UNDERSTANDING THE DETERMINANTS OF INTERNATIONAL TRADE IN AFRICAN COUNTRIES: AN EMPIRICAL ANALYSIS FOR GHANA AND SOUTH AFRICA

LAURA MÁRQUEZ-RAMOS[1]

Universitat Jaume I

Instituto de Economía Internacional

ABSTRACT

There are clear economic differences between developed and developing countries that lead to a different behaviour among them in the determinants of bilateral trade flows. Although a number of authors have focused on the determinants of the trade patterns, further research is needed for a better understanding of what goods and with which countries developed and developing economies trade. This paper focuses on the determinants of international trade in African countries. From an empirical perspective, two African economies, a developed (South Africa) and a developing country (Ghana) are analysed. Moreover, sector-heterogeneity is considered. Results show that determinants of trade have a different impact in developed and developing African countries. Geographical and social factors play a key role on trade relationships in South Africa. Moreover, technological innovation in importer countries leads to higher exports from this country. However, Ghana's exports are higher when they are addressed to countries with higher levels of economic freedom.

Keywords: International trade, gravity equation, heterogeneity

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1. INTRODUCTION

World trade has experienced an important increase in the last decades. Feenstra (1998) suggest several factors that explain this growth: Falling transport costs, trade liberalisation, economic convergence of countries and the increase of intermediate goods trade. In the same line, Baier and Bergstrand (2001) analyse what factors account for the growth of trade. Their results show that income growth, tariff rate reductions and lower transport costs have contributed to the growth of world trade. According to these authors, income growth explains 67% of the growth of trade, tariff reductions 25% and transport cost reductions 8%. These authors only use 16 OECD countries in the empirical analysis, and all of them are high-income countries. However, developed and developing countries face different economic characteristics and those play a different role in the growth of international trade.

The main aim of this paper is to investigate the differences existing between two African economies, a developed (South Africa) and a developing country (Ghana), concerning the pattern and the direction of international trade flows to deal with three main questions: what goods, with which countries and how much these countries trade (Deardorff, 1984).

The gravity model of trade is the empirical methodology most commonly used to analyse international trade flows determinants. When investigating why gravity works so well, Harrigan (2001) differentiates two types of studies: aggregate and disaggregate. Whereas this approach works well with aggregated data, it performs worse with disaggregated data. According to Frankel (2000) it is desirable to disaggregate to get a better estimate since too much emphasis is not put on individual estimates that may be exposed to

estimation error. Additionally, heterogeneity issues should be considered when analysing international trade patterns since determinants of international trade flows may differ across both countries and industries. From a gravity context, several authors have analysed whether there are different trade patterns for developed and developing countries (Loungani, Mody and Razin, 2002; Martínez-Zarzoso and Márquez-Ramos, 2005). Sector-heterogeneity has also been taken into account in gravity (Rauch, 1999; Tang, 2006).

In Section 2 special attention is paid to heterogeneity issues in the main determinants of international trade. Two types of heterogeneity are differentiated: country-heterogeneity and sector-heterogeneity. In Section 3 data, sources and variables are described. Section 4 presents the model specification to be estimated. In Section 5 an index measuring the intensity of exports of countries is used in a preliminary analysis to show the main determinants that foster that Ghana and South Africa trade with specific partners. Moreover, the empirical estimation is carried out for exports from Ghana and South Africa to 167 importer countries. At last, Section 6 presents conclusions and it discusses socio-economic implications of the estimated results.

2. THE GRAVITY MODEL OF BILATERAL TRADE

Aggregated versus disaggregated data

The gravity model has been the empirical workforce to analyse the determinants of bilateral trade flows. The first authors to apply the gravity model to international trade flows were Tinbergen (1962) and Pöyhönen (1963). This model, in its basic form, assumes that trade between countries can be compared to the gravitational force between two objects: it is directly related to countries' size and inversely related to the distance

between them. Exports from country *i* to country *j* are explained by their economic sizes, their populations, direct geographical distances and a set of dummies incorporating some characteristics common to specific flows. Theoretical support for the research in this field was originally very poor but since the second half of the 1970s several theoretical developments have appeared in support of the gravity model (Anderson, 1979; Bergstrand, 1985 and 1989; Helpman and Krugman, 1996; Deardorff, 1995).

In relation to why does gravity work, Harrigan (2001) discriminates between aggregated and disaggregated studies. This author states that "most of the evidence that gravity works comes from aggregated data (…) it is surprising how little work has been done on examining disaggregated gravity equations".[1] Two attempts that analyse disaggregated gravity equations are Feenstra, Markusen and Rose (2001) and Haveman and Hummels (2004).

Haveman and Hummels (2004) state that common elements contributing to theoretical foundation in gravity models (Anderson, 1979; Bergstrand, 1985) are complete specialisation and identical preferences, where each good is produced only in one country and consumers value variety, then importing all goods that are produced. In a world with two countries, one can still use these models to make clear predictions about bilateral trade patterns. However, in a multi-country world, these models say little about the pattern of bilateral trade other than predicting the set of partners with which a country trade. This does not mean that it is impossible to distinguish the sources of specialisation. Feenstra et al. (2001) show that theories of specialisation can be distinguished since elasticities of income in gravity equations should be different depending on whether or not there are entry barriers.

[1] Harrigan, 2001, page 41.

Haveman and Hummels (2004) examine a model with incomplete specialisation (multiple countries may produce each homogeneous good), where much lower trade volumes than in the case of complete specialisation are expected. These authors analyse a dataset of bilateral trade flows at the 4-SITC level and they show that countries do not buy all available goods. Therefore, a large number of zero observations and that the volume of trade is less than predicted at a sectoral level is a problem that makes that gravity model does not work as well in disaggregated analysis as it works in aggregated analysis.

Country-heterogeneity issues

There are clear economic differences between developed and developing countries that lead to a different behaviour among them in the determinants of bilateral trade flows. Many developing countries have important economic vulnerabilities, such as debt-related, high unemployment and inflation rates, poverty and unequal income distribution. Moreover, developing economies are characterised by higher levels of trade protection than developed countries and a number of them remain dependent on foreign aid. Then, the pooling assumption may be rejected in a sample of countries with different levels of economic development, since the determinants of trade may have different coefficients for high and low-income countries.

Traditionally, only a few studies have attempted to identify the differential impact of the determinants of trade on various groups of countries (Balassa, 1979; Baldwin, 1979) and some of them have focused on the different impact of trade policies on economic growth, then explaining the existing dispersion in growth rates among countries (Kawai, 1994).

In the last years, studies considering country-heterogeneity have proliferated and a number of authors have considered the existence of different trade patterns for developed

and developing countries from a gravity framework (Loungani et al., 2002; Martínez-Zarzoso and Márquez-Ramos, 2005). Other studies focus on the heterogeneity in specific variables, for instance, Filippini and Molini (2003) show that the elasticity of demographic variables have different signs and magnitudes in developed and developing countries.

Sector-heterogeneity issues

Heterogeneity in products also matters. Feenstra et al. (2001) find that different estimates of the gravity equation pertain to types of goods, rather than being features of countries. However, these authors run gravity regressions in two groups of countries, exports within the OECD and exports between OPEC and non-OPEC countries, then country-heterogeneity (at least not by level of development) is not really analysed since in the former sample they are considering exports of goods from developed countries to developed countries and, in the latter sample, they are considering exports from countries heavily resource dependent.

Harrigan (1993) analyses the effect of trade barriers, transport costs, tariff and non-tariff barriers on OECD imports in 1983 bilateral data for different manufacturing industries. Results show that there is a great heterogeneity across industries.

A classification that has been used broadly in the literature to deal with sector-heterogeneity is the classification introduced by Rauch (1999). Other empirical studies such as Feenstra et al. (2001), Tang (2006) and Giuliano, Spilimbergo and Tonon (2006) apply this classification.

Rauch (1999) classifies products in three groups: goods traded on an organized exchange (homogeneous goods), reference-priced and differentiated products. In a more recent

paper, Tang (2006) analyses the major contributions to growth of trade in differentiated goods. The author finds that income growth and technological factors are the major contributors to the growth of trade in differentiated products and that the impact of information technology is higher for exports of differentiated goods from developing countries to the United States.

3. STYLISED FACTS OF THE DETERMINANTS OF INTERNATIONAL TRADE

Trade costs: tariffs and transport costs

Trends towards geographical regionalisation and globalisation have led to the decreasing role of tariff barriers as an influencing factor on trade (see Figure A.1 in Appendix), then the relative importance of transport costs has increased, and these costs have become a relevant determinant of trade patterns. Figure A.2 (Appendix) shows the tendency of decreasing evolution line of maritime transport costs to decrease. This evolution line can be compared with the steeper decreasing slope displayed in the tariff evolution graph. Depending on the continent, transport costs vary range between an 8% and a 13% of the import values.

Despite their importance, few studies have focussed on transport costs, and existing research has mainly been carried out at an aggregate level. In fact, a wide range of articles considers only proxies for transport costs in their estimated models. For instance, gravity models use distance between country capital cities as a proxy for transport costs.

In relation to trade barriers, Lee and Swagel (1997) use disaggregated cross-country, cross-industry data of manufactured goods in 1988. These authors measure levels of protection by country and industry and find that tariff and non-tariff barriers differ from

one sector to another, and in general both of them are found to be lower between developed countries. The higher tariff levels in developing countries may reflect the greater importance of tariff revenue in government finance. Their measures of protection by industry indicate that antidumping practices and other non-tariff barriers apply overall to trade on sensitive commodities (food products, beverages, textiles, apparel, iron and steel). Lee and Swagel (1997) have only data on total imports and exports for each country and their results indicate that trade barriers have a negative effect on imports, although there is not conclusive evidence of the relative importance of tariffs and non-tariff barriers on trade. Using a different framework, Leamer (1990) finds that both tariffs and non-tariff barriers have a large import-reducing effect. In contrast, Harrigan (1993) finds that tariffs are a more substantial barrier to trade in manufactures between developed countries than non-tariff barriers using bilateral trade data. Recently, Anderson and van Wincoop (2004) point out that the use of non-tariff barriers is concentrated in a few sectors in 1999 (food products, textiles, apparel, timber and other manufactures).

