The Gravity of EBA preferences

- Disaggregating Trade Flows in Agriculture

Emil Persson*

Tutor: Joakim Gullstrand
Bachelor Thesis 2008-09-03
University of Lund - Department of Economics *emil.persson@yahoo.se

Abstract

This thesis makes an ex post evaluation of the EBA initiative and its influence on agricultural exports into the EU. I employ a gravity model for this purpose, and with dummy variables identifying seven groups of (agricultural) products this is a fairly new method. The data consists of 102 low- and middle income countries, of which 33 are LDC, and 2001 - 2005 is the time period covered. This makes a panel of 3577 observations, and due to a large number of missing dependent variables a Heckman sample selection model is used to account for potential selection bias. The results paint a rather gloomy picture of overall EBA country exports. However, there are deviations across groups of products, especially so when looking at the trend during the period.

Key words: Gravity model, Heckman sample selection, Agriculture, Disaggregated trade flows, EBA.

List of Abbreviations

ACP - African Caribbean and Pacific (Preferential Agreement).

CAP - Common Agricultural Policy (of the European Union).

CGE - Computable General Equilibrium.

EBA - Everything But Arms.

GSP - General System of Preferences.

HS - Harmonized System.

IRS - Increasing Returns to Scale.

LDC - Least Developed Countries.

PTA - Preferential Trade Agreement.

Index

1 Introduction

There seems to be an ever ongoing debate about the legitimacy of agricultural protection. Advocates have stressed the vulnerability of domestic farmers while the opponents lament developing country deprivation. As an answer to the critics the European Union initiated the 'Everything But Arms' (EBA) initiative, where the poorest countries were granted quite generous trade preferences. Or so it seemed anyway.

As shall be seen further down, the EBA initiative mostly covers agricultural products. An ex post assessment of the performance of receiving countries under this regime seems like an important issue, most so because exports would be expected to increase substantially following improved market access. Hence, the aim of the essay will be to *examine how the EBA initiative has affected the volume and structure of LDC agricultural exports into the EU.* Two questions are of primary interest:

(i) How well have the EBA countries performed vis-à-vis other low- and middle income countries?

(ii) Are there substantial differences across groups of products?

One way of measuring export performance is to compare observed flows of trade with a benchmark, e.g. an expected level given some theoretically derived explanatory variables. I intend to use a gravity model for this purpose, most so because of its accessibility and empirical accuracy. It will be important to look at a disaggregated level in order to see whether an overall EBA assessment masks deviations across different groups of products. The time period covered in the sample is 2001 - 2005, which means that the point of reference will be the performance of non - EBA (low- and middle income) countries during that time

Using a gravity model on a disaggregated level is a fairly unusual method, and hence this thesis is also a way of testing the adequacy of doing so. The most obvious alternative would be a computable general equilibrium (CGE) model, which has the advantage of wider coverage, such as handling income transfers within countries, and the disadvantage of some oversimplifying assumptions, like uniform transport costs across all countries (Bruntrup, 2006: p 5). The next section gives a short literature overview, where after the rest of the thesis is organized as follows. Section two introduces the EBA initiative and the subsequent chapter presents the modeling framework. After a description of the data the estimations are carried out in section four, where also some robustness checks are performed. Section five concludes.

1.1 Literature overview

Most of the work on trade liberalization employ a CGE - framework, and examples of gravity modeling with disaggregated data have been quite difficult to come by.

Beghin & Mensbrugghe (2005) conducts a World Bank study of the potentials in agricultural trade liberalization. They model worldwide future reform scenarios in a general equilibrium framework, where approximately 70 pct. of the gains from a (very ambitious) merchandise trade reform come from the agricultural sector (Beghin & Mensbrugghe, 2005: p 116). Furthermore, the largest potential for developing countries lie in the removal of domestic distortions, which is why a reform aimed solely at improving industrial country market access would actually have a negative effect on LDCs as a group (Beghin & Mensbrugghe, 2005: pp 135).

In a similar vein, but focusing primarily on poverty and European reform, *Winters (2005)* models the proposed Doha- and CAP (Common Agricultural Policy) reforms for the time being. Not surprisingly he finds that exporting countries would gain quite a lot from the price changes predicted while net importers of food are likely to lose out. And this is especially true for small developing countries (Winters, 2005: pp 328). The author emphasizes the effects on real income and factor returns for different groups of people, which can be quite damaging in poorer countries. He concludes that effects in the short run will be diverse (among groups and countries), while a longer perspective should see them translate into more wide reaching poverty alleviation (Winters, 2005: pp 341).

Unlike the previous two examples, which are focusing on welfare effects, *Sarker & Jayasinghe (2007)* explores the implications on trade within a gravity framework. They estimate regressions for several agricultural products, and by assigning dummies to specific bilateral pairings of trade partners they find that EU - 15 intraregional trade increased during the nineties for most of the major products. During the same period trade was also diverted away from the rest of the world, albeit the evidence was not so profound in this case (Sarker & Jayasinghe, 2007: pp 97).

Persson & Wilhelmsson (2006) also uses gravity modeling in their pursuit of the effects of preferential agreements (PTAs) on developing country trade. The authors examine many different PTA settings, and not surprisingly they find ACP preferences, believed to be the most generous, to generate the largest positive effects (Persson & Wilhelmsson, 2006: pp 13). Furthermore, countries joining the EU seem to import less from developing countries, and they also note that the relative importance of PTAs for developing countries has decreased

over time as the EU expands and trade liberalization continues (Persson & Wilhelmsson, 2006: pp 21).

Yu & Jensen (2003) focus on the potential effects of EBA on LDCs, and taking into account the preferences that these countries already enjoy the gains from EBA are predicted to be quite modest. The biggest potential lies in products subject to transitional safeguards, such as sugar, but if a plausible (according to the authors) reform of CAP is implemented these potential gains may indeed fail to materialize (Yu & Jensen, 2003: pp 15).

Another contemporary study is performed by *Brenton (2003),* and he also acknowledges the low coverage of products actually being further liberalized under EBA. For many of the products the most favored nation tariff is zero, and poor countries will term diversification of exports, not improved market access, as their primary target regarding export performance. Another conclusion is the low utilization rate of preferences, somewhere around 50 percent, which the author ascribes to rigid rules of origin (Brenton, 2003: pp 642).[1]

As sugar seems to be the most controversial issue in EBA there are also a number of studies on this subject. Both *Bruntrup (2006: pp 17)* and *Conforti & Rapsomanikis (2006: pp 8)* highlight the probable deterioration of prices (and export performance) following a CAP reform, with the ACP countries looking like the main losers.

The results from previous studies thus present (i) a positive view regarding worldwide liberalization in agriculture, but also (ii) quite modest expectations on LDCs to prosper under EBA.

[1] The effect shouldn't be as severe on agricultural products as they probably are less likely to be dependent on inputs (which is often a major issue when examining the distortionary effects of rules of origin), and Candau & Jean (2005: pp 17) provide some evidence on this.

2 The EBA initiative

The program, which came to force on 5 March 2001, is in effect an extension of preferences offered under the Generalized System of Preferences (GSP) scheme, and in short offers duty and quota free access to all LDC products except arms and munitions. Hence, the agreement covers products previously listed as sensitive, including for example beef, fruit & vegetables and cereals (European Community, 2001b). There are a few exceptions, however, as protection on rice, sugar and bananas will be phased out gradually until 1 July 2009, with liberalization on sugar and rice only to begin by 1 September 2006. Furthermore, these three products are subject to safeguards meaning that the Commission can invoke temporary measures of protection "if necessary to prevent damaging surges [of imports]" (European Community, 2001a).

Like in GSP, admission is granted based on LDC status, as determined by UN - criteria. Apart from low scores on income and human resources, instability of agricultural production and exports of goods and services, among other things, are considered when determining on LDC status. A population not greater than 75 million is also a prerequisite (Yu & Jensen, 2003: p 36). When EBA came into force there were 48 countries that fulfilled these criteria, which however doesn't mean automatic and unconditional qualification. Myanmar, for example, was recently suspended on a temporary basis, and others may fail to comply with some administrative demands. This matter will not be looked into any further in this thesis, but on a starting note 39 of the 48 countries were previous ACP (African, Caribbean and Pacific) beneficiaries, and thus the majority of LDC will probably enjoy good preferential access under EBA.

