUB – 1) + EPAs with individual SADC countries
4) FTA – FTA between EU and SADC

[13] Correcting Lomé tariffs only for African countries causes a distortion on relative preferences between African and other Lomé countries who are also enjoying preferential duties. As we are not focusing on market access we justify this partial correction. It also keeps the simulations simple and reproducible.

5) FGSP – SAHUB where GSP tariffs have been set to EU-imports instead for ACP-tariffs for non-LDC-countries (Botswana, Malawi, Zimbabwe, OSA (=Mauritius))[14]
6) SADC- Reference simulation to bring the difference of SADC and SAEU free trade area
7) GSP – Reference simulation to bring forth the effects of pure raising GSP –tariffs.

Even though we do not want to give any estimation of the sequences of the steps in the integration or of their realism, the experiment 4 of the total free trade area between SADC countries and the European Union can been seen as the deepest stage of integration. This phase can be reached by two alternative ways; either by South Africa hub - SAHUB -where South Africa is the hub between the EU and SADC countries or by EUHUB where the EU is the hub in the middle of African countries. The experiment 5 can be seen as the worst case as it involves increasing protection for some countries, which then benefits the countries that can keep their market access.

6. Results

Even though our focus in results is at the industry level, we first look at the aggregate results, especially the effects of simulations on GDP, the welfare and the terms of trade.

As in Kerkelä et al. (2000) the economy wide effects seem to be negative for many African economies in scenarios representing free trade area between EU and SADC and different changes in EU's protection policy. Differences between individual countries occur and effects are mainly due to strong model specific terms of trade effects (Lewis et al. 2000). However, the most striking welfare results seem to be explained by deteriorating net investments and, for minor degree, counter-intuitive allocation effects. With a closer look at the base data, we can see that there are negative savings for some of the countries. This is why the aggregate results are also negative.

For South Africa, simulations reveal often the adverse effects of liberalization on gdp and welfare. When gdp and activities are increasing, the simultaneous decrease in prices of exportable to importable (terms of trade) decrease and results in declining aggregate welfare. When the most beneficial scenario for South Africa in welfare terms would be pure SADC integration, the largest increase in gdp happens when South Africa integrates as a hub to the European Union and SADC is borne. The same gdp effect would realize in South Africa if some of the countries would adapt the GSP tariffs. (0.28 percent).

The effect of trade liberalization on the imports of high-tech commodities are described in the table 8. For instance, in the imports of transport equipment, where the original trade barriers are the highest, the largest increase in imports to all countries is largest in the case of wide integration (fta). The increase is smallest in the pure SADC case, where integration happens within Africa. For other countries mostly (ignoring Botswana and

[14] The applied GSP –tariffs in table 6 are modified from another study and need to be rechecked. The tariff e.g. for Botswana is incorrect as it belongs to customs union with South Africa and would not probably face GSP –tariffs if South Africa forms a free trade area with the European Union.

OSA) the increase in imports is smallest if integration happens only at the level of EU-South Africa.

In the figure 7 we have collected the levels results of some of the experiments to the domestic production of HT-industries. The actual changes are small and the only real changes happen in South Africa. Pure SADC integration will diminish the production of HT-products in South Africa whereas all the other integration patterns will increase it. In that sense the integration to global markets is justified also from the technological viewpoint. By looking at the structure of the economy we can compare the structure of value added before and after the liberalization. In the deepest integration phase, free trade area between the EU and SADC, for South Africa there is a slight increase in the value added in the production of primary products and decrease in the production of processed food and manufacturing as well as transport equipment production.

Trade creation dominates trade diversion (results not shown here) but it is clear that all these liberalization initiatives benefit EU at the expense of other developed countries.

7. Conclusions and caveats

In trading negotiations the European Union is performing as a unified trading partner. However, the relations with Southern African countries have been built by single countries and cultural factors have their role in promoting trade as well. This is reflected e.g. in the official language which is often the same as in the former host country of the colonies. These factors have also a significant role in the diffusion of technology and learning through international economic activity, especially in person-to person contacts. This feature would argue for treating single European countries as separate when analyzing the spillover effects from the EU to the Southern Africa. And if these effects can be shown to have an impact in trade liberalization, the EU is not such a homogenous trading partner any more.