Then, the impact of tariffs in the analysis of trade determinants is ambiguous. On the one hand, relatively high foreign tariffs would be associated with lower exports for an industry. In this case, tariffs increase costs and reduce trade. On the other hand, high foreign tariffs might be a response to countries competition, indicating industries in which a country is comparatively strong. In what follows, the role of tariff barriers is studied more deeply from an empirical point of view.

Tang (2006) includes tariffs and transport costs measures in a gravity framework. Tariffs are measured as the effective tariff rate that the United States charges on imports from the exporter country for product group k and transport costs are measured as the total freight

cost as a percentage of import value for product group k from the exporter country to the United States. Results show the expected ambiguous effect of tariffs on trade. For differentiated goods, tariffs have a positive effect on the US imports, then US tariffs might be a response to countries competition, indicating that US is comparatively strong in differentiated goods. For reference-priced and homogeneous goods, tariffs have a negative effect on the US imports, then relatively high US tariffs are associated with lower imports for these industries. Fink, Mattoo and Neagu (2005) also find that tariffs have a negative impact on trade for reference-priced and homogeneous goods, however, tariff variable is not statistically different from zero in the case of differentiated goods. The reason could be that tariffs are in general low for differentiated products.

In relation to transport costs, Tang (2006) shows that transport costs have a higher effect on trade for homogeneous goods. This result is also obtained in other studies considering sector-heterogeneity such as Giuliano et al. (2006), in line with the idea that homogeneous goods are on average heavier and more costly to move than other goods (Rauch, 1999) and that differentiated products generally have higher value-to-size or value-to-weight ratios, and thus they should be less affected by transport costs (Huang, 2007).

Geography and the role of distance

The negative correlation between geographical distance and bilateral trade volumes is one of the most robust empirical findings in economics (Leamer and Levinsohn, 1995). However, it is still unclear exactly what information is embodied in the distance coefficients that are estimated in gravity regressions. Filippini and Molini (2003) state that "distance is much more than geography: it is history, culture, language, social

relations and many other things".[1] In recent studies, a number of authors have contributed to the debate on the interpretation of distance effects. Factors such as informational costs, tastes and preferences, and unfamiliarity have been considered. Loungani et al. (2002) show that distance involves more than just transport costs and that informational cost may be behind the impact of distance on trade. Blum and Goldfarb (2006) find that distance is a good proxy for differences in tastes and preferences. Their results provide a new explanation for the persistence effect of distance in gravity regressions. This suggests that the distance effect in gravity will persist for a number of products even if transport costs, search costs and other trade barriers associated with distance are reduced to zero, which is the case to some extent for Internet trade. For the distance effect to disappear there needs to be a homogenisation of cultures. Huang (2007) shows that unfamiliarity can explain part of the negative correlation between geographical distance and bilateral trade volumes. This author shows that higher uncertainty-aversion leads to lower trade flows to distant partners than gravity models predict. However, the author's interpretation of the distance coefficient (i.e. higher negative coefficients in the distance variable are interpreted as meaning that trade is less likely to take place with foreign countries that are far away) could be misleading. According to Buch, Kleinert and Toubal (2004) and Márquez-Ramos, Martínez-Zarzoso and Suárez-Burguet (2007), the magnitude and sign of the distance coefficient are related to the importance of bilateral activities with partners that are far away relative to those that are located nearby. Moreover, the coefficient of distance may differ among developed and developing countries. They show that when controlling for country-heterogeneity the distance coefficient decreased by 13.55% for developed countries and increased by 29.7% for developing countries over the period

[1] Filippini and Molini, 2003, page 699.

1980-1999. The authors classify each group of countries according to the different scenarios outlined by Buch et al. (2004). Developing countries can be placed in the scenario where distance costs decrease non-proportionally and the decrease is greater for smaller distances since the magnitude of the distance coefficient increased over the period 1980-1999, whereas developed countries can be placed in the scenario where the distance costs decrease non-proportionally and the decrease is smaller for smaller distances since the magnitude of the distance coefficient decreased over the same period 1980-1999. For developing countries, export flows for small distances increase over time, whereas export flows for large distances decrease over time, and therefore trade with far-away countries decreases in relation to trade with nearby countries. The opposite applies to developed countries.

Heterogeneity in products also matters in distance. Rauch (1999) finds that proximity (when adjusted with distance effects and with transportability), is more important for differentiated products. A possible reason may be that incomplete information matters since differentiated products tend to be less traded because there is less demand for them outside the country in which they are produced. This result is opposite to Fink et al (2005) who find that distance coefficient is lower in absolute value for differentiated products.

Technological innovation

International trade theory highlights the importance of technological innovation in explaining the international competitiveness of a country (Fagerberg et al., 1997). Recently, Freund and Weinhold (2004) justify the inclusion of Internet variables in a bilateral trade model. Additionally, empirical applications show that heterogeneity

matters in technological innovation. Loungani et al. (2002) distinguish between developed and developing countries when analysing whether better information can substitute for geographical distance. Their results point towards the existence of country-heterogeneity in the different determinants of international trade since they show that technological innovation is a "substitute" of distance in developing countries (better information decreases the effect of distance), whereas technological innovation and distance are "complementary" in developed countries (better information magnifies the effect of distance). This may occur when trade in differentiated products dominates and that physical proximity and high information technology reinforces each other in fostering trade. Developing countries can overcome the disadvantage of distance by investing in technological innovation. This result is in the same line that Freund and Weinhold (2004) who show the importance of new technologies on trade as measured by Internet hosts.

Martínez-Zarzoso and Márquez-Ramos (2005) divide the countries in a 62-country sample according to their level of economic development: high-income, medium-income and low-income countries. Technological endowments have a higher effect on trade in developing economies. Moreover, Tang´s result (2006) that the impact of information technology is higher for exports of differentiated goods from developing countries. Technological variables are therefore of great importance to increase the participation of the poorest economies in the world economy.

Fink et al. (2005) analyse the effect of communication costs on bilateral trade flows taking into account sector-heterogeneity. Their results show that communication costs have a significant effect on international trade and that they are of greater importance for

trade in differentiated products than for trade in homogeneous products. In this line, Tang (2006) analyses the contribution of technological innovation to the growth of the United States imports. This author finds that technological innovation has a higher effect on the growth of trade in differentiated goods than in the growth of trade in referenced and homogeneous goods in the past two decades.

Language and colonial ties as measures of cultural similarities

A number of international trade studies focus on the effect of countries sharing a language (Frankel, Stein and Wei, 1998; Helliwell, 1999). Among them, Helliwell (1999) explores the economics of language in 22 OECD-contries and 11 developing countries. The author finds that the general common language effect seems to be driven by the role of English. The other languages analysed, German, French and Spanish, are not found significant in the empirical regressions.

Country-heterogeneity in language is found by Guo (2004). This author shows that language influences on trade are more significant in China (a developing country) than in the United States (a developed country).

Rauch (1999) finds that sector-heterogeneity matters in language and colonial ties. These variables are more important for differentiated products. The reasons could be that incomplete information matters since differentiated products tend to be less traded because there is less demand for them outside the country in which they are produced, and similarity of foreign preferences since trade in differentiated products increases with links. The author argues that this result supposes that "firms develop their varieties of differentiated products to suit niches in their home markets. We suppose further that they do this (…) because positive transportation costs make this the best decision, ceteris

paribus. This could explain why differentiated products tend to be less traded: there is less demand for them outside the country in which they are produced".[1]

Regionalism versus Multilateralism

Regional integration agreement (RIA) dummies are frequently included in gravity models of trade. A positive coefficient means that countries engaged in an integration agreement trade more.

RIAs have a differential effect in differentiated, reference-priced and homogeneous sectors. Feenstra et al. (2001) show that Free Trade Agreements have a lower effect over time on trade flows in differentiated and reference-priced goods, whereas they have a higher effect on trade flows in homogeneous goods. However, the effect is higher for differentiated goods. Rauch (1999) shows evidence of a differential impact by sectors of European Community and European Free Trade Association. Tang (2006) shows evidence that NAFTA has different impact on the United States imports. NAFTA seems to have a higher positive effect on trade among members for differentiated than for homogeneous goods.[2]

In relation to multilateralism, Rose (2004) investigates whether the World Trade Organisation (WTO) and its predecessor the General Agreement on Tariffs and Trade (GATT) have promoted trade. Results show that membership in the GATT/WTO does not have a significant effect on trade. The author states "perhaps this is because many countries extend most-favoured-nation status to outsiders even though they are not obligated to do so; perhaps GATT/WTO membership has not forced developing countries

[1] Rauch, 1999, page 31.
[2] Although this result is not conclusive since when OLS is estimated with time effect, the effect of NAFTA is higher for trade in homogeneous than for differentiated goods.

to change trade policy substantially; perhaps there is some other reason".[1] This author points out that decomposing trade by industry may be interesting since the multilateral trade system has been less successful at liberalising trade in exempted sectors such as agriculture and textiles.