It is important to acknowledge the fact that many countries enjoy preferences into the EU under different schemes[2], where for example the ACP agreement (which mostly consists of former European colonies) dates all the way back to 1957. Furthermore, in 2004 there were 178 developing countries eligible for GSP treatment (Senior Nello, 2005: pp 370). So making a comparison between EBA and other countries doesn't mean comparing free market access to some group facing homogenous tariffs and quotas. But it should be the closest shot available to a natural experiment of this kind.

Looking at EBA, which of course is an ambitious program, the optimist will salute it as a gift to the developing world while the cynic shall call it a deceptive way of reforming CAP

[2] See Persson & Wilhelmsson (2006) for an extensive assessment on this subject, and Bhagwati (1995), for example, on the issue of preferential agreements in general.

and making adherence to forthcoming WTO negotiations possible. Without making judgment prior to investigation it is clear that the effects need to be examined carefully, and one way to start is by looking at liberalization contra the amount of exports in each subgroup.

Due to previous preferential agreements the liberalization under EBA is not exceptionally wide ranging, with only 919 affected tariff lines at the HS - 8 level. However, most of them are agricultural products, as can be seen in column 2 in Table 2.1 below.

	No. of HS items	**Av. Pre EBA tariff**	**Volume of exports**	**Share of exports***
Product category			*1.000 USD*	*pct.*
Sugar	9	75-103	67,618	100,0
Veg. & fruit etc.	35	2,3	17,203	13,9
Cereals etc.	12	37,1	11,283	100,0
…	…	…	…	…
Beverages	108	1,2	432	31,3
Proc. rice	17	87,4	399	100,0
Meat	153	9,7-19,2	378	40,2
Bovine meat	48	9,7-19,2	217	100,0
…	…	…	…	…
Paddy rice	16	61,6	38	100,0
Dairy prod	165	51,2	21	58,3
…	…	…	…	…
Fishing	0	0,0	0,0	0,0
…	…	…	…	…
Total	919	…	99,896	4,0

Table 2.1: Product coverage of the EBA initiative. Note that the data is for 1999.
Source: Yu & Jensen (2003).
** The share of total EBA exports.*

The interesting part here is columns 2 and 3 combined, where it can be seen that the potential for increasing exports under EBA is biggest for (non - sensitive) products contributing to a big share of total LDC exports while being subject to extensive pre - EBA tariffs. Sugar exporters stand as potential gainers[3] when the protection here is finally phased out, which is not during the period of investigation in this thesis. Fruit & vegetables comprise quite a heavy deal of exports from LDCs, approx. 17 million USD, but there is not much to cut from the initial 2,3 pct. tariff rate. Therefore, cereal exporters look like the only really potential gainers, with a 37,1 pct. tariff to be removed. Elsewhere there are a few high tariff lines scheduled for elimination, like the one for dairy products, but flows in this category is not

[3] Although looming reforms on the internal sugar market could depress the prices and thus liberalization here doesn't automatically translate into big gains for LDC exporters. See for example Bruntrup (2006) for a (pessimistic) view on this matter.

directly massive. In all, the EBA products account only for a 4 pct. share of total agricultural exports from LDC countries in 1999 (Yu & Jensen, 2003: pp 11).

3 Theory and method: general considerations

The gravity model will be put forth in this section, with both theoretical background and empirical specification described quite closely. Furthermore, as the Heckman sample selection model will be used to correct for possible sample selection bias, it will be introduced and described in section 3.2.

3.1 The gravity model

In its simplest form the gravity model has bilateral volumes of trade as a function of the distance between two countries and the product of their GDPs. Although the model at first seemed to appear in a theoretical vacuum the empirical results have been remarkably accurate. The pioneering work of Tinbergen (1962) has enjoyed improvements in a number of areas, such as theoretical underpinnings (e.g. Anderson [1979]; Helpman & Krugman [1985]; Deardorff [1998]) and empirical specification (e.g. Anderson & van Wincoop [2003]; Haveman & Hummels [2004]; Santos Silva & Tenreyro [2006]). There have been extensions to incorporate the effects of Free Trade Areas (Frankel [1997]) and Currency Unions (Rose [2000]), while some recent applications also allows for firm heterogeneity (Helpman et. al [2007]).

3.1.1 Theoretical background

The standard theory of international trade used in the model has been one of monopolistic competition, a situation where firms differentiate their goods in order to create preferences and enjoy some degree of market power (Helpman & Krugman, 1985: pp 131). Firms will specialize in one good[4], and differentiation can be either by the place of origin or minor product characteristics. Another assumption is that preferences are homothetic and identical, which is captured by a CES (constant utility of substitution) function:

$$u_k = [\sum (D_{k\omega})^{\delta}]^{\frac{1}{\delta}}, \qquad with\ \delta = 1 - \frac{1}{\sigma} \tag{eq. 3.1}$$

where u is utility, D marks demand, σ will be the elasticity of substitution between pairs of varieties, and k ,ω denotes industry and variety respectively. From this relationship it is clear

[4]This should be the profit maximizing behavior in the presence of IRS.

that consumer utility increases with the number of varieties consumed.[5] The situation that follows will then be characterized by (i) complete specialization of production (of varieties), and (ii) consumers that demand all varieties produced (Anderson & Wincoop, 2003: p 174). Somewhat simplified, we can have that country i consumes its income share of world production of a certain good (produced by country j), and with complete specialization this will also be the total world production of that good. Summing over all sectors will yield that

$$M_{ij} = \frac{Y_i Y_j}{Y_w} \qquad (eq.\,3.2)$$

that is, imports to i from j is determined by the product of their GDPs relative to total world output (Haveman & Hummels, 2004: pp 202; Helpman & Krugman, 1985: pp 159).

Of course, trade in the real world is unlikely to occur without friction. Early work saw impediments to trade modeled as absolute bilateral distance between pairs of countries, which was eventually extended, e.g. by Anderson & van Wincoop (2003: pp 174), to also highlight the importance of relative trade barriers. The authors argue that prices differ between regions due to trade costs, and with a general equilibrium framework[6] they arrive at $P_j = f(P_i, \theta, t_{ij})$, where the price in j will be a function of price in i, income shares and bilateral trade costs (assumed to be symmetrical). This implies the incorporation of $\left(P_i P_j / t_{ij}\right)^{\sigma-1}$ in the gravity equation, and a simple justification can be that i´s propensity to trade with j may very well be determined by bilateral trade costs (t_{ij}), but in relation to the costs associated with other trading partners, i.e. the rest of the world ($P_i P_j$).

The above derivation seems quite well suited to explain the soaring rates of intra - industry trade in the eighties. However, since it may not explain the zero - trade flows that are more likely to appear in a traditional framework, it becomes somewhat less appealing when dealing with North - South trade in agriculture. Thus it may be a good idea to incorporate some elements of the Heckscher - Ohlin model. It is well known that if two countries differ substantially in relative factor endowments we may also have complete specialization of

[5] Using $D_{i\omega} = E/pn$, with E n p representing expenditure share, number of varieties and a price index respectively, $\partial u/\partial n = \left(\frac{1}{\sigma-1}\right) \times \left(\frac{E}{p}\right) n^{\left(\frac{1}{\sigma-1}\right)-1} > 0$, since a plausible assumption is of σ to exceed 1 (see Helpman & Krugman, 1985: pp 113).