The results on marginal effects of trade liberalization to the technology diffusion are quite anticipated. When the effects on aggregate level remain marginal they can not be very large at the industry level either. Also the structural changes cannot be borne from trade liberalization.

We have still a good reason to believe that not every effects are included in the basic type of cge-models and they ignore the tacit impacts of trade described in chapter 3. This calls for including new aspects into the basic model. The productivity increase through imports is one possible way. Even though the exports is shown to have more impacts on the productivity in the data in the USA (Bernard et al.) the same cannot be supposed to hold for developing countries, where the imports could play a more important role.

Integration is not only trade policy and several papers have brought this issue up. (Rodrik) In trade policy simulations we can still predict the changes in comparative advantage and patterns in trade and production. Several other defaults have to also be

taken into account. E.g. Sequential reductions in tariffs have not been taken into account, only a abrupt in this study.

The recent research on international technology diffusion still does give an encouraging message for implementing the results into the industry-level cge-models anyway. E.g. Keller (1997b, 2000) suggests that import composition might matter for technology diffusion if countries receive a relatively high share of their total imports from one particular country – such as is the case for Canada which imports about 80 % from the United States. These kind of results could well be adapted in GTAP model and have also been done in the recent working paper by Itakura et. al (2003).

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List of figures and tables:

Table 1. Country classifications used in the study

SADC (all ACP)	SADC ⊃ SACU	SADC ⊃ LDC	SADC non-LDC
Angola, Botswana, DRC, Lesotho, Malawi, Mauritius **Mozambique,** Namibia, Seychelles South Africa, Swaziland, **Tanzania, Zambia**, Zimbabwe **Bolded = LDC**	Botswana, Lesotho, Namibia, South Africa, Swaziland	Angola, Mozambique, Tanzania, Zambia	Botswana, DRC, Lesotho, Malawi, Mauritius, Namibia, Seychelles, South Africa, Swaziland, Zimbabwe

Table 2: Regional Aggregation

1	EU	European Union	
2	RSACU	Rest of SACU (Namibia, RSA)	
3	Botswana	Botswana	
4	Malawi	Malawi	
5	Mozambique	Mozambique	SADC
6	Tanzania	Tanzania	
7	Zambia	Zambia	
8	Zimbabwe	Zimbabwe	
9	OSA	Other Southern Africa (Angola & Mauritius)	
10	RSS	Rest of Sub-Saharan Africa	
11	USA	The United States	
12	JPN	Japan	
13	ASIAD	Newly Industrialized Asian countries	
14	ROW	All other regions	

Table 3: Commodity Aggregation

1	Veg	*Vegetables, fruit, nuts*	v_f	Vegetables, fruit, nuts		
2	Scb	*Sugar cane & beet*	c_b	Sugar cane, sugar beet		
3	Pfb	*Fibres*	pfb	Plant-based fibers		
4	Ocr	*Crops nec*	ocr	Crops nec		
5	Opp	*Other primary products*	pdr	Paddy rice	Oap	Animal products nec
			wht	Wheat	Rmk	Raw milk
			gro	Cereal grains nec	Wol	Wool, silk-worm cocoons
			osd	Oil seeds	For	Forestry
			ctl	Cattle,sheep,goats,horses	Fsh	Fishing
6	Ffu	*Fossile fuel*	col	Coal		
			oil	Oil		
			gas	Gas		
7	Dia	*Diamonds*	omn	Minerals nec		
8	Bov	*Bovine meat*	cmt	Meat: cattle,sheep,goats,horse		
9	Sgr	*Sugar*	sgr	Sugar		
10	Opf	*Other processed food*	omt	Meat products nec	Pcr	Processed rice
			vol	Vegetable oils and fats	Ofd	Food products nec
			mil	Dairy products	B_t	Beverages and tobacco products
11	Tcf	*Textiles industries*	tex	Textiles		
			wap	Wearing apparel		
			lea	Leather products		
12	Crp	*Chemical, rubber, plastics*	crp	Chemical, rubber, plastics		
13	Ome	*Machinery and equipment*	ome	Machinery and equipment nec		
14	Transeq	*Transport equipment*	mvh	Motor vehicles and parts	Otn	Transport equipment nec
15	Ele	*Electronic equipment*	ele	Electronic equipment		
16	Met	*Metal industries*	i_s	Ferrous metals	fmp	Metal products
			nfm	Metals nec		
17	Oind	*Other industries*	lum	Wood products	nmm	Mineral products nec
			ppp	Paper products, publishing	omf	Manufactures nec
			p_c	Petroleum, coal products		
18	Util	*Utilities*	ely	Electricity	wtr	Water
			gdt	Gas manufacture, distribution		
19	Cns	*Construction*	cns	Construction		
20	Trans	*Trade and transport*	trd	Trade	atp	Air transport
			otp	Transport nec	cmn	Communication
			wtp	Sea transport		
21	Ser	*Services*	ofi	Financial services nec	ros	Recreation and other services
			isr	Insurance	osg	PubAdmin/Defence/Health/Educat
			obs	Business services nec	dwe	Dwellings