Subramanian and Wei (2005) show that GATT/WTO promotes trade, although they identify four asymmetries: developed versus developing country members; new versus old developing country members; imports of members from other members versus imports from non-members; liberalised versus exempted (highly protected) sectors. Industrial country WTO members are more open than developing countries WTO members; new members in WTO are more open than old members and the obligations to liberalise in the old WTO members have not become stringent enough to actually lead them to be more open than non-WTO members; non-members do not seem to benefit equally from the liberalisation than member countries under the WTO (imports from WTO members are greater than from non-members). These authors differentiate among two types of discrimination: explicit discrimination, barriers are higher against imports from non-WTO members than from WTO members; and *de facto* discrimination, barriers are higher on products of greater interest to non-members because these products have not been the subject of reciprocity negotiations in the WTO. Finally, the positive effect of WTO is higher in more liberalised sectors and the magnitude of the coefficient on WTO decreases over time, thus showing partial evidence of the decreasing effect of trade multilateralism on international trade flows.

4. DATA, SOURCES AND VARIABLES

[1] Rose, 2004, page 112.

In this paper, two African countries are selected for the empirical analysis: a low-income (Ghana) and a medium-income economy (South Africa). Different socio-economic and geographical factors characterise these countries.

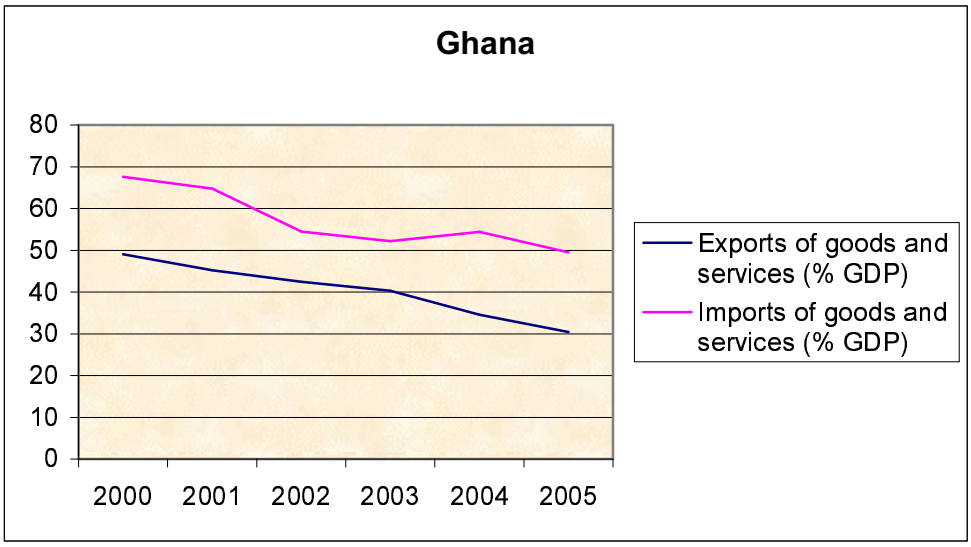
Ghana is characterised because it is well endowed with natural resources and it has approximately twice the per capita output of the poorer countries in West Africa. Even so, the 31.4% of population are below the poverty line and Ghana remains heavily dependent on international financial and technical assistance. Gold, timber, and cocoa production are major sources of foreign exchange. The domestic economy continues to revolve around subsistence agriculture. Priorities include tighter monetary and fiscal policies, accelerated privatization, and improvement of social services. Inflation should ease but remains a major internal problem.

South Africa has undergone a remarkable transformation since its democratic transition in 1994. It is an emerging market with an abundant supply of natural resources; well-developed financial, legal, communications, energy, and transport sectors; it has a modern infrastructure supporting an efficient distribution of goods to major urban centres throughout the region. However, growth has not been strong enough to lower South Africa's high unemployment rate (GDP per capita grew at an average of 1.2 per cent per year since 1994 and the unemployment rate is 26.6%). High unemployment and low growth may be the result of the divestment of the non-mineral tradable sector since the 1990s, then South Africa has been deprived from growth opportunities that other countries have experienced (Rodrik, 2006).

Economic problems such as poverty remain from the apartheid era (the population below the poverty line is 50%). South African economic policy focuses on targeting inflation and liberalising trade as means to increase job growth and household income.

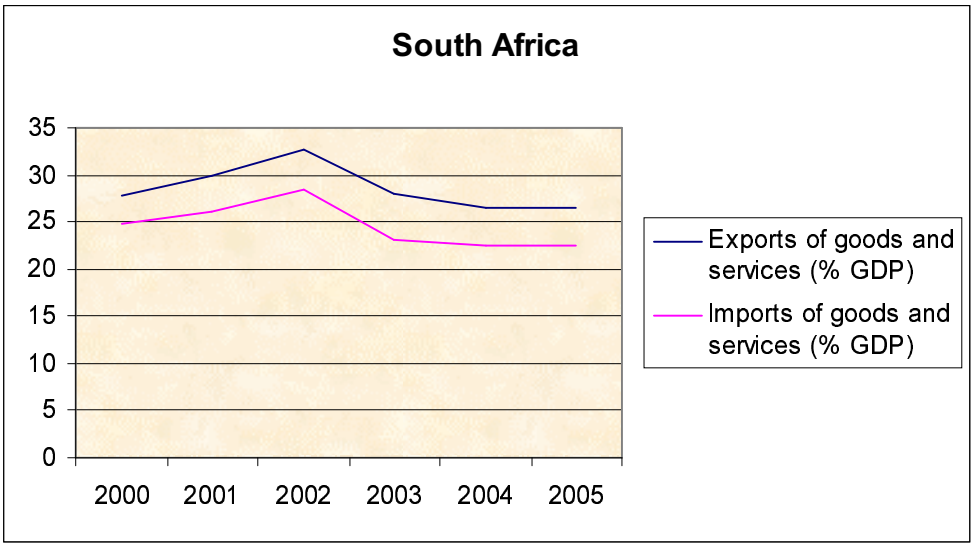
Figure 1 and 2 show the evolution over time of aggregated exports and imports of goods and services for Ghana and South Africa, respectively. A decreasing tendency on trade flows is observed from the year 2000 for the case of Ghana and also in South Africa from 2002 onwards. Ghana imports more goods and services than exports. South Africa shows the opposite trade pattern.

Figure 1



Source: WDI online (2006)

Figure 2



Source: WDI online (2006)

In order to analyse what are the main determinants of international trade in these two African economies, bilateral trade data by commodity from Feenstra, Lipsey, Deng, Ma and Mo (2005) are used. The level of disaggregating is the 4-digit Standard International Trade Classification (SITC), revision 2. These data are used to construct revealed comparative advantage indices to determine countries' specialisation in Ghana and South Africa in the year 2000. In the empirical analysis, the determinants of exports from Ghana and South Africa to 167 importer countries are analysed (see Table A.1, Appendix).

Revealed Comparative Advantage

The revealed comparative advantage (RCA) is calculated according to Balassa (1965) measure of relative export performance by country and industry, defined as country's share of world exports of a good divided by its share of total world exports, as expressed in equation (1):

$$RCA_{ik} = \frac{X_{ik} / X_{wk}}{X_{iN} / X_{wN}} \cdot 100 \qquad (1)$$

where RCA_{ik} is the revealed comparative advantage index of commodity k for country i. X_{ik} is the value of exports of commodity k by country i, X_{wk} is the value of exports of commodity k from the world, X_{iN} is the value of exports of all commodities by country i and X_{wN} is the value of exports of all commodities from the world. A ranking of the 10 industries that rank first the higher positive value of the RCA is constructed for Ghana and South Africa and Rauch classification is used to determine if countries are specialised in goods traded on an organised exchange (homogeneous), reference-priced or differentiated goods (Rauch, 1999). Table A.2 in Appendix list the codes of the sectors used in the final sample, which includes 146 sectors with homogeneous goods, 349 sectors with reference-priced goods, and 694 sectors with differentiated goods.

According to equation (1), country i has a comparative advantage in exporting commodity k when RCA_{ik} is greater than 1. Table A.3[1] in Appendix shows the main sectors in which Ghana and South Africa are specialised. Specialisation in referenced products seems to be the most common pattern for the African countries considered in this study.

Two types of data are used in the sectoral analysis. Those that vary across countries and those that vary across sectors. On the one hand, incomes, incomes per capita, transport costs, trade imbalance, technological innovation, economic freedom, geographical, cultural and integration dummies are those variables incorporating country-variability. On the other hand, tariffs, high-technology and sectoral dummies are those incorporating

[1] Table A.3 in Appendix. The second column lists the ranking of the ten industries in which each country is highly specialised; the third column outlines a description of the sectors, and the fourth column shows the corresponding Rauch conservative classification (1999).

sector-variability. Then, different data bases are used to construct the variables for the regression analysis: World Development Indicators (2005) for incomes and incomes per capita, World Integrated Trade Solution (WITS) for tariffs, and Doing Business (2006) database for transport costs, recently elaborated by the World Bank and that compiles procedural requirements for exporting and importing a standardized cargo of goods. The GATT/WTO accession dates for countries entering until 2000 are obtained from the WTO webpage. Distance between capitals, common official language and colony dummies are obtained from the dataset constructed by CEPII.[1] The data of the Index of Economic Freedom are obtained from The Heritage Foundation webpage.

International trade flows are heavily imbalanced between areas. This disequilibrium applies both to general world trade and to containerised seaborne trade. The divergence associated with the sign of trade imbalance occurs as a result of the freight rate price fixing mechanisms applying in the liner market. The liner company knows that on one of the legs of the turnaround trip, the percentage of vessel capacity utilisation will be lower, and therefore adapts its pricing scheme to the direction of the trip and its corresponding expected cargo. Freight rates will be higher for the shipments transported on the leg of the trip with more traffic, as the total amount charged for this leg must compensate the relatively reduced income from the return trip, when part of the vessel's capacity will inevitably be taken up with repositioned empty containers. Excess capacity on the return trip will increase the competition between the various liner services, and as a result freight rates will tend to be lower.

[1] The dist_cepii file is obtained from http://www.cepii.fr/anglaisgraph/bdd/distances.htm. The language variable is based on the fact that two countries share a common official language (comlang_off) and simple distances are calculated following the great circle formula, which uses latitudes and longitudes of the most important cities/agglomerations (in terms of population).