[6] The market-clearing conditions are used to solve for equilibrium price indices (P_i, P_j) and demand (X_{ij}) for bilateral trade relations between j and i.

production[7], and therefore it seems important to include some measure of comparative advantage in the gravity model. This is indeed what Evenett & Keller (2002: pp 285) does, such as

$$M_{ij} = (\gamma_i - \gamma_j)\frac{Y_i Y_j}{Y_w}, where\ \gamma_k = K_k/L_k, \forall\ k \ni i,j$$

$$(eq.3.3)$$

This line of reasoning can be used in a multicountry world as well, although some modifications are necessary. With many countries producing homogenous goods consumers will be indifferent towards whom to buy from, since prices will be equalized around the world in the presence of identical techniques of production and zero transport costs. Now, the introduction of transport costs again makes it possible to derive the gravity model. Since $P_i = P_j(1 + t_{ij})$, positive and variable (among partners) trade costs will drive demand towards the cheapest source of supply, and we shall be able to pin down the patterns of bilateral trade (Haveman & Hummels, 2004: pp 203). Here, comparative advantage determines the set of potential trading partners, and the transport costs should decide which one that will be made associate of commerce. Respective income of the countries can be thought of as either a proxy for multilateral trade or as a theoretical derivation of the volume of trade in a $\{2 * 2 * 2\}$ factor proportions model (Haveman & Hummels, 2004: pp 209; Deardorff, 1995: p 8).

Furthermore, it is also possible to impose CES preferences on Heckscher - Ohlin production. With the standard assumptions of the model it is true that in the presence of trade costs there will be no trade between any pair of countries with the same factor prices.[8] Unequal factor prices, then, will be the driving force behind differentiation of production, and again trade costs shall determine the pairing of trade partners. With differentiated production and a CES structure of demand, trade shall depend both on bilateral trade costs and the average distance to all suppliers (Deardorff, 1995: pp 17). This is a resemblance of, or actually the predecessor to, the Anderson & van Wincoop (2003: pp 174) gravity model of monopolistic competition described at the outset of this section.

[7] As the K/L – ratio determines input prices in a two - factor economy, high enough differences in endowments will cause the production of a capital intensive good unprofitable in the labor abundant country (Kaempfer et. al, 1995: pp 98).

[8] With similar production functions and constant returns the exporter will always have to charge a higher price than the domestic producers, i.e. since $P_i = P_j(1 + t_{ij})$. With unequal factor prices, caused by abundance of factors for example, this disadvantage can be overcome.

To summarize, this section has seen the derivation of a gravity model from different theories of international trade, i.e. monopolistic competition and factor proportions theory. There are other possibilities as well, like the use of a Ricardian setting (Eaton & Kortum [2001]), while Evenett & Keller (2002: pp 309) also highlights the unsurprising fact that increasing returns and factor endowments explain different parts of the observed international trade patterns. Putting aside the theoretical derivation of the model, it is very common to depart from either eq. 3.2 or 3.3, with the addition of some proxy for trade resistance. In our case the volume of trade will be modeled as

$$VT = f(Y_i, Y_j, D_{ij}, \zeta_{ij}). \qquad (eq. 3.4)$$

with D_{ij} consisting of an array of variables that should affect the resistance towards trade, and ζ_{ij} should be a measure of comparative advantage (as in eq. 3.3). The next section delves into the issues of specifying the gravity model for empirical use.

3.1.2 Specifying trade resistance

In the simplest version of the model transport costs are incorporated with a measure of absolute distance, a term that is likely to pick up effects of a whole lot of variables that might be trade impeding. Leamer & Levinsohn (1994: p 44) identified distance as a good proxy for transport costs, while both transaction- and communication costs should increase the farther away a partner is situated (Head, 2003: p 7).

The common praxis has been to extend this standard equation in a number of ways, often by imposing a set of dummy variables. These can capture special sought after effects, like those of a Free Trade Area or a Currency Union, while they should also decompose the variables that are correlated with the distance term. Examples of these dummies are adjacency, common language and/or religion, and whether or not two countries share the same colonial heritage. These measures are intended to model the ease of doing business and the costs associated with establishing new trade relations, both whom are non - trivial parts of the costs facing exporters.

In addition, access to water should press down the costs of international trade. Thus, *landlocked* is a standard term in the gravity equation, and for countries designated to poor infrastructure and communication an unfavorable geographical position may seriously increase transportation costs (Limao & Venables, 2001: pp 461). Of course, with access to relevant data infrastructure can be included as a variable of its own, but preferably in the form of an index rather than a dummy.

When explicitly concerned with agricultural products it seems important to include a *climate* dummy. Some products, e.g. sugar, can be produced much cheaper in warmer climates, whereas coffee simply won't survive without it. In this case, (the right) climate should be a comparative advantage to the former and a prerequisite for the latter. The construction of climate dummies for each and one of the countries in the sample may very well prove to be time consuming, and an alternative would be to simply use the absolute value of country latitudes as an explanatory variable.

Due to the explosive increase in the number of *regional trade agreements*, it may be a good idea to include dummies that can capture their possible effects on bilateral trade flows. Greenaway & Milner (2002) presents an overview of the literature on Free Trade Agreements, and Rose (2000; 2004) finds currency unions to be highly influential, while WTO membership surprisingly isn't.

The dummies described above are generally quite good at capturing the features of bilateral trade resistance, which leaves us with the task of identifying a good measure for trade costs against all other trading partners. Anderson & van Wincoop (2003) introduced the concept of multilateral trade resistance in cross - section analysis, and while their method has clear theoretical merit[9], it is quite complicated. Another option would be the use of GDP - weighted distance, deemed to measure the *remoteness* of a country towards the rest of the world.[10] Following Carrére (2006: p 227) it can be defined as

$$R_i = \left[\sum Y_l (D_{il})^{1-\sigma}\right]^{\frac{1}{1-\sigma}} \qquad (eq.3.5)$$

This is simply the sum of the GDP - weighted distances between i and all its trading partners, and the measure shall be used together with bilateral trade resistance, which can be summed up by

$$t_{ij} = \prod C_{i,j} \times e^{\sum \mathrm{DUM_{ij}}} \qquad (eq.3.6)$$

The last equation tells us that bilateral trade resistance will be measured as a function of (i) the product of some continuous variables, $C_{i,j}$, meant to capture country specific disadvantages as well as the distance between partners, and (ii) the sum of dummy variables as discussed above. The gravity model is almost always specified in a log - log form, and a

[9] With the price indices derived from a general equilibrium model, as described in a previous section.
[10] Concurrently, the distance to Washington will be of greater economic importance than the distance to Kiribati.

formulation like eq. 3.6 will have the convenient property that the estimates of a continuous variable will measure elasticity (with respect to volumes of trade) while categorical variables shall assess magnitude, like the volume of trade for EBA countries during the sample period.

There are some problems, however, when working with developing countries. Some data, e.g. on infrastructure, is seriously limited. It therefore becomes difficult to construct meaningful variables, other than distance, to be included in $C_{i,j}$ above. One solution would be to work with country specific effects, like assigning one dummy to each exporter, a method both Cheng & Wall (2005: pp 54) and Matayas (1997: pp 363) argue will correct some of the potential bias that might otherwise threaten the dummy variables. This method would probably also capture some of the multilateral trade effects mentioned above.

3.1.3 What about the zeroes?

A potential problem with the gravity model is the empirical reality of zero trade flows (Haveman & Hummels, 2004: p 210). The extent of zeroes should vary with country selection and the level of aggregation, but there is reason to believe that a sample of disaggregated North - South trade flows in agriculture will contain a considerable amount of zero values in the dependent variable.

Theoretical explanations for these zeroes are often sought in models that allow for firm heterogeneity and emphasize the large fixed costs of exporting. Here a firm's production cost will depend on their level of productivity, and therefore only the more productive producers can be profitable exporters (Melitz, 2003: pp 1698). The basic insight of this, i.e. that fixed costs causes firms to self select into exporting, shouldn't necessary be lost in a model assuming homogenous firms. But the issue will instead be to find country - level determinants of advantages to the exporting sector, and some of the dummies believed to influence bilateral trade resistance have been used for this purpose (Helpman et. al, 2007: pp 16). I intend to elaborate on a few different variables in this role, starting with some measure of comparative advantage.