Table 4. Exports to world markets from Southern Africa, in MioUSD 1997

	2 RSACU	3 Botswana	4 Malawi	5 Mozambique	6 Tanzania	7 Zambia	8 Zimbabwe	9 OSA
1 veg	728.9	0.1	4.2	28.3	78.4	6.9	39.9	4.3
2 scb	0.1	0	0	0	4.8	0	0	0.4
3 pfb	31.5	0.6	5.9	22.4	133.5	11.7	133.9	0
4 ocr	165.7	0	204.3	5.3	229.5	29.3	732.1	16.4
5 opp	648.9	9.2	6.6	21.8	68	10.5	105.3	24.1
6 ffu	2345.8	27.9	13.1	0	0	0.2	5	4212.7
7 dia	1518.6	2120.6	0	7.5	0.7	15.6	86.8	1
8 bov	89.8	49.3	0	1.4	1.5	0.3	32.9	0.8
9 sgr	299.8	4.1	17.9	16.7	8.6	24.4	77.8	375.6
10 opf	1028.2	21.1	3.9	92.5	110.8	4.4	77.4	160.5
11 tcf	1136.9	69.1	50.1	12.2	49	40.6	129	914.9
12 crp	2323.7	43.3	2.8	4.7	9.4	2.4	79.4	14
13 ome	2019.2	7	0.9	16.5	9.7	9.7	43	67
14 transeq	1228.4	300.8	1.5	4.7	1.2	4.7	29.6	9
15 ele	409.9	11.9	0.4	2	0.8	1.9	8.6	5.5
16 Met	11844.7	13	0.5	5.9	17.9	622.6	455.6	12.2
17 Oind	3335.1	20.7	3.2	8.2	47	27.2	188.2	483.4
18 util	395	1.9	0.5	33.7	0.4	104.4	0.8	4
19 cns	15.6	7.6	3.4	4.7	10	5.6	11.2	11.2
20 trans	3091.9	85.4	38.9	55.1	259.6	81.6	148.5	599.6
21 ser	1730.6	118.6	44.4	58	66.9	73.7	159.5	441.3
Total	34388.4	2912.2	618.5	401.5	1107.5	1077.9	2544.5	7358