In this paper, a trade imbalance variable (in weight, metric tons) is constructed according to equation (2).

$$\textbf{\textit{Trade}}\ \mathrm{Im}\textbf{\textit{balance}} = \frac{\left|\boldsymbol{X}_{iw} - \boldsymbol{M}_{wj}\right|}{\max(\boldsymbol{X}_{iw}, \boldsymbol{M}_{wj})} \qquad (2)$$

Where X_{iw} are the exports (in weight) from the exporter country to the world and M_{wj} are the imports (in weight) from the world to the importer country. When constructing trade imbalance as expression (2), bilateral variability in transport costs among countries is taken into account. Trade imbalance is calculated with trade data obtained from Feenstra et al. (2005).

Recently, Tang (2006) makes an analysis for 103 countries exporting to the United States that raises the possibility that specialisation in information technology sectors in developed and developing economies could have a different effect in both kinds of economies. Therefore, technological innovation is included in the regression with Technological Achievement Index -TAI (UNDP, 2001). Additionally, sector variability is considered with a high-technology dummy. The list of high-technology products is based on R&D intensities (Table A.4, Appendix). Concordances from the Centre for International data at UC Davis between SITC revision 2 and revision 3 are used since trade data are defined using SITC revision 2. Finally, sectoral dummies that classify products according to Rauch (1999) are obtained from Jon Haveman's International Trade data webpage.

Table A.5[2] shows a summary of the data used in the empirical analysis.

[2] Table A.5 in Appendix. The first column lists the variables used for empirical analysis; the second column outlines a description of the variables, and the third column shows the data sources.

5. EMPIRICAL ANALYSIS

Model specification

In order to incorporate sector-heterogeneity in the empirical analysis of trade determinants in African countries, a gravity equation is estimated with disaggregated data. Therefore, previous papers considering sector-heterogeneity are taken into account (Feenstra et al., 2001; Tang, 2006). A number of dummies representing geographical and cultural characteristics and integration dummies to analyse the impact of a RIAs and multilateral liberalisation on international trade are added. Sectoral dummies for high-technology goods and for referenced and homogeneous goods are also included in the regression. The model is expressed in additive form using a logarithmic transformation. The estimated equation is:

$$\begin{aligned}\ln \boldsymbol{X}_{ijk} &= \alpha_0 + \alpha_1 \cdot \ln \boldsymbol{Y}_j + \alpha_2 \cdot \ln \boldsymbol{YH}_j + \alpha_3 \cdot \ln \boldsymbol{Tariff}_{jk} + \alpha_4 \cdot \boldsymbol{TC}_j + \alpha_5 \cdot \boldsymbol{imb}_{ij} + \\ &+ \alpha_6 \cdot \boldsymbol{TAI}_j + \alpha_7 \cdot \ln \boldsymbol{free}_j + \alpha_8 \cdot \boldsymbol{WTO} + \alpha_9 \cdot \boldsymbol{ECOWAS} + \alpha_{10} \cdot \boldsymbol{hightech}_k + \\ &+ \alpha_{11} \cdot \mathrm{hom}_k + \alpha_{12} \cdot \boldsymbol{ref}_k + \alpha_{13} \cdot \ln \boldsymbol{Dist}_{ij} + \alpha_{14} \cdot \boldsymbol{Lang}_{ij} + \alpha_{15} \cdot \boldsymbol{Land}_j + \\ &+ \alpha_{16} \cdot \boldsymbol{Adj}_{ij} + \alpha_{17} \cdot \boldsymbol{Colony}_{ij} + \varepsilon_{ijk}\end{aligned} \qquad (3)$$

where *ln* denotes natural logarithms.

The model is estimated with 4-digit SITC bilateral exports data from Ghana and South Africa (i) to 167 importer countries (j) in the year 2000. Ordinary Least Squares (OLS) estimation on the double log specification as given by equation (3) is performed.

X_{ij} denotes the value of exports from country *i* to *j*, Y_j and YH_j are income and income per capita in the destination market, and $Tariff_{jk}$ is the simple average of all countries effectively applied rates duty type in the importer country for each commodity k from Ghana and South Africa. TC_j is transport costs of the importer country. Imb_{ij} is the trade imbalance existing between trading partners. This variable is built according to equation (2). TAI_j is a technological variable measuring technological innovation in the importer country. $Free_j$ denotes the index of economic freedom in the importer country. Higher value for this index indicates lower economic freedom in the country.

WTO is a dummy that takes a value of 1 when the importer country is a signatory of the World Trade Organisation in 2000, ECOWAS takes a value of 1 when countries are members of the Economic Community of West African States, then is only included in the regression for the case of Ghana.

$Hightech_k$ is a dummy that takes the value of 1 when commodity k is a high-technology commodity (Table A.4, Appendix). Hom_k and ref_k dummies are included in the model to take into account sector-heterogeneity in the regression. Hom_k takes the value of 1 when the commodity k is homogeneous, zero otherwise; whereas ref_k takes the value of 1 when the commodity k is reference-priced, zero otherwise, according to conservative Rauch classification (1999).[2] $Dist_{ij}$ is the geographical great circle distance in kilometres between the capitals of country *i* and *j*. $Lang_{ij}$ is a dummy for countries sharing the same language. $Land_j$ takes the value of 1 when the importer country is landlocked. Adj_{ij} is a dummy that indicates whether the trading partners are contiguous. $Colony_{ij}$ is a dummy

[2] The "conservative" classification minimises the number of 4-digit commodities that are classified as either organised-exchange or reference-priced.

that takes the value of 1 when trading partners have ever had a colonial link. Finally, ε_{ijk} is independently and identically distributed among countries.

Main results

When measuring trade between two specific countries, several statistical indices can be used. One of them is the trade intensity index, which can appear in two forms: export intensity index and import intensity index. An index greater (less) than unity can be interpreted as an indication of larger (smaller) than expected trade flows between the two countries concerned. Wu and Zhou (2006) have applied this measure to analyse China-India bilateral trade.

In this section, as a preliminary analysis to determine factors that promote trade between two countries, data are aggregated for Ghana and South Africa to construct bilateral export intensity index (XII) in the year 2000 according to equation (4).

$$XII_{ij} = \frac{x_{ij} / X_{iw}}{M_{jw} / (M_w - M_{iw})} \qquad (4)$$

where XII_{ij} is the country i's export intensity index to j, x_{ij} the country i's exports to country j, X_{iw} the country i's total exports to the world, M_{jw} the country j's total imports from the world, M_w the world total imports and M_{iw} the country i's total imports from the world.

Table 1 shows the results obtained by measuring trade intensity from the exporter countries (Ghana and South Africa) to a 65-country sample used in previous papers in gravity analysis with aggregated data (Márquez- Ramos et al. 2007).

Results show that Ghana exports more than expected to high-income European countries, whereas the intensity of exports for the African medium-income country considered

(South Africa) is remarkably higher with other African countries (Ghana, Kenya, Mozambique and Tanzania).

Table 1. Export Intensity Index.

		Ghana	South Africa
South Africa	Medium-income	0.67	-
Algeria	Medium-income	0.07	0.11
Argentina	Medium-income	0.00	0.53
Australia	High-income	0.25	1.29
Austria	High-income	1.46	0.36
Belgium-Lux	High-income	1.69	1.22
Bolivia	Low-income		0.00
Brazil	Medium-income	0.09	0.71
Bulgaria	Medium-income	0.51	0.11
Canada	High-income	0.22	0.27
Chile	Medium-income	0.00	0.50
China	Low-income	0.35	0.79
Colombia	Medium-income	0.05	0.41
Costa Rica	Medium-income		0.01
Croatia	Medium-income		0.10
Cyprus	Medium-income	0.00	0.08
Denmark	High-income	0.59	0.17
Dominican Rp	Medium-income		0.07
Ecuador	Low-income	0.00	0.02
Egypt	Low-income	0.00	0.24
Slovaquia	Medium-income	0.21	0.27
Finland	High-income	0.28	0.24
France	High-income	1.54	0.46
Germany	High-income	1.29	0.99
Ghana	Low-income	-	7.72
Greece	Medium-income	0.73	0.33
Hong Kong	High-income	0.03	0.56
Honduras	Low-income		0.22
Iceland	High-income	0.00	0.08
Ireland	High-income	2.80	0.31
Israel	Medium-income	0.09	2.81
Italy	High-income	1.72	1.65
Jamaica	Low-income	0.00	0.46
Japan	High-income	0.69	1.36
Kenya	Low-income	0.00	23.69
Korea South	Medium-income	0.12	1.04
Mexico	Medium-income	0.00	0.17
Mozambique	Low-income	0.00	124.05
Netherlands	High-income	5.94	0.58
Nicaragua	Low-income		0.06
Norway	High-income	0.46	0.66
Nepal	Low-income		0.00

Panama	Medium-income	0.00	0.03
Peru	Medium-income	0.12	0.36
Pakistan	Low-income	0.00	0.73
Poland	Medium-income	0.54	0.27
Portugal	Medium-income	0.59	0.60
Paraguay	Medium-income	0.00	0.37
Czech Republic	Medium-income	0.14	0.12
El Salvador	Medium-income		0.00
Senegal	Low-income	0.00	1.26
Singapur	High-income	0.07	0.29
Spain	Medium-income	1.32	0.97
Sudan	Low-income	0.00	1.13
Sweden	High-income	0.11	0.19
Syrn Arab Rp	Medium-income	0.00	0.25
Switzerland	High-income	1.21	0.61
Tanzania	Low-income	0.00	39.41
Trinidad Tbg	Medium-income	0.00	0.26
Turkey	Medium-income	2.76	0.54
UK	High-income	2.24	2.38
Uruguay	Medium-income	0.00	0.32
USA	High-income	0.91	0.63
Venezuela	Medium-income	0.00	0.14

Source: Feenstra, Lipsey, Deng, Ma and Mo (2005) and own elaboration.
Notes: The first column lists the 65 importer countries used for the analysis; the second column shows the group in which each country is classified according to its level of income (GDP per capita, PPP, current international $). Columns 3 and 4 show the bilateral export intensity index of Ghana and South Africa to each of the 65 importer countries considered. Due to limitations in data availability, the Ghana export intensity index cannot be constructed with a number of countries.