The econometric difficulties start with the log - linearization of the model, first and foremost since the log of zero is undefined. One way to deal with this would be to arbitrary add a small constant to the dependent variable, e.g. $ln\,(y+1)$, so that y never takes the value of zero. However, the result is often inferior to alternative solutions, yielding large biases in the estimated coefficients (Santos Silva & Tenreyro, 2006: p 648; Martin & Pham, 2008: p 17). Another common solution is to simply exclude the observations with zero trade flows. This is generally a bad idea since this means the loss of information, particularly about the

variables that caused the zeroes in the first place. That is, a variable that influences the decision not to trade *and* the volume of trade will be biased upwards in an OLS regression that excludes all observations with zeroes (Linders & de Groot, 2006: p 8, 21; Santos Silva & Tenreyro, 2006: p 648). It is also possible to correct for the zeroes with a Tobit model. Here it is assumed that the zeroes contain actual small values which have been rounded downwards to zero. Examples may be a set of data that only reports values exceeding 1000 $, which then becomes the threshold for truncation. The model will use information about the probability of being censored, and the difference to just excluding the zero observations is that the probability distribution of y is altered to account for this censoring (Long, 1997: p 187). This is a suitable technique in the cases where censoring actually has occurred, but if the data set is accurate enough then the zeroes are more likely to be the causes of economic decisions[11] (not to trade) rather than censoring. It is more desirable, then, to try and model these actual decisions (Linders & de Groot, 2006: p 4).

There are important connections between the potential to trade and the flows of trade between two countries, which is influenced by similar but not identical variables. This insight shall provide a basis for using the Heckman model described in the next section.

3.2 A model of sample selection

As was mentioned above it may be wise to correct for the potential bias introduced by zeroes in the dependent variable. That is, the result of not doing so may or may not be biased estimates, which is only clear after correction has taken place. I intend to use the Heckman (1979) sample selection model (short named Heckit), most so since it is a quite straightforward way to actually model the decisions whether or not to trade. In short, Heckit is a two - step procedure: (i) it models the probability of trade between two countries, i.e. how countries *select* into trading relations, and (ii) this information is used to estimate a *gravity equation* robust to sample selection bias.

3.2.1 The selection

There are many cases, in economics but also in other fields of research, where the dependent variable might not be directly observable. Zero imports is such a case. The probability of trade between two countries, for example, should be continuous and dependent on a set of

[11] This decision should be based on the assessment of profitable exporting destinations, which is connected to the ability to meet the associated fixed costs.

variables, w, such that $z^* = wa + v$, where z* is the probability of bilateral trade and v is a disturbance term. However, we only observe whether or not trade actually takes place, so

$$z = \begin{cases} 1 \; if \; z^* > 0, i.e \; there \; is \; trade, or \\ 0 \; if \; z^* \leq 0, and \; no \; trade \; occurs \end{cases}$$

$$(eq. 3.7)$$

The probability of trade to occur will then be[12]

$$\Pr(z = 1|w) = .. = \Phi(wa)$$

$$(eq. 3.8)$$

where Φ represents the cumulative distribution function of v, assumed to be normal. That is, the probability of trade, z*, given w is a function of the c.d.f. evaluated at wα, where z* is required to exceed zero in order to be observed (Long, 1997: pp 34). The vector of parameters, α, is then estimated using maximum likelihood.[13] Knowing something about the (unobserved) probability to trade is an important building block for Heckit, most so since it can then be examined whether the sample selection is indeed random or not.

3.2.2 The gravity equation

Following Long (1997: pp 215), a formal approach of Heckit may look like this: we are interested in estimating the volume of trade, $y^* = x\beta + \varepsilon$, which is however only observed for flows greater than zero, modeled as z in eq. 3.7. This probability should be correlated[14] with the volume of trade, and by assuming that the respective errors, v and ε, are correlated and normally distributed, the expected value of y given that z* exceeds zero can be modeled as

$$E[y|z = 1] = x\beta + \gamma\lambda, \qquad with \; \lambda = \frac{\phi(-wa)}{\Phi(-wa)}$$

$$(eq. 3.9)$$

Here the quotient, λ, is the standard normal p.d.f., $\phi(.)$, divided by the standard normal c.d.f., Φ(.), simply measuring the probability of being included in the sample. With this last equation it is clear that a standard gravity equation, regressing y solely on x for the observations where $z = 1$, run the risk of being biased due to the omission of λ (Ibid.).[15]

[12] The full relationship will be $Pr(z = 1|w) = Pr(z^* > 0|w) = Pr(wa + \varepsilon > 0|w) = Pr(\varepsilon \leq wa|w) = F(wa) = \Phi(wa)$.

[13] This will maximize the probability of observing the actual sample, assumed to be normally distributed and generated by β. This estimator has the properties of consistency, efficiency and normality (Greene, 2003: pp 470; Long, 1997: pp 52).

[14] That is, the vectors of independent variables in respective equation, w and x, should be correlated.

[15] Actually, $\gamma = \rho\sigma_\varepsilon$ where $corr_{\varepsilon v} = \rho$, such as situations only where $\rho = 0$ yield unbiased estimates of y regressed on x, i.e. when selection into trade relationships is completely random.

In the Heckit two - step process, then, a probit model (the probability modeled in eq. 3.7 and 3.8) will initially be estimated. Next, λ is computed and included in the gravity equation, which can be estimated using standard OLS techniques. The final equation may be subject to problems of collinearity, which is why the performance of this estimator improves substantially if $x \neq w$ (Martin & Pham, 2008: p 13; Leung & Yu, 1996: pp 227). The exclusion of at least one explanatory variable from x may be theoretically unjustified in some cases, whereas recent works suggest that this shouldn't be the case with a gravity equation, as argued in previous sections.

When using Heckit, a decision needs to be made whether to estimate the whole system with ML or use the two - step approach described above. While the full ML may be a marginally better performer it is also more of a burdensome procedure. Further, an alternative parametric sample selection model is the two - part model, and Leung & Yu (1996: pp 207) find that each of the two models perform well under different conditions. I take it that the Heckman model should be quite well suited to gravity modeling, with large variations in Y and the possibility to exclude one selection variable from the final equation. Martin & Pham (2008: pp 25) examine the performance (with Monte Carlo simulations) of different sample selection models, and they find Heckit to perform very well in a gravity setting. After this section about the gravity- and Heckman models in general, we shall proceed to formulate a model and use it in the empirical exercise.

4 Estimation

In a straightforward manner, the basic framework (to be used in various forms) will be

$$ln\, M_{ijt} = \alpha + \mu_j + \lambda_t + \beta \boldsymbol{X}_{jt} + \gamma \boldsymbol{D} + \varepsilon_{ij} \qquad (eq.\, 4.1)$$

where M_{ijt} is imports to EU-15 from developing country j at time t, and μ_j and λ_t are country- and time fixed effects respectively. $\mathbf{X}$ is a vector of explanatory variables in natural logarithms, and $\mathbf{D}$ will be a set of dummy variables used to capture exporter heterogeneity and the sought after effects of being an EBA country. E_{ijt} is a normal distributed error term. For the Heckman specifications selection is made on the basis of reported imports exceeding the value of zero, and a measure of openness (the ratio of imports plus exports to GDP) has been found to be the most suitable selection variable.[16] The explanatory variables are *GDP*, *GDP per capita*, *remoteness* and the absolute value of *latitude* as a proxy for the climate of the exporting country. In addition, *landlocked* is included amongst the dummy variables, and *agricultural land per capita* will be used as a crude measure of comparative advantage.[17]

A few additional notes on this equation may be in order. First, since it is only exports into the EU that is of primary interest the explanatory variables for importer, i, has been excluded. Another consequence of this design is that distance and remoteness should be more similar to each other, i.e. since the remoteness of importer will be (almost constant) and equal in distance to the distance variable, and hence distance will be excluded as well. These exclusions are based both on reasoning and empirical testing, and data on imports should, all else equal, be better reported than that of exports.[18] As already noted, the dependent variable is EU - 15 imports, and a year dummy has been used in order to capture general effects specific for each year, not least the enlargement in 2005.

This model may be susceptible to some problems, most notably collinearity, which will be tested for. Endogeneity should not really be an issue since imports of agricultural products shouldn't constitute a big enough part of the independent variables, like GDP. The fixed effects are used in order to detect country specific heterogeneity, like internal transport costs, not picked up by the other variables.