Figure 5. Import tariffs for imports from HT-countries to Southern Africa

EU	**1 EU**	**2 RSACU**	**3 Botswana**	**4 Malawi**	**5 Mozambique**	**6 Tanzania**	**7 Zambia**	**8 Zimbabwe**	**9 OSA**
1 veg	0	25.6	25.6	31.9	19.1	7.9	10.9	15.6	5.6
2 scb	0	0.2	17.1	0	7.6	0	0	0	8.7
3 pfb	0	17.1	34	42.3	2.5	39.6	0.1	0	0.1
4 ocr	0	9.2	9.2	37.3	4.1	30.2	5.2	7.8	12.9
5 opp	0	24.7	23.6	15.6	2.5	19.3	8.4	6.2	1.5
6 ffu	0	0	8.3	0	3.6	1	20.1	25.7	12.1
7 dia	0	1.2	29.7	0	10	9.7	17.8	16	13.8
8 bov	0	72	72	28	5.9	26	14.4	24.3	7
9 sgr	0	86.5	86.5	4.1	7.4	9.8	20	24.2	17.5
10 opf	0	71.6	67.1	32.6	32.5	21.6	16.5	43.2	31.3
11 tcf	0	17.9	24.8	34.7	23.7	17.7	17.6	23.8	8.9
12 crp	0	5.4	24.4	10.7	11.9	15.2	10.1	12.8	21.5
13 ome	0	5.4	21.9	19.2	7.6	15.9	8.3	11	27.5
14 transeq	0	20.3	22.3	24.7	10.3	15.2	15.4	26.4	25.7
15 ele	0	1.8	20.5	30.7	13	22.8	15.3	17.4	42.9
16 Met	0	7.6	35	22.3	13	21.3	14.9	24.2	22.4
17 Oind	0	8.9	25.8	15.2	10.6	23.6	13.6	17	40.8
18 util	0	0	0	0	0	0	19.6	0	0.3
19 cns	0	0	0	0	0	0	0	0	0
20 trans	0	0	0	0	0	0	13.3	0	3.1
21 ser	0	0	0	0	0	0	8.8	11.5	7.1
Total	0	375.3	547.7	349.2	185.4	296.8	250.4	307	310.7

Bilateral tariffs from EU to country in column

USA	1 EU	2 RSACU	3 Botswana	4 Malawi	5 Mozambique	6 Tanzania	7 Zambia	8 Zimbabwe	9 OSA
1 veg	14.5	25.6	25.6	38.6	33.4	22.5	21.9	22.7	35.7
2 scb	251.4	0.2	17.1	0	7.6	0	0	0	8.7
3 pfb	0	17.1	34	42.3	0	0	0.1	0	0.1
4 ocr	3.1	9.2	9.2	0	11.6	40	5	3.2	0.1
5 opp	10.9	38.7	46.1	5.5	5.2	9.7	9.3	6.4	19.7
6 ffu	0	0	8.3	0	3.6	4.2	20.1	25.7	12.1
7 dia	0	0.4	29.7	0	3.8	17.5	0	5	0
8 bov	88.9	72	72	28	5.9	0	11.7	24.3	0
9 sgr	76.4	86.5	86.5	4.1	5.9	0	11.6	24.2	10.6
10 opf	19.3	35	63.5	1	18.5	29.7	18.1	47	14.8
11 tcf	8.8	21.6	22.3	28.5	28.7	20.1	17.6	37.8	27.3
12 crp	4.3	4.1	24.4	7.3	2.9	15.6	15.3	13.9	26.4
13 ome	2.8	5.6	21.9	18.3	5.9	12.9	8.8	10.5	26.3
14 transeq	3.3	7.8	22.3	15.3	5.9	15.7	12.2	14.6	39.9
15 ele	3.9	1.6	20.5	34.3	9.2	31.1	17.4	23.6	31.7
16 Met	2.6	5.7	63.6	22.1	10	23.5	18.2	26.7	18
17 Oind	2.7	5.5	25	23.3	25.3	27.5	17.1	26.3	31.1
18 util	0	0	0	0	0	0	19.6	0	0.2
19 cns	0	0	0	0	0	0	0	0	0
20 trans	0	0	0	0	0	0	13.3	0	2.5
21 ser	0	0	0	0	0	0	8.5	11.5	5.9
Total	492.9	336.7	592	268.6	183.4	269.9	245.9	323.6	311.1