As a further step, equation (3) is estimated by OLS for Ghana and South Africa to 167 importer countries. Table 2 shows final results.

Table 2. Determinants of international trade. The case of Ghana and South Africa.

	Ghana	South Africa
Constant term	-1.68	7.25
	-0.18	4.15
Importer's income	0.25	0.14
	1.85	3.37
Importer's income per capita	0.24	-0.07
	0.37	-0.64
Tariffs	-0.08	-0.15
	-0.61	-2.97
Importer's transport costs	0.35	-0.03
	1.03	-0.39
Trade Imbalance	0.71	-0.07
	1.43	-0.40
Importer's TAI	-1.72	2.28
	-0.86	2.19
Importer's Economic Freedom	-2.12	0.93
	-1.42	2.57
WTO dummy	-0.07	-0.42
	-0.10	-2.76
ECOWAS dummy	-0.05	-
	-0.02	-
Hightechn dummy	-0.83	-0.14
	-2.53	-1.92
Homogeneous goods dummy	1.01	0.72
	3.23	4.45
Referenced goods dummy	0.47	0.31
	1.83	5.15
Distance	-0.12	-0.56
	-0.24	-3.44
Language dummy	-0.16	0.17
	-0.38	1.50
Importer's Landlocked dummy	-0.77	-0.36
	-1.81	-1.52
Adjacency dummy	-	0.11
	-	0.51
Colonial dummy	0.03	0.29
	0.05	2.83
R-squared	0.15	0.12
Number of observations	220	5 293

Notes: T-statistics are in shading cells. The dependent variable is the natural logarithm of exports in value (thousands of US$). Income, income per capita, transport costs, tariffs, economic freedom and distance are also in natural logarithms. The estimation uses White's heteroscedasticity-consistent standard errors.

Table 2 shows that importer's income coefficient is positive and significant for both Ghana and South Africa. However, importer's income per capita variables are not significant.

The effect of tariffs varies across countries. A negative and significant effect of tariffs on international trade is found in South Africa, then tariffs increase costs and reduce international trade. However, the effect of the structure of tariffs in importers is not significant for the case of Ghana. Moreover, importer's transport costs and trade imbalance do not seem to deter exports in Ghana and South Africa. Figure A.2 (Appendix) shows and increasing tendency of maritime transport costs over the period 1990-2000 in Africa. Therefore, for African economies, transport cost reductions do not play a relevant effect on exports.

Technological innovation endowments in the importer country have a positive and significant effect on trade flows in South Africa. Then, the technological innovation investment carried out in other countries leads to higher exports from South Africa. This may be due in part to a spillover effect existing among developed and developing countries since higher levels of economic development in the poorest countries can be reached by trading because of technological innovation performed in developed countries (Coe, Helpman and Hoffmaister, 1997).

Results show that the effect of multilateral liberalisation on international trade is negative and significant for South Africa, and regional integration (ECOWAS) does not foster exports from Ghana.

High-technology dummy indicates that these African countries are not specialised in high-technology sectors. Homogeneous and reference-priced dummies show that these countries are relatively specialised in homogeneous goods.

In relation to geographical and social variables, distance has a negative effect on trade flows when exports are from South Africa. The effect of sharing a language is not significant, although South Africa trades more with countries that have common colonial ties such as United Kingdom and Netherlands.

Finally, beta coefficients are used by some researchers to compare the relative strength of the various predictors within the model. Since the beta coefficients are all measured in standard deviations they are comparable when the explanatory variables are expressed in different units. Beta coefficients are reported in Table 3.

Table 3. Beta coefficients.

	Ghana	South Africa
Importer's income	0.16	0.16
Importer's income per capita	0.13	-0.05
Tariffs	-0.04	-0.06
Importer's transport costs	0.08	-0.01
Trade Imbalance	0.12	-0.01
Importer's TAI	-0.18	0.29
Importer's Economic Freedom	-0.26	0.18
WTO dummy	-0.01	-0.06
ECOWAS dummy	-0.01	-
Hightech dummy	-0.13	-0.03
Homogeneous goods dummy	0.28	0.12
Referenced goods dummy	0.14	0.09
Distance	-0.05	-0.22
Language dummy	-0.04	0.05
Importer's Landlocked dummy	-0.13	-0.07
Adjacency dummy	0.00	0.02
Colonial dummy	0.01	0.05

According to beta coefficients the most important variables fostering exports differ for Ghana and South Africa. Ghana exports more to countries with high level of economic freedom (high-income European countries), whereas South Africa exports more to countries with low level of economic freedom (other African countries). Trade barriers do not seem to deter significantly trade flows from these African economies, although Ghana is benefited with the current structure of trade imbalance. Ghana imports more than exports, then freight rates are lower for the shipments transported on the leg of the trip with less traffic (exports). Finally, geographical distance and technological innovation are the most important determinants of exports from South Africa.

6. CONCLUSIONS

A number of authors have focused on the determinants of the trade patterns, however further research is needed for a better understanding of what goods and with which countries developed and developing economies trade. This paper focuses on the determinants of international trade in two African countries: South Africa (low-income economy) and Ghana (medium-income economy). In the empirical analysis, country and sector-heterogeneity are considered. Results show that determinants of trade have a different behaviour in developed and developing African countries. Technological innovation, geographical and social factors play a key role on trade relationships in South Africa, whereas Ghana's exports are higher when they are addressed to countries with higher levels of economic freedom. Ghana exports more than expected to high-income European countries, whereas the intensity of exports from South Africa is considerably higher with other African countries.

According to Baier and Bergstrand (2001) the main factors explaining world trade growth are income growth, tariff and transport cost reductions. In the case of the African economies studied in this paper, trade flows decrease from the year 2000 onwards. The importer's income is found to be a relevant variable to foster international trade flows, however the effect of tariffs varies across countries. Transport cost reductions do not play a relevant effect on exports from African countries. Additionally, results show evidence of a spillover effect existing among developed and developing countries.

In relation to multilateralism, The WTO Ministerial Conferences are of great importance since various issues discussed there impact countries, especially poor ones, and their economic futures. Nonetheless, results in this paper show that the effect of multilateral liberalisation on international trade is not significant for Ghana and it is negative for South Africa. In the last years, WTO talks have collapsed. High-income countries want to talk about new issues that are part of the free trade and liberalisation ideas that they promote. Otherwise, low-income countries want to talk about old issues mostly on agriculture that affected them the most. Then, there is a need for contingency plans in the context of multilateral trade negotiations. Dobson (2001) points out that the international trading system seems to be losing its "liberalising momentum", whereas RIAs are proliferating. However, RIAs will not be WTO-compliant unless they aim to free up trade in essentially all sectors on non-discriminatory basis. In fact, results in this paper show that the Economic Community of West African States, does not foster exports from Ghana.

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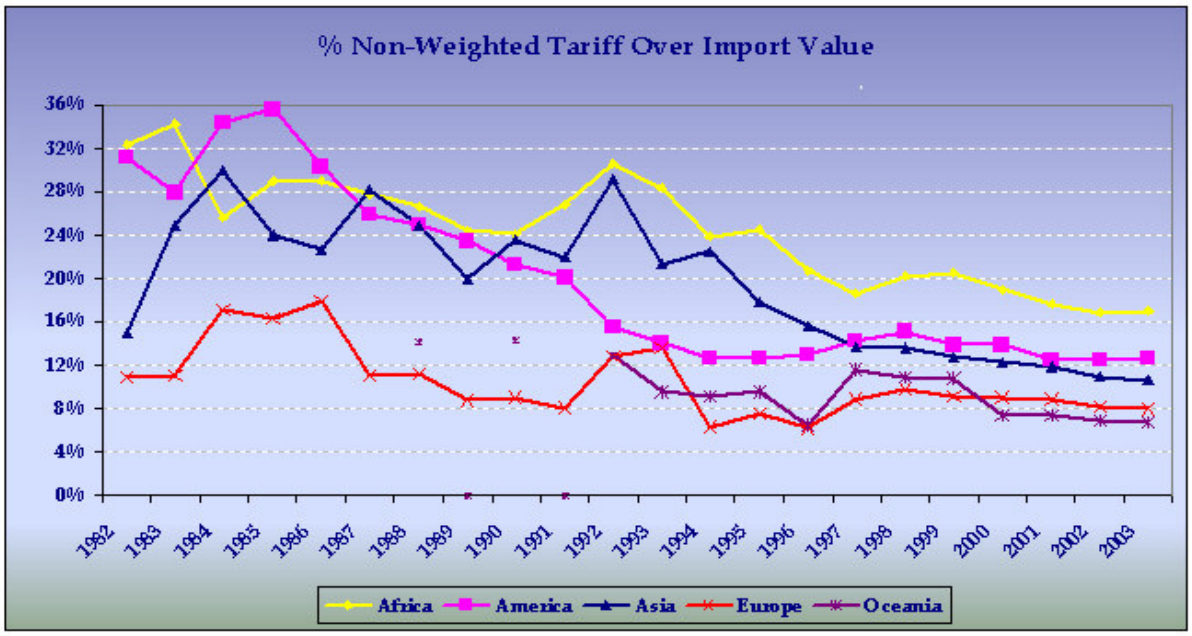
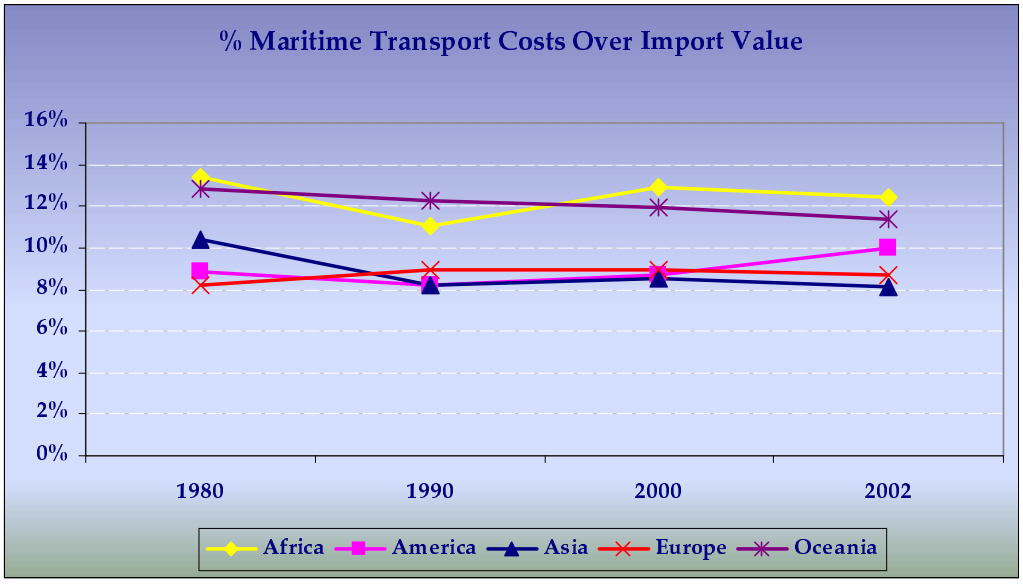
APPENDIX