[16] I have tried with various measures of agricultural comparative advantage, and also a lagged value of exports, but openness proved to be best suited (i.e. significant in the selection but not in the gravity regression).
[17] On a very general level developing countries may face the choice of exporting labor intensive goods, like clothes and textiles, or land intensive goods like agricultural products.
[18] Since imports are more likely to be generating (tariff- and tax-) income to the country, reporting procedures should probably be more precise.

4.1 The data

The data consist of 102 low- and middle income countries (as defined by the World Bank), of which 33 are LDC and thus qualify for EBA status. Originally there are 158 countries on that list, 49 defined as LDC, and I have selected the sample after data availability on the independent variables. Data on imports are collected from source OECD, SITC rev. 3, and most of the other variables come from the world development indicators (WDI) database. Distance- and climate variables are calculated from CEPII data, and the coverage of EBA preferences is listed in Persson & Wilhelmsson (2006). A complete description of countries, variables and sources can be found in the Appendix. Exports are divided in seven product groups, and figure 4.1 displays their respective flow into the EU in 2001.

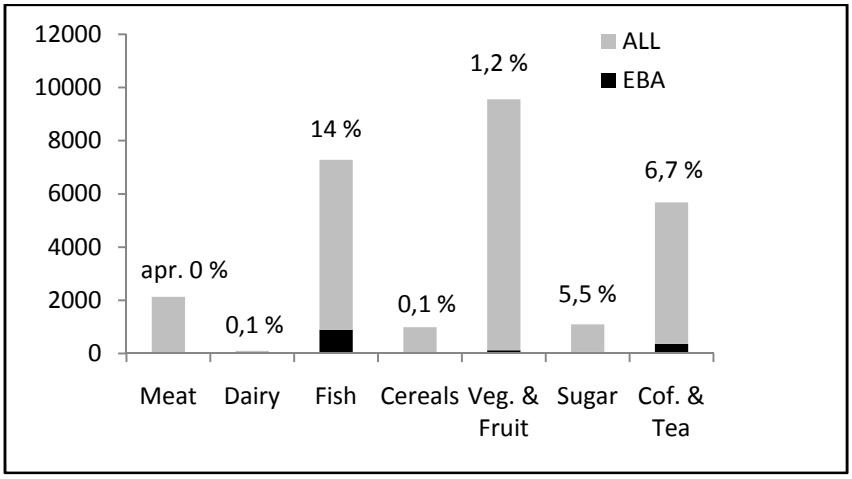

Figure 4.1: EU - 15 imports of agricultural products in 2001. Billions of USD.
Source: source OECD, SITC rev. 3; own calculations.

The volume of exports can be read off the vertical axis, and the relation between EBA countries and all low- and middle income countries (included in the sample) is visualized in each pile. There are quite big differences across products, where for example fish by large contributes to the biggest amount of EBA exports, both in absolute and relative terms. Notably there are virtually no exports of dairies from the 102 countries analyzed, and EBA exports of meat are almost non - existent.

Next we are curious about what happens during the sample period, and figure 4.2 shows the evolution of agricultural exports between 2001 and 2005. Now, some large changes can be seen. Most notably EBA exports of meat increases heavily. Veg. & fruit and fish follow the trend for all countries quite closely, while dairy exports actually moves backwards. Before jumping to conclusions it is important to remember that the EBA share of

meat- and cereal exports consisted of virtually zero pct. in 2001. Actually, meat was still the smallest in 2005, and cereal had increased its share with only half a percent or so.

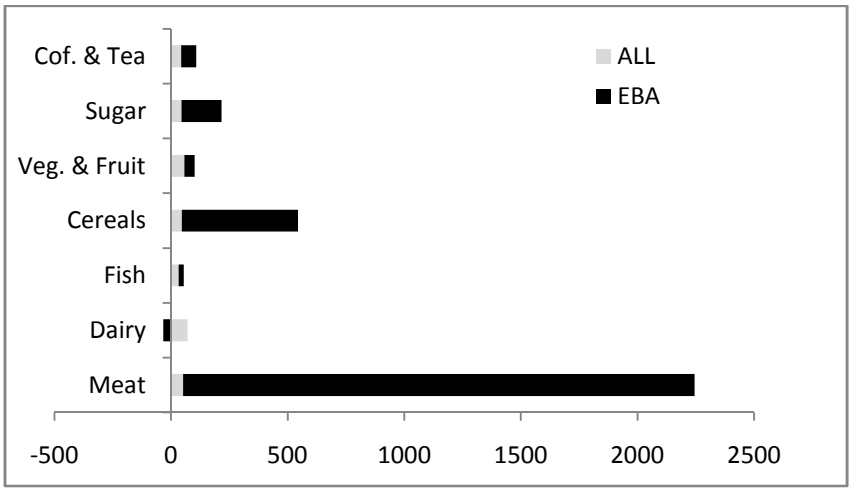

Figure 4.2: The percentage change, read of the horizontal axis, of exports between 2001 and 2005. The values are deflated with US CPI - index.
Source: source OECD, SITC rev. 3; own calculations.

It is also important to acknowledge how other variables have changed during the period, as for example population- and income growth in the EU should, all else equal, contribute to increased demand for food. This is where the gravity model comes in, as we shall try to determine whether the volumes of exports during the period are in line with some natural level of trade, as predicted by the set of independent variables.

On an ending note there are 1059 no. of zero trade flows present in the sample, which is almost one third of the 3577 observations in total. This confirms the initial suspicion regarding the number of zeroes in disaggregated data, and it quite motivates some sort of control for sample selection bias.

4.2 Results and discussion

Using the information from previous sections we should by now have some clues about what to expect from the estimations. In section two cereals was identified as a product group with big potential, while both meat and dairy products have enjoyed large tariff reductions. And as was seen in the previous section, meat- and cereal exports increased by far the most when measuring the percentage changes during the period. Dairy, however, moved slightly backwards. Furthermore, some of the literature reviewed indicated large potential benefits from removing barriers in agriculture. It is important to remember, though, that both Winters

(2005) and Beghin & Mensbrugghe (2005) are concerned with all developing countries, which is quite different from the exercise of comparing the least developed ones to other low- and middle income countries. And of course, by using a gravity model the changes in volume and structure of imports are made conditional on theoretically derived determinants of international trade.

For starters, the difference (in exported volumes) between EBA- and non EBA countries will be of primary interest, and table 4.1 presents four specifications on this matter.

	OLS†		Heckman			
	1	2	3		4	
No of obs.	3577		3577 (2518)††		3577 (2518)††	
			Regr.	*Sel.*	*Regr.*	*Sel.*
Variables						
GDP	1,47*	1,47*	0,85*	0,26*	0,97*	0,35*
GDP per capita	-0,20	-0,20**	-0,02	-0,06*	-0,04	-0,08*
Agriculture	0,10	0,10	0,23*	-0,02	0,23*	-0,02
Latitude	-0,06	-0,01	0,00	-0,01	0,01	-0,02
Openess	1,07*	1,07*		0,46*		0,58*
Remoteness	-0,53*	-0,53*	0,12	-0,19*	-0,05	-0,24*
Landlocked	-2,17*	-2,17*	-0,93*	-0,38*	-1,05*	-0,51*
T. 02	0,12	0,12	0,14	0,00	0,14	0,00
T. 03	0,03	0,03	0,30	-0,06	0,28	-0,09
T. 04	-0,00	-0,00	0,11	-0,04	0,11	-0,05
T. 05	0,02	0,02	0,39**	-0,09	0,36**	-0,14
EBA	-1,39*		-0,67*			
Meat		-3,29*			-3,31*	
Dairy		-1,25*			-2,19*	
Cereals		-1,97*			-2,25*	
Veg. & Fruit		-1,03*			-1,70*	
Cof. & Tea		0,15			0,11	
Sugar		-2,26*			0,15	
Fish		-0,06			0,05	
R^2	0,27	0,52				
Inv. Mills Ratio			1,71		1,95*	

Table 4.1: Estimating the volume of trade. All continuous variables are in logs. Note that the constant has been left out. The EBA dummy (in column 1 and 3) measures the deviation of EBA country performance vis-à-vis non EBA countries, and in column 2 and 4 this is disaggregated to the performance of each group of commodity, e.g. the deviation of EBA meat exports from non - EBA meat exports.