Bilateral tariffs from the USA to country in column

JPN	1 EU	2 RSACU	3 Botswana	4 Malawi	5 Mozambique	6 Tanzania	7 Zambia	8 Zimbabwe	9 OSA
1 veg	14.5	25.6	25.6	38.6	8.2	40	21.9	22.7	13.2
2 scb	251.4	0.2	17.1	0	7.6	0	0	0	8.7
3 pfb	0	17.1	34	42.3	0	0	0.1	0	0.1
4 ocr	3.1	9.2	9.2	33.8	11.6	40	14.2	24.1	0.2
5 opp	13.4	5	32.3	7.2	4.7	13	20.9	0	0.9
6 ffu	0	0	8.3	0	3.6	4.2	20.1	25.7	11.9
7 dia	0.3	4.3	29.7	0	0	0	21	27.2	20.3
8 bov	88.9	72	72	28	5.9	8.5	11.7	24.3	12.5
9 sgr	76.4	86.5	86.5	4.1	5.9	0	11.6	24.2	10.6
10 opf	29.2	46.3	60.3	48.1	8.4	22.4	11	26.6	4.2
11 tcf	8.7	7.8	23.9	15.1	18.8	14.9	21.6	27.9	7.5
12 crp	4.9	12.5	24.4	9.9	24.3	10.1	22.2	10.8	33.4
13 ome	3.2	5	21.9	21.7	5.6	19.1	9.8	8.1	19.9
14 transeq	8.4	22	22.3	17.2	9.6	17.7	16.8	27.5	55.2
15 ele	4.5	1.6	20.5	37	7.5	20.5	20.1	21.7	47.4
16 Met	4	6.1	74	12.7	11	18.5	15.2	22.2	27.4
17 Oind	3.7	7	24	14.4	16.1	21.2	14.3	9	29.4
18 util	0	0	0	0	0	0	19.6	0	0
19 cns	0	0	0	0	0	0	0	0	0
20 trans	0	0	0	0	0	0	13.3	0	2.7
21 ser	0	0	0	0	0	0	8.4	11.5	5.8
Total	514.6	328.1	585.9	330.1	149	250.1	294	313.8	311.2

Bilateral tariffs from Japan to country in column

ASIAD	1 EU	2 RSACU	3 Botswana	4 Malawi	5 Mozambique	6 Tanzania	7 Zambia	8 Zimbabwe	9 OSA
1 veg	14.5	25.6	25.6	38.6	8.2	29.5	21.9	22	14.7
2 scb	251.4	0.2	17.1	0	7.6	0	0	0	8.7
3 pfb	0	17.1	34	42.1	0	0	0.1	0	0.1
4 ocr	3.1	9.2	9.2	33.5	11.6	10.9	14.2	7.5	18.8
5 opp	11.4	3.8	17.5	8.9	15.1	6.4	17.1	8	15.3
6 ffu	0	0	8.3	0	3.6	4.2	20.1	25.7	12.1
7 dia	0	4.2	29.7	0	3.8	24.5	21	27.2	20
8 bov	88.9	72	72	28	5.9	36	11.7	24.3	12.5
9 sgr	76.4	86.5	86.5	4.1	5.3	30	11.6	24.2	10.6
10 opf	26.3	45.1	58.4	43.9	25.1	25	14.9	30.4	24
11 tcf	10.6	23.7	24.6	36.1	34	16.7	22.2	37.7	12.6
12 crp	5	5.7	24.4	25.1	16.1	18.5	11.3	13.2	28.8
13 ome	3.7	7.6	21.9	26.2	13.7	16.5	10.4	20.3	35.2
14 transeq	6.4	22.8	22.3	32.2	23.3	13.3	17.1	28	40.7
15 ele	4.2	3.4	20.5	37.6	32.7	27.8	24.6	52.8	34.7
16 Met	3.9	8.1	55	26.8	28.2	23.2	16.6	24.3	46.5
17 Oind	4.4	10.2	24.5	6.8	14.9	25.4	5.9	20.1	33
18 util	0	0	0	0	0	0	19.6	0	0.3
19 cns	0	0	0	0	0	0	0	0	0
20 trans	0	0	0	0	0	0	13.3	0	3.8
21 ser	0	0	0	0	0	0	9.8	11.5	7.9
Total	510.1	345.2	551.4	390	249.3	307.9	283.5	377.3	380.4