Figure A.1



Source: World Bank (2005b)

Figure A.2



Source: *Review of Maritime Transport*, 2004. UNCTAD, and own elaboration

Table A.1. Importer countries.

	Country	Code		Country	Code		Country	Code		Country	Code
1	Afghanistan	AFG	43	Denmark	DNK	85	Kuwait	KWT	127	Rwanda	RWA
2	Albania	ALB	44	Djibouti	DJI	86	Kyrgyzstan	KGZ	128	Samoa	WSM
3	Algeria	DZA	45	Dominican Rp	DOM	87	Lao P.Dem.R	LAO	129	Saudi Arabia	SAU
4	Angola	AGO	46	Ecuador	ECU	88	Latvia	LVA	130	Senegal	SEN
5	Argentina	ARG	47	Egypt	EGY	89	Lebanon	LBN	131	Seychelles	SYC
6	Armenia	ARM	48	El Salvador	SLV	90	Liberia	LBR	132	Sierra Leone	SLE
7	Australia	AUS	49	Eq.Guinea	GNQ	91	Libya	LBY	133	Singapore	SGP
8	Austria	AUT	50	Estonia	EST	92	Lithuania	LTU	134	Slovakia	SVK
9	Azerbaijan	AZE	51	Ethiopia	ETH	93	Madagascar	MDG	135	Slovenia	SVN
10	Bahamas	BHS	52	Fiji	FJI	94	Malawi	MWI	136	Somalia	SOM
11	Bahrain	BHR	53	Finland	FIN	95	Malaysia	MYS	137	South Africa	ZAF
12	Bangladesh	BGD	54	France,Monac	FRA	96	Mali	MLI	138	Spain	ESP
13	Barbados	BRB	55	Gabon	GAB	97	Malta	MLT	139	Sri Lanka	LKA
14	Belarus	BLR	56	Gambia	GMB	98	Mauritania	MRT	140	St.Kt-Nev-An	KNA
15	Belgium-Lux	BEL	57	Georgia	GEO	99	Mauritius	MUS	141	Sudan	SDN
16	Belize	BLZ	58	Germany	DEU	100	Mexico	MEX	142	Suriname	SUR
17	Benin	BEN	59	Ghana	GHA	101	Mongolia	MNG	143	Sweden	SWE
18	Bermuda	BMU	60	Gibraltar	GIB	102	Morocco	MAR	144	Switz.Liecht	CHE
19	Bolivia	BOL	61	Greece	GRC	103	Mozambique	MOZ	145	Syria	SYR
20	Bosnia Herzg	BIH	62	Greenland	GRL	104	Myanmar	MMR	146	TFYR Macedna	MKD
21	Brazil	BRA	63	Guatemala	GTM	105	Nepal	NPL	147	Taiwan	TWN
22	Bulgaria	BGR	64	Guinea	GIN	106	Neth.Ant.Aru	ANT	148	Tajikistan	TJK
23	Burkina Faso	BFA	65	GuineaBissau	GNB	107	Netherlands	NLD	149	Tanzania	TZA
24	Burundi	BDI	66	Guyana	GUY	108	New Calednia	NCL	150	Thailand	THA
25	Cambodia	KHM	67	Haiti	HTI	109	New Zealand	NZL	151	Togo	TGO
26	Cameroon	CMR	68	Honduras	HND	110	Nicaragua	NIC	152	Trinidad Tbg	TTO
27	Canada	CAN	69	Hungary	HUN	111	Niger	NER	153	Tunisia	TUN
28	Cent.Afr.Rep	CAF	70	Iceland	ISL	112	Nigeria	NGA	154	Turkey	TUR
29	Chad	TCD	71	Indonesia	IDN	113	Norway	NOR	155	Turkmenistan	TKM
30	Chile	CHL	72	Iran	IRN	114	Oman	OMN	156	UK	GBR
31	China	CHN	73	Iraq	IRQ	115	Pakistan	PAK	157	USA	USA
32	China HK SAR	HKG	74	Ireland	IRL	116	Panama	PAN	158	Uganda	UGA
33	China MC SAR	MAC	75	Israel	ISR	117	Papua N.Guin	PNG	159	Ukraine	UKR
34	Colombia	COL	76	Italy	ITA	118	Paraguay	PRY	160	Untd Arab Em	ARE
35	Congo	COG	77	Jamaica	JAM	119	Peru	PER	161	Uruguay	URY
36	Costa Rica	CRI	78	Japan	JPN	120	Philippines	PHL	162	Uzbekistan	UZB
37	Cote Divoire	CIV	79	Jordan	JOR	121	Poland	POL	163	Venezuela	VEN
38	Croatia	HRV	80	Kazakhstan	KAZ	122	Portugal	PRT	164	Viet Nam	VNM
39	Cuba	CUB	81	Kenya	KEN	123	Qatar	QAT	165	Yemen	YEM
40	Cyprus	CYP	82	Kiribati	KIR	124	Rep Moldova	MDA	166	Zambia	ZMB
41	Czech Rep	CZE	83	Korea D P Rp	PRK	125	Romania	ROM	167	Zimbabwe	ZWE
42	Dem.Rp.Congo	ZAR	84	Korea Rep.	KOR	126	Russian Fed	RUS			

Table A.2. List of 4-digit SITC sectors (conservative classification)

Differentiated sample (694 sectors)

0015	2230	5332	6114	6533	6618	6935	7161	7311	7444	7621	7810
0115	2235	5334	6115	6535	6620	6940	7162	7312	7447	7622	7812
0118	2237	5335	6116	6536	6623	6941	7163	7313	7448	7628	7820
0141	2238	5410	6117	6538	6624	6942	7164	7314	7450	7630	7821
0342	2330	5413	6118	6539	6630	6943	7165	7315	7451	7631	7822
0460	2331	5414	6120	6540	6631	6944	7180	7316	7452	7633	7830
0461	2332	5415	6130	6541	6632	6950	7188	7317	7453	7638	7831
0480	2440	5416	6131	6542	6633	6951	7189	7331	7456	7640	7832
0483	2450	5417	6132	6543	6638	6952	7210	7339	7459	7641	7840
0484	2480	5419	6133	6544	6640	6953	7211	7360	7461	7642	7849
0485	2481	5510	6210	6549	6641	6954	7212	7361	7462	7643	7850
0488	2482	5513	6213	6550	6642	6955	7213	7362	7463	7648	7851
0560	2483	5530	6214	6552	6643	6956	7219	7367	7464	7649	7852
0565	2484	5534	6250	6553	6644	6957	7220	7369	7465	7710	7853
0567	2672	5540	6251	6560	6645	6960	7224	7370	7468	7711	7860
0576	2683	5541	6252	6561	6646	6963	7230	7371	7471	7712	7861
0580	2685	5542	6253	6562	6647	6964	7231	7372	7472	7720	7862
0581	2686	5543	6254	6563	6648	6965	7232	7373	7473	7721	7863
0582	2690	5720	6255	6564	6649	6966	7233	7374	7474	7722	7868
0583	2711	5721	6259	6565	6650	6968	7234	7410	7478	7725	7910
0589	2731	5722	6280	6570	6651	6970	7240	7411	7483	7730	7912
0619	2770	5723	6282	6571	6658	6973	7243	7412	7490	7731	7920
0712	2771	5821	6289	6572	6659	6974	7244	7413	7491	7732	7923
0724	2772	5822	6292	6573	6660	6975	7245	7414	7492	7740	7925
0730	2784	5824	6330	6574	6664	6978	7246	7415	7493	7741	7928
0731	2789	5829	6332	6575	6665	6990	7247	7416	7499	7742	7930
0733	2910	5836	6344	6576	6666	6991	7248	7417	7510	7750	7931
0739	2911	5838	6350	6577	6674	6992	7250	7418	7511	7751	7932
0742	2919	5839	6351	6578	6720	6993	7251	7420	7512	7752	7937
0914	2920	5841	6353	6579	6724	6995	7252	7421	7513	7753	7938
0980	2922	5842	6359	6580	6725	6996	7259	7422	7518	7754	7939
0984	2923	5850	6419	6581	6733	6997	7260	7423	7519	7757	8120
0985	2924	5852	6420	6582	6780	6998	7263	7424	7520	7758	8121
0986	2926	5910	6424	6583	6781	6999	7264	7425	7522	7760	8122
0989	2927	5912	6428	6584	6782	7110	7265	7426	7523	7761	8124
1110	2929	5913	6511	6585	6783	7111	7266	7427	7525	7762	8131
1122	3221	5914	6518	6589	6785	7112	7267	7428	7526	7763	8132
1213	3224	5921	6519	6590	6790	7120	7268	7430	7527	7764	8210
2112	3231	5980	6520	6591	6791	7130	7269	7431	7528	7768	8211
2114	3350	5982	6522	6592	6793	7132	7270	7434	7529	7780	8212
2116	3354	5983	6523	6593	6794	7133	7271	7435	7590	7781	8213
2117	3359	5986	6524	6594	6795	7138	7272	7436	7591	7782	8215
2120	4313	5988	6525	6595	6910	7139	7280	7440	7610	7783	8217
2121	4314	5989	6526	6596	6920	7140	7281	7441	7611	7784	8219
2122	5241	6110	6529	6597	6930	7149	7283	7442	7612	7786	8310
2123	5330	6112	6530	6613	6931	7160	7284	7443	7620	7788	8311