† Standard errors are robust.
* Indicates significance at 95 pct. - level.
** Indicates significance at 90 pct. - level.
†† There are 2518 uncensored observations.

In the two OLS estimations a single unit was added to all observations on the dependent variable, making the log - log transformation possible. This is somewhat arbitrary and doesn't explicitly handle the export decision, as argued in section three above. No country fixed effects are used as they would disturb all time invariant variables, EBA dummies included. Reading in column 1, it can be seen that GDP, remoteness and landlocked all are significantly different from zero and carry expected signs. A one percentage increase in exporter GDP will, all else equal, increase aggregate agricultural exports with 1.47 pct. The openness variable is also positive and significant, displaying an almost one to one relationship with exports. The independent variables explain about 27 pct. of the variation in exports, which seems reasonable since flows are included separately in the dependent variable. Naturally, using only total exports in agriculture would increase the fit, but we would be unable to say anything about differences across groups of products. The EBA dummy, measuring the difference between EBA- and non - EBA countries, indicates a 75 pct. worse overall performance for EBA countries during the sample period.[19]

Next, as seen in specification 2, dummies for each product group are included. Not unsurprisingly, R^2 increases to 0,52, while no other important changes have taken place. Looking at the group dummies, each one measuring the difference between EBA- and non - EBA exports in that specific category, the results are quite depressing (and somewhat unexpected). In five of the seven product groups EBA countries performed between 64- and 96 pct. worse than their non - EBA counterparts, with meat and sugar being the worst performers. Additionally, the measure of comparative advantage doesn't seem to exert any influence whatsoever on aggregate exports.

We now move on to the Heckman specifications, were openness was initially found to influence the decision to trade but not the volume, and has thus been used as a selection variable. First and foremost, remoteness shows significance only in the selection, while it is the other way around for agricultural land per capita. Regarding the former, one immediate explanation is that it is a better proxy for fix than variable costs, especially when dealing with mostly poor countries. This is interesting, but also a bit worrying since no other measure of costs, bar landlocked, seems to be present in the gravity model. This is partly amended by the introduction of fixed effects estimation, which has unfortunately only been possible in the OLS framework. As for the significance of the latter, then, it is only good news since it was expected to have a positive influence.

[19] $100*(e^{-1,39}-1)$

These results suggest that there is some form of sample selection bias present in the sample, although it was just rejected at the 0,90 - level of significance.[20] And as the primary subjects of interest, EBA countries performed considerably better than in the OLS estimation, trading some 49 pct. less than what is predicted by the gravity equation. On a disaggregated level there is clear selection bias, as indicated by the inverse mills ratio statistic. EBA sugar exports are not, as opposite to in the OLS, significantly different from non EBA country exports. Furthermore, EBA dairy exports performed considerably worse in the Heckman specification, while results for the other product groups more or less resemble those of the OLS estimation.

An overall negative performance of EBA countries was rather expected, as it would naturally take some time for export increases to gather momentum and overcome (for example) constraints in supply capacity. However, during the period we would expect EBA exports to increase more than those of their non EBA counterparts. In order to measure this effect a trend is introduced and interacted with EBA- and non - EBA group dummies.[21] The results can be seen in table 4.2, where the displayed product dummies measure within - group (EBA and non - EBA) deviations of respective product group. Thus, column 1 and 2 tell us that the development over time for overall EBA exports wasn't significantly different from that of the other countries. This masks some important deviations on a disaggregated level. Judging by the OLS specification, non - EBA exports has enjoyed a homogenous development over the period, with none of the product groups deviating significantly from the average trend. As for the EBA countries, meat exports grew some 33 pct. less than the average, while the corresponding number for tea & coffee was 68 pct. above average.

Next, the fix effects estimations do not change the overall picture, as the only deviations are the positive and significant trends in EBA fish- and non EBA sugar exports. Also, the higher R^2 suggests that there are some variables uncounted for in the previous estimations, but judging by the relative similar results on the EBA dummies this shouldn't need to be a big cause of concern. However, I wasn't able to estimate the Heckman models with fix effects, and we can only assume that it would behave in a similar manner to the OLS specifications.

[20] The t stat. is 1,63, such as $P > |z|$ becomes 0,102.

[21] In spec. 2, for example, $\ln M_{ijt} = .. + \beta_1 Tr + \beta_2 EBA + \beta_3(Tr \times Grp_2) + .. + \beta_8(Tr \times Grp_7) + \beta_9(EBA \times Tr) + \beta_{10}(EBA \times Tr \times Grp_2) + .. + \beta_{15}(EBA \times Tr \times Grp_7)$. Concurrently, β_9 will indicate how much the excluded EBA group differs from the average EBA trend, and β_1 indicates the difference between the excluded non EBA group and the average non EBA evolution of exports.

	OLS†				Heckman			
	1	2	3	4	5		6	
No of obs.	3577		3577		3577 (2518)††		3577 (2518)††	
					Regr.	*Sel.*	*Regr.*	*Sel.*
Variables								
GDP	1,47*	1,47*			0,85*	0,26*	0,97*	0,35*
GDP per capita	-0,20	-0,20**			-0,02	-0,06*	-0,04	-0,08*
Agriculture	0,10	0,10			0,23*	-0,02	0,23*	-0,02
Latitude	-0,06	-0,06			0,00	-0,01	0,01	-0,02
Openess	1,08**	1,08**				0,46*		0,58*
Remoteness	-0,54*	-0,54*			0,12	-0,19*	-0,04	-0,24*
Landlocked	-2,17*	-2,17*			-0,93*	-0,38*	-1,01*	-0,52*
Fix effects			YES	YES				
EBA dev.	0,07		0,14		0,01			
Meat		-0,40*		-0,41*			-0,5*	
Dairy		0,12		0,11			-0,4	
Cereals		-0,03		-0,04			-0,22**	
Veg. & Fruit		0,18		0,17			-0,18	
Cof. & Tea		0,52*		0,51*			0,29*	
Sugar		-0,06		-0,08			0,37*	
Fish		0,35		0,34**			0,24*	
Non-EBA dev.								
Meat		0,1		0,18			-0,21	
Dairy		-0,24		-0,14			-0,11	
Cereals		-0,00		-0,09			0,22**	
Veg. & Fruit		-0,00		-0,09			0,14	
Cof. & Tea		-0,07		0,02			0,03	
Sugar		0,2		0,30*			0,11	
Fish		-0,26		-0,17			0,05	
R^2	0,27	0,52	0,37	0,63				
Inv. Mills Ratio					1,70		1,81*	

Table 4.2: Estimating the volume of trade. Focus is on the development (during the sample period) across groups of countries and products. All continuous variables are in logs. Note that the constant has been left out. As in table 4.1 the EBA dummy measures the difference between EBA and non - EBA countries, whereas the dummies for each commodity group pins the development of this group against the overall trend of EBA exports. See footnote 21 for specification.

† Standard errors are robust.
* Indicates significance at 95 pct. - level.
** Indicates significance at 90 pct. - level.
†† There are 2518 uncensored observations.

The Heckman estimations show no differences on an aggregate level, while a disaggregation results in a positive and significant deviation of non - EBA exports of cereals. For EBA countries both sugar-, coffee & tea- and fish exports enjoyed a positive

development between 2001 and 2005, measuring 48-, 34-, and 27 pct. respectively. Meat performance was even worse than in the OLS estimation, and the exports of cereals deviated negatively when sample selection bias was controlled for.

It is at first quite puzzling that the results in table 4.2 stand in such a contrast to the percentage changes over the period, as displayed in figure 4.2. But two factors should contribute to this discrepancy, as (i) the estimations have volume of trade, not the percentage change, as the dependent variable. EBA meat exports, for example, still consisted of the smallest part of developing country exports in 2005. And (ii), the regressions estimate the variation in volume of exports *conditional* on the variation in explanatory variables, i.e. $E[y_i|X_j, D_j = 1]$.