Bilateral tariffs from ASIAD to country in column

Figure 1: Sources of imports in R&D-industries in SADC

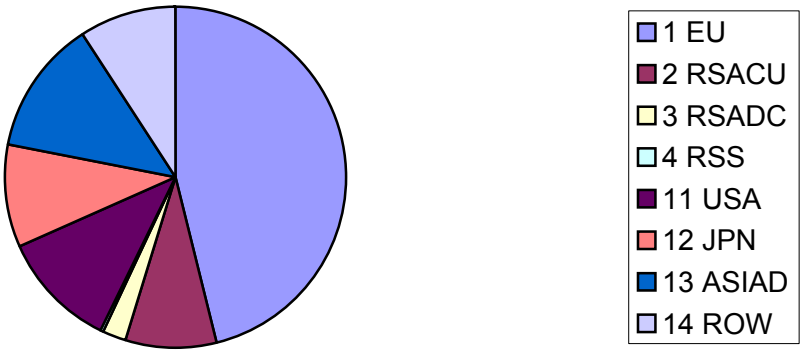

Figure 2:Sources of Imports of R&D-industries in SADC excl. South Africa

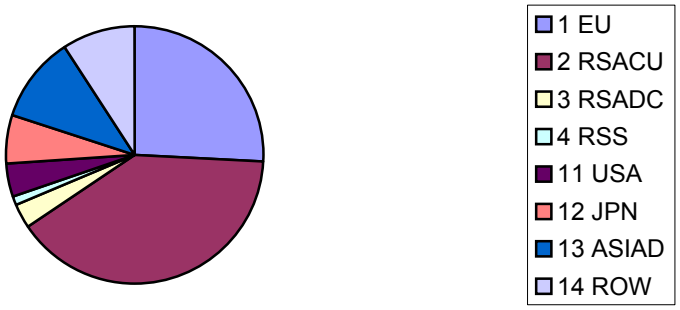

Figure 4. Domestic HT-production vs. income level

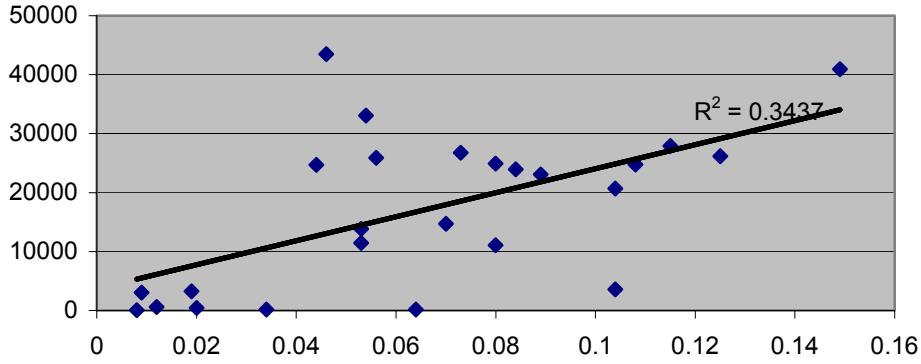

Figure 3. Utilization of HT-products vs. income level

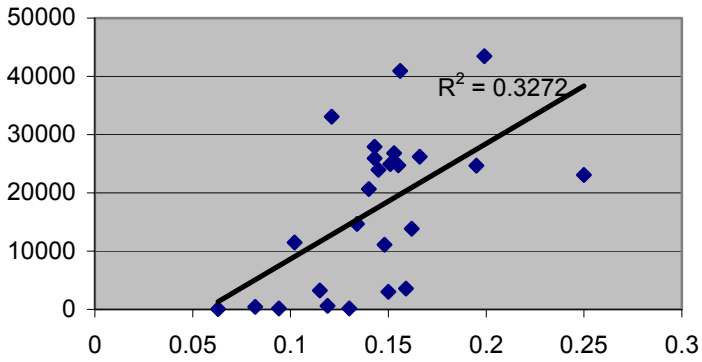

Figure 5. Imports of HT-products vs. income level

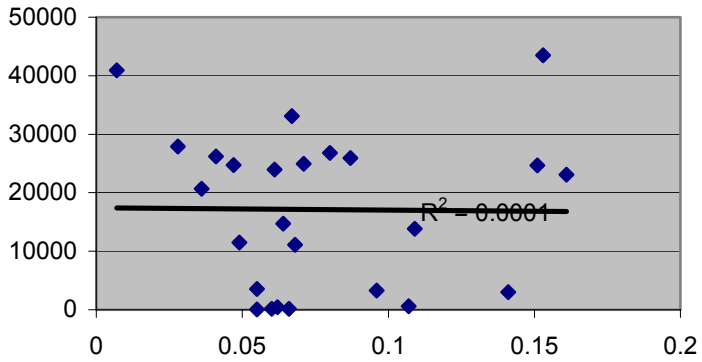

Table 6. Applied GSP –tariffs (source UNCTAD, Janne Niemi's calculations)