8312	8423	8435	8452	8465	8512	8740	8813	8854	8933	8959	8993
8313	8424	8437	8453	8469	8513	8741	8820	8855	8939	8960	8994
8319	8425	8438	8454	8470	8514	8742	8822	8857	8940	8970	8996
8411	8426	8439	8455	8471	8515	8744	8830	8859	8941	8972	8997
8412	8427	8440	8456	8472	8517	8745	8831	8920	8942	8980	8998
8413	8428	8441	8458	8480	8710	8746	8840	8921	8943	8981	8999
8414	8429	8442	8459	8481	8711	8747	8841	8922	8944	8982	9110
8415	8430	8443	8460	8482	8719	8748	8842	8925	8946	8983	9310
8416	8431	8447	8461	8483	8720	8749	8843	8928	8947	8984	9410
8420	8432	8448	8462	8484	8730	8810	8850	8930	8950	8986	9510
8421	8433	8450	8463	8510	8731	8811	8851	8931	8951	8990	
8422	8434	8451	8464	8511	8732	8812	8852	8932	8952	8991	

Reference-priced sample (349 sectors)

0019	0344	0622	2470	2734	3250	5146	5240	5754	5922	6545	6755
0112	0345	0720	2471	2740	3345	5147	5243	5755	5931	6551	6757
0114	0360	0722	2472	2741	3351	5148	5249	5759	5972	6610	6760
0129	0361	0723	2474	2780	3352	5150	5251	5791	5977	6611	6761
0140	0362	0750	2475	2782	3353	5154	5259	5792	5981	6612	6762
0142	0363	0752	2479	2783	3410	5155	5310	5793	6113	6670	6763
0149	0370	0811	2510	2785	3413	5156	5311	5799	6340	6672	6764
0161	0371	0812	2511	2786	3425	5157	5312	5811	6341	6710	6768
0168	0372	0814	2512	2851	3510	5158	5320	5812	6342	6712	6770
0171	0470	0819	2516	2852	4111	5160	5322	5813	6343	6713	6822
0172	0471	1120	2517	2860	4310	5161	5323	5816	6345	6714	6832
0173	0481	1121	2518	2870	4311	5162	5331	5817	6410	6715	6842
0174	0540	1123	2519	2871	4312	5163	5411	5820	6411	6716	6852
0175	0542	1124	2632	2872	5110	5169	5620	5823	6412	6730	6863
0176	0544	1210	2633	2873	5111	5220	5621	5825	6413	6731	6880
0179	0545	1220	2650	2874	5112	5221	5622	5826	6414	6732	6890
0220	0546	1222	2657	2875	5113	5223	5623	5827	6415	6734	6898
0221	0547	1223	2658	2876	5114	5224	5629	5830	6416	6740	6899
0222	0548	2110	2659	2877	5119	5225	5711	5831	6417	6741	6932
0223	0561	2111	2660	2878	5120	5226	5712	5832	6418	6742	
0224	0564	2119	2665	2879	5121	5230	5719	5833	6421	6743	
0230	0571	2221	2666	2880	5122	5231	5729	5834	6510	6744	
0240	0572	2223	2667	2881	5123	5232	5731	5835	6514	6745	
0250	0574	2224	2670	2882	5124	5233	5739	5837	6515	6746	
0251	0575	2225	2671	2890	5130	5234	5741	5840	6516	6747	
0252	0579	2226	2687	2925	5137	5235	5742	5843	6517	6748	
0253	0586	2232	2712	3211	5138	5236	5743	5849	6521	6749	
0340	0616	2234	2730	3220	5139	5237	5751	5851	6531	6750	
0341	0620	2460	2732	3230	5140	5238	5752	5911	6532	6751	
0343	0621	2462	2733	3232	5145	5239	5753	5920	6534	6753	

Homogeneous sample (146 sectors)

0010	0125	0449	0599	0810	2322	2682	3340	4218	4245	6826	6891
0011	0350	0450	0610	0813	2610	2710	3341	4222	4249	6827	9610
0012	0351	0451	0611	0910	2613	2721	3342	4225	5222	6830	9710
0013	0352	0452	0612	0913	2614	2722	3343	4229	6512	6831	
0014	0410	0453	0615	1211	2630	2810	3344	4230	6513	6840	
0110	0411	0459	0710	1212	2631	2814	4110	4232	6810	6841	
0111	0412	0541	0711	2220	2640	2815	4112	4234	6811	6850	
0113	0420	0570	0713	2222	2641	2816	4113	4236	6812	6851	
0116	0421	0573	0721	2227	2649	2820	4212	4239	6820	6860	
0120	0422	0577	0740	2311	2651	2821	4213	4240	6821	6861	
0121	0423	0585	0741	2312	2654	2822	4215	4241	6823	6870	
0122	0430	0591	0743	2320	2680	2823	4216	4242	6824	6871	
0123	0440	0592	0751	2321	2681	3330	4217	4243	6825	6872	

Table A.3. Revealed Comparative Advantage.

		International Specialisation Index-SICT rev. 2, 4digit	Conservative Rauch classification
		South Africa	
1	2877	MANGANESE ORES AND CONCENTRATES	reference priced
2	6812	PLATINUM AND OTHER METALS OF THE PLATINUM GROUP	homogeneous goods
3	2786	SLAG,DROSS,SCALINGS AND SIMILAR WASTE,N.E.S.	reference priced
4	2516	CHEMICAL WOOD PULP,DISSOLVING GRADES	reference priced
5	6716	FERRO-ALLOYS	reference priced
6	2879	ORES & CONCENTRAT.OF OTHER NON-FERROUS BASE METAL	reference priced
7	5721	PROPELLENT POWDERS AND OTHER PREPARED EXPLOSIVES	differentiated products
8	2890	ORES & CONCENTRATES OF PRECIOUS METALS;WASTE,SCRA	reference priced
9	2687	SHEEPS/LAMBS WOOL/OTHER AIMAL HAIR,CARDED/COMBED	reference priced
10	2117	SHEEP & LAMB SKINS WITHOUT THE WOOL,RAW(FRESH ETC)	differentiated products
		Ghana	
1	721	COCOA BEANS,WHOLE OR BROKEN,RAW OR ROASTED	homogeneous goods
2	2877	MANGANESE ORES AND CONCENTRATES	reference priced
3	723	COCOA BUTTER AND COCOA PASTE	reference priced
4	6341	WOOD SAWN LENGTHWISE,SLICED/PEELED,BUT NOT PREPAR.	reference priced
5	2771	INDUSTRIAL DIAMONDS,SORTED,WHETHER OR NOT WORKED	differentiated products
6	371	FISH,PREPARED OR PRESERVED,N.E.S. INCLUDING CAVIAR	reference priced
7	2483	WOOD OF NON-CONIFEROUS SPECIES,SAWN,PLANED,TONGUE	differentiated products
8	2659	VEGETABLE TEXTILE FIBRES,N.E.S. AND WASTE	reference priced
9	2223	COTTON SEEDS	reference priced
10	548	VEGETABLE PRODUCTS,ROOTS & TUBERS,FOR HUMAN FOOD	reference priced

Source: Feenstra, Lipsey, Deng, Ma and Mo (2005). Own elaboration.

Table A.4. High-technology sectors.