As has already been suggested collinearity could be one cause of concern, especially with the large number of dummy interactions and a fairly high degree of censoring. And the mutual correlations between explanatory variables are far from negligible. This is evident from the variance of inflation ($VIF = 1/(1 - R^2)$) displayed in table 4.4 and 4.5, as values above 10 are usually referred to as a point of caution.

Variable	Full	Censored
EBA	8,19	22,18
GDP	3,24	2,80
EBA x $GRP_{2\text{-}7}$	2,81	7,67-4,42
Remoteness	2,79	2,45
$GRP_{2\text{-}7}$	2,52	2,96-1,82
GDP per capita	1,90	1,96
T.02-05	1,60	1,60
Openness	1,40	1,43
Latitude	1,34	1,44
Landlocked	1,32	1,30
Agriculture	1,12	1,14
Mean VIF	2,49	3,70

Table 4.4: VIF - values.

Variable	Full	Censored
EBA x Tr.	12,48	23,87
$GRP_{2\text{-}7}$ x Tr.	10,47	14,59-9,25
$GRP_{2\text{-}7}$	9,35	13,47-9,09
Tr.	8,26	10,66
EBA	6,57	6,71
GDP	3,25	2,80
EBA x $GRP_{2\text{-}7}$ x Tr.	2,84	6,63-1,67
Remoteness	2,79	2,45
GDP per capita	1,90	1,96
Openness	1,40	1,43
Latitude	1,34	1,44
Landlocked	1,32	1,30
Agriculture	1,12	1,14
Mean VIF	6,30	8,30

Table 4.5: VIF - values. Time trend included.

However, both the variance of the error term and of the explanatory variables can also inflate the variance of the estimators, meaning that a high VIF - value may not necessary be the cause of serious collinearity (Gujarati, 2006: pp 374).[22] Leung & Yu (1996: p 224) argue that a condition index is a better way of detecting collinearity.[23] Table 4.6 and 4.7 display the largest condition indices with their corresponding biggest variation in explanatory factors, X1 and X2 respectively. A condition index above 30 with a corresponding explained variance of more than 0,5 in two or more explanatory variables should be an indication of serious collinearity.

	Condition index	X1	X2
Full	8,25	-	-
Censored	12,99	0,96	0,84

Table 4.6: Condition index. Intercept adjusted.

	Condition index	X1	X2
Full	16,8	0,82	0,55
Censored	20,95	0,87	0,70

Table 4.7: Condition index. Intercept adjusted and time trend included.

Luckily, the values never approach such numbers, even if the censored sample comes quite close when the time trend is included. We shall now move on to the concluding section.

[22] For example, in a three - variable regression, $var(b_2) = \frac{\sigma^2}{\sum x_{2i}^2} VIF$.

[23] This method builds on an analysis of the variance in linear combinations of variables from the correlation matrix, and the corresponding proportion of variance they explain in independent variables (see for example Belsley et. al., 1980).

5 Conclusion

An ex post assessment of agricultural exports under the EBA initiative has been made in this thesis, and the most important results are presented below.

- On the aggregate, EBA countries exported 49 pct. less than other low- and middle income countries when evaluated against an expected level of trade. Furthermore, there appeared no signs of improvements over the period.

- A total measure naturally masks some deviations between groups of products, and meat-, dairy- and cereal exports were all around 90 pct. lower from the EBA countries. Over the period, EBA exports of sugar, coffee & tea and fish increased the most, while meat and cereals again lagged behind.

- Most of the explanatory variables behaved as was expected by theory and there was also a clear selection bias, especially so on a disaggregated level. GDP and landlocked were biased quite a lot upwards and downwards respectively, and remoteness only affected the decision whether or not to trade after the bias was controlled for.

It certainly looks like the EBA countries were outperformed by other low- and middle income countries between 2001 and 2005. There were no signs of increasing aggregate volumes, while coffee & tea-, sugar- and fish exports seem to have increased at the expense of the other product groups. The immediate conclusions one draws from these results are that better market access is not everything for the least developed countries, and that the EBA initiative have failed to significantly change the volume and structure of LDC agricultural exports into the EU.

The method of disaggregating the flows into different product categories has worked quite well, and it should prove an accessible alternative to CGE modeling. Of course, one should beware the risk of overfitting the model, and some of my specifications did approach a point were collinearity could have become a serious problem.

It was a surprise that the agricultural measures only played a minor role in determining agricultural trade flows, and further that the value of absolute latitude never even proved significant. One explanation probably lies in the aggregation of data, as there should be different comparative advantages for different groups of (agricultural) products. I did

experiment with interactions between the product groups and agriculture/latitude, with results indicating that this might be a fruitful project for continued research. Another area of great importance is of course the constraints facing very poor countries as it may help us to understand the failure of seemingly ambitious preference programs, like the EBA initiative.

References

Anderson, J. E. (1979). "A Theoretical Foundation for the Gravity Equation", *American Economic Review*, vol. 69(1), pp 106-116.

Anderson, J. E. & E. Wincoop, (2003). "Gravity with Gravitas: A Solution to the Border Puzzle", *American Economic Review*, vol. 93 (1), pp 170-192.

Beghin, J. C. & D. Mensbrugghe, (2005). "Global Agricultural Reform: What is at Stake?" in Aksoy, M. A. & J. C. Beghin (eds), (2005). *Global Agricultural Trade and Developing Countries*. World Bank.

Belsley, D., E. Kuh, & R. Welsch, (1980). *"Regression diagnostics: Identifying influential data and sources of collinearity",* Wiley: New York.

Bhagwati, J., (1995). "U.S. Trade Policy: The Infatuation With Free Trade Agreements" in Bhagwati, J., and A. O. Krueger (eds.), (1995). *The Dangerous Drift to Preferential Trade Agreements*. AEI Press.

Brenton, P., (2003). "Integrating the Least Developed Countries into the World Trading system: The Current Impact of European Union Preferences Under 'Everything But Arms'", *Journal of World Trade,* vol. 37 (3), pp 623-646.

Bruntrup, M., (2006). "Everything But Arms (EBA) and the EU-Sugar Market Reform - Development Gift or Trojan Horse?". German Development Institute.

Candau, F. & S. Jean, (2005). "What Are EU Trade Preferences Worth for Sub – Saharan Africa and Other Developing Countries?", CEPII Working Paper, No 2005 - 19.

Carrére, C., (2006). "Revisiting the effects of regional trade agreements on trade flows with proper specification of the gravity model", *European Economic Review*, vol. 50, pp 223-247.

CEPII: Centre d'Etuded Prospectives et d'Informations Internationales.

- available at: http://www.cepii.fr/anglaisgraph/bdd/distances.htm (2008-07-16).

Cheng, I. & H. Wall, (2005). “Controlling for Heterogeneity in Gravity Models of Trade And Intergration”, *Federal Reserve Bank of St. Louis Review*, vol. 87 (1), pp 49-63.

Conforti, P. & G. Rapsomanikis, (2006). “Preference Erosion and Trade Costs in the Sugar market: the Impact of the Everything But Arms Initiative and the Reform of the EU Policy”, Paper presented at International Association of Agricultural Economists Conference, Australia, August 12-18 2006.

Deardorff, A. V., (1998). “Determinants of Bilateral Trade: Does Gravity Work in a Neoclassical World?” in J. A. Frankel (ed), (1998). *The regionalization of the world economy*. University of Chicago Press: Chicago.

Eaton, J. & S. Kortum, (2001). ”Technology, geography and trade”, *Econometrica*, vol. 70 (5), pp 1741-1779.

European Community, 2001a. “EU approves ‘Everything But Arms’ trade access for least developed countries”. Press release: Brussels 26 February 2001.
- available at: http://ec.europa.eu/trade/issues/global/gsp/eba3.htm (2008-06-27)

European Community, 2001b. “Generalised System of Preferences - Council Regulation amending the GSP so as to extend duty and quota free access to least-developed countries (LDCs)”. Brussels 1 March 2001.
- available at: http://ec.europa.eu/trade/issues/global/gsp/eba4_sum.htm (2008-06-27).

Evenett, S. J. & W. Keller, (2002). “On Theories Explaining the Success of the Gravity Equation”, *Journal of Political Economy*, vol. 110 (2), pp 281-316.