	1 EU	2 RSACU	3 Botswana	4 Malawi	5 Mozambique	6 Tanzania	7 Zambia	8 Zimbabwe	9 OSA
1 veg								3.8	1.4
2 scb									
3 pfb									
4 ocr								2.8	2.8
5 opp				6.2				9.7	9.7
6 ffu				0.5				0.5	0.5
7 dia									
8 bov									
9 sgr									
10 opf				8.3				12.3	9.1
11 tcf			7.9	5.0				7.4	3.6
12 crp				4.2				4.2	4.2
13 ome				0.5				3.8	2.2
14 transeq				1.0				1.0	1.4
15 ele									
16 Met				2.0				4.3	4.2
17 Oind				2.1				2.1	3.0
18 util									
19 cns									
20 trans									
21 ser									

Table7 Aggregate Results

Qgdp	SAEU	SAHUB	EUHUB	FTA	SADC	FGSP	GSP
EU	0	0	0	0	0	0	0
RSACU	0.18	0.28	0.15	0.23	0.1	0.28	0
Botswana	-0.29	0.51	0.05	0.82	0.81	0.53	0.03
Malawi	0.02	0.11	-0.05	0.3	0.15	0.11	0
Mozambique	0.07	0.02	-0.01	0.16	0	0.02	0
Tanzania	0	-0.09	-0.27	-0.19	-0.04	-0.09	0
Zambia	0	-0.07	-0.12	-0.07	-0.02	-0.08	0
Zimbabwe	0.01	0.42	-0.37	0.64	0.52	0.32	-0.16
OSA	0.01	-0.45	-0.15	0.1	-0.4	-0.62	-0.17

EV	SAEU	SAHUB	EUHUB	FTA	SADC	FGSP	GSP
EU	1101	900	1764	1534	-237	994	96
RSACU	-285	211	-455	-92	483	199	-5
Botswana	0	31	36	70	31	33	2
Malawi	3	23	2	30	25	23	-1
Mozambique	14	15	-5	13	3	15	1
Tanzania	1	-8	-98	-86	0	-9	0
Zambia	7	4	0	4	0	4	0
Zimbabwe	3	88	-84	75	128	41	-58
OSA	4	-24	72	131	-31	-87	-65

Tot	SAEU	SAHUB	EUHUB	FTA	SADC	FGSP	GSP
EU	0.05	0.04	0.07	0.06	-0.01	0.04	0
RSACU	-1.59	-0.59	-1.94	-1.22	1.01	-0.62	-0.01
Botswana	0.47	0.03	0.36	0.14	-0.41	0.06	0.02
Malawi	0.36	2.73	0.11	2.72	2.8	2.65	-0.09
Mozambique	1.36	2.44	0.05	2.04	1.1	2.48	0.07
Tanzania	0.03	0.66	-1.85	-0.92	0.92	0.63	-0.01
Zambia	0.6	0.43	0.25	0.28	-0.18	0.43	0.01
Zimbabwe	0.08	2.09	-1.08	1.45	2.96	0.99	-1.34
OSA	0.05	-0.03	-1.12	-1.02	-0.2	-0.75	-0.73