SITC4, rev. 2	DESCRIPTION
5221	CHEMICAL ELEMENTS
5222	INORGANIC ACIDS AND OXYGEN COMPOUNDS OF NON-METAL
5223	HALOGEN AND SULPHUR COMPOUNDS OF NON-METALS
5224	METALLIC OXIDES OF ZINC,CHROMIUM,MANGANESE,IRON,
5225	OTH.INORG.BASES & METALLIC OXID., HYDROXID.& PEROX.
5241	FISSILE CHEMICAL ELEMENTS AND ISOTOPES
5249	OTHER RADIO-ACTIVE AND ASSOCIATED MATERIALS
5311	SYNTHETIC ORGANIC DYESTUFFS
5312	SYNTH.ORGANIC LUMINOPHORES;OPTIC.BLEACHING AGENTS
5411	PROVITAMINS & VITAMINS,NARURAUREPROD.BY SYNTHESIS
5413	ANTIBIOTICS N.E.S.,NOT INCL. IN 541.7
5414	VEGETAB.ALKALOIDS,NATURAL/REPRODUCED BY SYNTHESIS
5415	HORMONES,NATURAL OR REPRODUCED BY SYNTHESIS
5416	GLYCOSIDES;GLANDS OR OTHER ORGANS & THEIR EXTRACTS
5417	MEDICAMENTS(INCLUDING VETERINARY MEDICAMENTS)
5419	PHARMACEUTICAL GOODS,OTHER THAN MEDICAMENTS
5823	ALKYDS AND OTHER POLYESTERS
5911	INSECTICIDES PACKED FOR SALE ETC.
5912	FUNGICIDES PACKED FOR SALE ETC.
5913	WEED KILLERS (HERBICIDES)PACKED FOR SALE ETC.
5914	DISINFECT.,ANTI-SPROUTING PROD.ETC.PACKED FOR SALE
7144	REACTION ENGINES
7148	GAS TURBINES,N.E.S.
7149	PARTS OF THE ENGINES & MOTORS OF 714-AND 718.8-
7187	NUCLEAR REACTORS AND PARTS
7188	ENGINES & MOTORS,N.E.S.SUCH AS WATER TURBINES ETC.
7281	MACH.TOOLS FOR SPECIALIZED PARTICULAR INDUSTRIES
7283	MACH.FOR SORTING,SCREENING,SEPARATING,WASHING ORE
7284	MACH.& APPLIANCES FOR SPEZIALIZED PARTICULAR IND.
7361	METAL CUTTING MACHINE-TOOLS
7362	METAL FORMING MACHINE TOOLS
7367	OTHER MACH.-TOOLS FOR WORKING METAL OR MET.CARBIDE
7371	CONVERTERS,LADLES,INGOT MOULDS AND CASTING MACH.
7372	ROLLING MILLS,ROLLS THEREFOR AND PARTS
7373	WELDING,BRAZING,CUTTING,SOLDERING MACHINES & PARTS
7511	TYPEWRITTERS;CHEQUE-WRITTING MACHINES
7512	CALCULATING MACHINES, CASH REGISTERS.TICKET & SIM.
7518	OFFICE MACHINES, N.E.S.
7521	ANALOGUE & HYBRID DATA PROCESSING MACHINES
7522	COMPLETE DIGITAL DATA PROCESSING MACHINES
7523	COMPLETE DIGITAL CENTRAL PROCESSING UNITS
7524	DIGITAL CENTRAL STORAGE UNITS,SEPARATELY CONSIGNED
7525	PERIPHERAL UNITS,INCL.CONTROL & ADAPTING UNITS
7528	OFF-LINE DATA PROCESSING EQUIPMENT. N.E.S.
7591	PARTS OF AND ACCESSORIES SUITABLE FOR 751.1-,751.8
7599	PARTS OF AND ACCESSORIES SUITABLE FOR 751.2-,752-
7638	OTHER SOUND RECORDERS AND REPRODUCERS

7641	ELECT.LINE TELEPHONIC & TELEGRAPHIC APPARATUS
7642	MICROPHONES, LOUDSPEAKERS, AMPLIFIERS
7643	RADIOTELEGRAPHIC & RADIOTELEPHONIC TRANSMITTERS
7648	TELECOMMUNICATIONS EQUIPMENT
7649	PARTS OF APPARATUS OF DIVISION 76-
7722	PRINTED CIRCUITS AND PARTS THEREOF
7723	RESISTORS,FIXED OR VARIABLE AND PARTS
7731	INSULATED,ELECT.WIRE,CABLE,BARS,STRIP AND THE LIKE
7732	ELECTRIC INSULATING EQUIPMENT
7741	ELECTRO-MEDICAL APPARATUS
7742	APP.BASED ON THE USE OF X-RAYS OR OF RADIATIONS
7762	OTHER ELECTR.VALVES AND TUBES
7763	DIODES,TRANSISTORS AND SIM.SEMI-CONDUCTOR DEVICES
7764	ELECTRONIC MICROCIRCUITS
7768	PIEZO-ELECTRIC CRYSTALS,MOUNTED,PARTS OF 776-
7781	BATTERIES AND ACCUMULATORS AND PARTS
7782	ELECT.FILAMENT LAMPS AND DISCHARGE LAMPS
7783	ELECTR.EQUIP.FOR INTERNAL COMBUSTION ENGINES,PARTS
7784	TOOLS FOR WORKING IN THE HAND WITH ELECT.MOTOR
7788	OTHER ELECT.MACHINERY AND EQUIPMENT
7921	HELICOPTERS
7922	AIRCRAFT NOT EXCEEDING AN UNLADEN WEIGHT 2000 KG
7923	AIRCRAFT NOT EXCEEDING AN UNLADEN WEIGHT OF 15000 KG
7924	AIRCRAFT EXCEEDING AN UNLADEN WEIGHT OF 15000 KG
7925	AIRCRAFT EXC GLIDERS,AIRSHIPS ETC
7928	AIRCRAFT,N.E.S.BALLOONS,GLIDERS ETC AND EQUIPMENT
7929	PARTS OF HEADING 792--,EXCL.TYRES,ENGINES
8710	OPTICAL INSTRUMENTS AND APPARATUS
8720	MEDICAL INSTRUMENTS AND APPLIANCES
8741	SURVEYING, HYDROGRAPHIC, COMPASSES ETC.
8742	DRAWING,MARKING-OUT,DISC CALCULATORS AND THE LIKE
8743	INSTR.NON ELECTRICAL,FOR MEASURING,CHECKING FLOW
8744	INSTR.& APP.FOR PHYSICAL OR CHEMICAL ANALYSIS
8745	MEASURING,CONTROLLING & SCIENTIFIC INSTRUMENTS
8748	ELECTRICAL MEASURING, CHECKING, ANALYSING INSTRUM.
8749	PARTS,N.E.S.ACCESSORIES FOR 873-,8743-,87454,8748
8811	PHOTOGRAPHIC,CAMERAS,PARTS & ACCESSORIES
8812	CINEMATOGRAPHIC CAMERAS,PROJECTORS,SOUND-REC,PAR
8813	PHOTOGRAPHIC & CINEMATOGRAPHIC APPARATUS N.E.S
8841	LENSES,PRISMS,MIRRORS,OTHER OPTICAL ELEMENTS
8842	SPECTACLES AND SPECTACLE FRAMES
8946	NON-MILITARY ARMS AND AMMUNITION THEREFOR
8981	PIANOS AND OTHER STRING MUSICAL INSTUMENTS
8982	OTHER MUSICAL INSTRUMENTS OF 898.1-
8983	GRAMOPHONE RECORDS AND SIM.SOUND RECORDINGS
8989	PARTS OF AND ACCESSORIES FOR MUSICAL INSTRUMENTS
8991	ART.& MANUF.OF CARVING OR MOULDING MATERIALS
8993	CANDLES,MATCHES,PYROPHORIC ALLOYS ETC.
8994	UMBRELLAS,PARASOLS,WALKING STICKS,PARTS
8996	ORTHOPAEDIC APPLIANCES,SURGICAL BELTS AND THE LIKE

8997	BASKETWORK, WICKERWORK ETC. OF PLAITING MATERIALS
8998	SMALL-WARES AND TOILET ART.,FEATHER DUSTERS ETC.
8999	MANUFACTURED GOODS,N.E.S.

Source: OECD and Eurostat. Own elaboration.

Table A.5. Variable description and sources of data.

Variable	Description	Source
X_{ij} : Exports from i to j	Value of exports from Ghana and South Africa to 167 countries, in thousands of US dollars in the year 2000	Feenstra et al. (2005)
Y_j : Importer's income	Importer's GDP, PPP (current international $)	World Bank (2005a)
YH_j : Importer's income per capita	Importer's GDP per capita, PPP (current international $)	World Bank (2005a)
$Tariff_{jk}$	Effectively applied rates	WITS (2006) http://wits.worldbank.org/witsnet/StartUp/Wits_Information.aspx
TC_j: Importer's transport costs	Transport costs (US$ per container)	Doing Business (2006)
Imb	Trade Imbalance	Feenstra et al. (2005), author's calculations
TAI_j : Importer's TAI	Technological variable	UNDP (2001), author's calculations
$Free_j$: Importer's economic freedom	Index of Economic Freedom	Miles et al. (2006) http://www.heritage.org/index/
WTO dummy	WTO accession for countries entering until 2000	WTO (2006) http://www.wto.org/english/thewto_e/whatis_e/tif_e/org6_e.htm
ECOWAS dummy	Dummy variable = 1 if the trading partners are members of ECOWAS, 0 otherwise	
$Hightech_k$ dummy	Dummy variable = 1 when commodity is a high-technology commodity, 0 otherwise	
Hom_k dummy	Dummy variable = 1 when a commodity is homogeneous, according to Rauch classification (1999), 0 otherwise	Jon Haveman's Internationa Trade Data webpage http://www.macalester.edu/research/economics/PAGE/HAVEMAN/Trade.Resources/TradeData.html
Ref_k dummy	Dummy variable = 1 when a commodity is reference-priced, according to Rauch classification (1999), 0 otherwise	Jon Haveman's Internationa Trade Data webpage
$Dist_{ij}$: Distance	Great circle distances between the most important cities in trading partners	CEPII (2006) http://www.cepii.fr/anglaisgraph/bdd/distances.htm
$Lang_{ij}$: Language dummy	Dummy variable = 1 if the trading partners share the same official language, 0 otherwise.	CEPII (2006)
$Land_j$: Landlocked dummy	Dummy variable = 1 if the importer country is landlocked, 0 otherwise.	CEPII (2006)
Adj_{ij} : Adjacency dummy	Dummy variable = 1 if the trading partners share a common border, 0 otherwise.	CEPII (2006)
$Colony_{ij}$: Colony dummy	Dummy variable = 1 if the trading partners have ever had a colonial link, 0 otherwise.	CEPII (2006)