Frankel, J., A., (1997). “*The Regionalization of the World Economy”*, University of Chicago Press: Chicago.

Greenaway, D. & C. Milner, (2002). “Regionalism and Gravity”, *Scottish journal of Political Economy*, vol. 49 (5), pp 574-584.

Greene, W. H., (2003). *"Econometric Analysis"*. Pearson Education: New Jersey.

Gujarati, D. N., (2006). *"Essentials of Econometrics"*, McGraw Hill: Singapore.

Haveman, J. & D. Hummels, (2004). "Alternative hypotheses and the volume of trade: the gravity equation and the extent of specialization", *Canadian Journal of Economics*, vol. 37 (1), pp 199-218.

Head, K., (2003). "Gravity for Beginners", Faculty of Commerce, University of British Columbia.
- available at: economics.ca/keith/gravity.pdf (2008-07-16).

Heckman, J. J., (1979). "Sample Selection Bias as a Specification Error", *Econometrica*, vol. 47 (1), pp 153-161.

Helpman, E. & P. Krugman, (1985). *"Market Structure and Foreign Trade: Increasing Returns, Imperfect Competition and the International Economy"*. MIT Press: Cambridge.

Helpman, E., M. Melitz & Y. Rubenstein, (2007). *"Estimating Trade Flows: Trading Partners and Trading Volumes"*, NBER Working Papers, No. 12927.

Kaempfer, W. H., J. R. Markusen, J. R. Melvin & K. E. Maskus, (1995). *"International trade: theory and evidence"*. Mc Graw – Hill Education: New York.

Leamer, E., E. & J. A. Levinsohn, (1994). "International Trade Theory: The Evidence", NBER, Working Paper, No W4940.

Leung, S. F. & S. Yu, (1996). "On the Choice Between Sample Selection and Two-Part Models", *Journal of Econometrics*, vol. 72, pp 197-229.

Limao, N. & A. J. Venables, (2001). "Infrastructure, Geographical Disadvantage, Transport Costs, and Trade", *The World Bank Economic Review*, vol. 15 (3), pp 451-479.

Linders, G. J. & H. Groot, (2006). “Estimation of the Gravity Equation in the Presence of Zero Flow”, Tinbergen Institute, Discussion Paper, No. 072/3.

Long, J. S., (1997). *“Regression Models for Categorical and Limited Dependent Variables”*. Sage Publications: London

Martin, W. & C. S. Pham, (2008). “Estimating the Gravity Model when Zero Trade Flows are Frequent”, MPRA Paper, University Library of Munich.

Matayas, L., (1997). “Proper Econometrics Specification of Gravity Model”, *The World Economy*, vol. 20 (3), pp 363-368.

Melitz, M. J., (2003). “The Impact of trade on Intra – Industry Reallocations and Aggregate Industry Productivity”, *Econometrica*, vol. 71 (6), pp 1695-1725.

Nello, S., (2005). *“The European Union: Economics, Policies and History”*. Mc Graw – Hill Education: Glasgow.

OECD: SourceOECD, SITC – rev. 3.
- available at (licensed material): www.sourceoecd.org (2008-07-16).

Persson, M., & F. Wilhelmsson, (2006). “Assessing the Effects of EU Trade Preferences for Developing Countries” in Bourdet, Y., Gullstrand, J., and K. Olofsdotter (eds.), (2007). *The European Union and Developing Countries: Trade, Aid and Growth in an Integrating World*. Edward Elgar.

Rose, A., (2000). “One money, one market: the effect of common currencies on trade”, *Economic Policy*, vol. 30, pp 7-33.

Rose, A., (2004). “Do We Really Know That The WTO Increases Trade?”, *American Economic Review*, vol 94 (1), pp 98-115.

Santos Silva, J. M. C. & S. Tenreyro, (2006). “The Log of Gravity”, *The Review of Economics and Statistics*, vol. 88 (4), pp 641-658.

Sarker, R. & S. Jayasinghe, (2007). “Regional trade agreements and trade in agri – food products: evidence for the European Union from gravity modeling using disaggregated data”, *Agricultural Economics*, vol. 37, pp 93-104.

Tinbergen, J., (1962). “*Shaping the World Economy”*. Twentieth Century Fund: New York.

Winters, L., (2005). “The European Trade Policies and Poverty”. *European Review of Agricultural Economics*, vol. 32 (3), pp 319-346.

World Bank: World Development Indicators.
- available at (licensed material): www.worldbank.org (2008-07-16).

Yu, W. & T. V. Jensen, (2003). “Tariff Preferences, WTO Negotiations and the LDCs: The case of the ‘Everything But Arms’ initiative”. Danish Research Institute of Food Economics (FOI).

Appendix

Table A.1 lists all variables with their description, sources and comments.

Variable	Description	Source
Import groups, c.i.f.		Source OECD, SITC rev. 3
Meat	Meat and meat preparations.	
Dairy	Dairy and birds' eggs.	
Cereals	Cereals and preparations.	
Veg. & Fruit	Vegetables and Fruits.	
Cof. & Tea	Coffee, tea, cocoa spices and manufactures thereof.	
Sugar	Sugar, sugar preparations and honey.	
Fish	Fish, crustaceans, mollusks and preparation thereof	
Independents		
GDP	Gross domestic product, USD (constant 2000).	World Bank: WDI
GDP per capita	Gross domestic product per capita, USD (constant 2000).	World Bank: WDI
Agriculture	Ratio of agricultural land to population.	World Bank: WDI
Latitude	Absolute value of latitude.	CEPII: www.cepii.fr
Openness	Ratio of imports plus exports to GDP.	World Bank: WDI
Dummies		
Landlocked	No access to int. water (1, 0 otherwise).	CEPII: www.cepii.fr
T. 01 – 05	Dummy for year 2001 – 2005.	
EBA	Exporter is an EBA country.	Persson & Wilhelmsson (2006)
Interactions		
Trend	Time trend, 1..5 (for 2001 = 1).	
EBA x $G_{1\text{-}7}$	EBA country exporting: meat for 1, dairy 2 etc.	
$G_{1\text{-}7}$ x Tr.	Group dummy x time trend.	
EBA x $G_{1\text{-}7}$ x Tr.	EBA dummy x time trend x group dummy.	

Table A.1: Variable description.

Table A.2 lists the exporting countries in the sample.

EBA	**Other**		
Bangladesh	Albania	Jordan	Uruguay
Benin	Algeria	Kazakhstan	Uzbekistan
Bhutan	Argentina	Kenya	Venezuela, RB
Burkina Faso	Armenia	Kyrgyz Republic	Vietnam
Cambodia	Azerbaijan	Lebanon	Zimbabwe
Cape Verde	Belarus	Lithuania	
Central African Republic	Belize	Macedonia, FYR	
Chad	Bolivia	Malaysia	
Comoros	Bosnia and Herzegovina	Mauritius	
Congo, Dem, Rep,	Botswana	Mexico	
Djibouti	Brazil	Moldova	
Equatorial Guinea	Bulgaria	Morocco	
Eritrea	Cameroon	Namibia	
Ethiopia	Chile	Nicaragua	
Gambia, The	China	Nigeria	
Guinea	Colombia	Oman	
Guinea-Bissau	Costa Rica	Pakistan	
Lesotho	Cote d'Ivoire	Paraguay	
Madagascar	Croatia	Peru	
Malawi	Dominica	Philippines	
Maldives	Dominican Republic	Romania	
Mali	Ecuador	Russian Federation	
Mauritania	Egypt, Arab Rep,	Seychelles	
Mozambique	El Salvador	South Africa	
Rwanda	Gabon	Sri Lanka	
Samoa	Georgia	Suriname	
Senegal	Ghana	Swaziland	
Sudan	Guatemala	Syrian Arab Republic	
Tanzania	Guyana	Tajikistan	
Togo	Honduras	Thailand	
Uganda	India	Tunisia	
Yemen, Rep,	Indonesia	Turkey	
Zambia	Iran, Islamic Rep,	Ukraine	

Table A.2: Countries included in the sample.