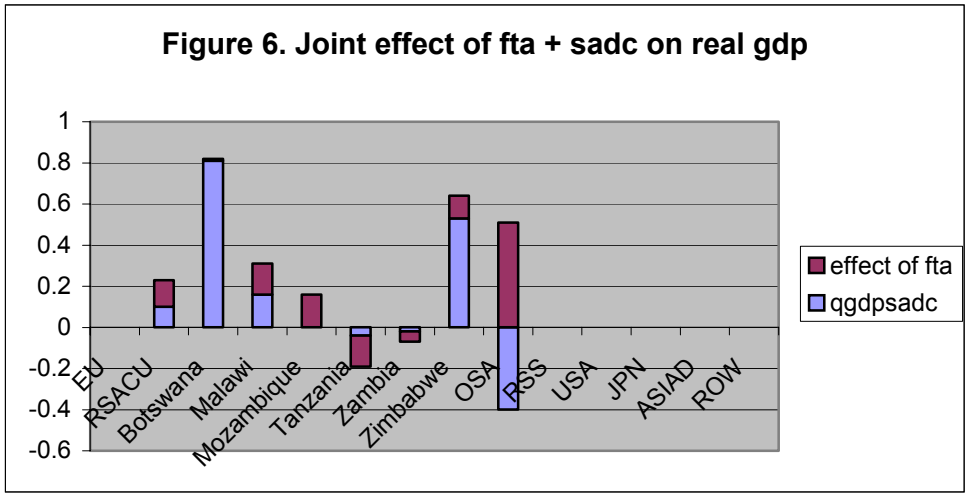

Table 8. Effect of scenarios to imports of Ht-products in Southern African countries

Saeu	EU	RSACU	Botswana	Malawi	Mozambique	Tanzania	Zambia	Zimbabwe
Crp	0.04	1.54	-3.41	0.99	1.2	0.17	0.12	0.18
ome	0.05	2.84	-0.99	0.62	1.35	0.01	0.94	-0.02
transeq	0.16	**28.5**	0.03	0.87	1.58	0.02	1.64	0.24
ele	0.04	1.34	0.01	0.81	1.69	0.01	0.98	-0.06
Sacf								
Crp	0.03	3.43	-0.89	14.68	6.97	3.51	1.25	0.58
ome	0.04	5.44	0.4	13.31	8.36	1.99	9	8.92
transeq	0.14	34.78	1.05	24.41	8.03	1.74	14.7	12.55
ele	0.03	3.6	1.15	25.77	8.86	2.21	11.61	11.01
Euhub								
Crp	0.05	0.94	-3	4.33	1.55	3.07	0.62	1.5
ome	0.08	1.96	2.47	7.31	3.57	3.46	4.88	1.88
transeq	0.22	26.53	3.65	11.48	2.63	5.29	6.98	4.15
ele	0.08	0.53	3.55	13.33	4.19	3.89	8.79	2.62
Fta								
Crp	0.05	2.48	-0.41	18.08	7.91	6.52	1.7	1.5
ome	0.07	3.86	3.9	17.31	10.74	5.38	12.23	10.25
transeq	0.19	30.79	4.73	30.38	9.21	6.92	18.47	14.12
ele	0.06	2.17	4.72	33.52	11.66	6.03	18.31	13.01
Sadc								
Crp	-0.01	1.86	3.22	14.46	5.81	3.51	1.07	-0.43
ome	-0.02	2.55	1.67	12.88	7.17	2.18	7.97	9.8
transeq	-0.03	5.61	1.11	24.4	6.67	1.94	12.58	13.27
ele	-0.01	2.23	1.24	25.86	7.3	2.41	10.46	12.22
Fgsp								
Crp	0.03	3.38	-0.81	14.66	6.99	3.51	1.22	0.52
ome	0.04	5.37	0.45	13.24	8.42	1.97	9.03	7.98
transeq	0.14	34.65	1.11	24.28	8.08	1.71	14.71	11.38
ele	0.03	3.55	1.22	25.59	8.92	2.18	11.63	9.86
Gsp								
Crp	0	-0.03	0.05	-0.02	0.03	0	-0.03	0.07
ome	0	-0.03	0.01	-0.07	0.08	-0.01	0.03	-1.25
transeq	0	-0.06	0.03	-0.16	0.07	-0.01	0	-1.63
ele	0	-0.02	0.04	-0.22	0.09	-0.01	0.01	-1.54

Figure 7. Difference to base data in domestic production (for domestic use) in R&D-industries