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CHANGES IN THE STRUCTURE OF WORLD TRADE IN AGRI-FOOD PRODUCTS: evidence from gravity modelling in a long term perspective, 1950-2000

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ABSTRACT

This study examines the reasons for changes in the composition of international trade in agricultural and food products. We use a Gravity Model to compare the impact of the key factors in bilateral agri-food trade, which we split into three main product groups, between 1963 and 2000 for a representative sample of 40 countries. Our results show how intervention and/or protectionism, the level of participation in intra-industrial trade and the effects of national and per capita income growth have determined the rise in high value-added products and processed goods and the declining share of traditional, basic commodities.

Keywords: Agri-food trade, Gravity Model, GATT, Regional Trade Agreements, home market effect

RESUMEN

El objetivo de esta investigación es determinar las causas de los cambios en la composición del comercio internacional de productos agrarios y alimentos. Para este propósito el trabajo compara a través de un modelo de gravedad el impacto de los factores más importantes en el comercio bilateral agroalimentario y de tres grupos de productos en los que puede dividirse, entre 1963 y 2000 y para una muestra representativa de 40 países. Los resultados ponen de relieve cómo la intervención pública y/o protección, el grado de participación en el comercio intra-industrial, y los efectos de crecimiento de la renta y renta per capita fueron determinantes para el auge de los productos más elaborados y de mayor valor añadido y la caída en la participación relativa de aquellos más básicos y tradicionales.

Palabras clave: comercio alimentos agrarios, modelo de gravedad, GATT, Acuerdos regionales de comercio, tamaño y acceso a los mercados

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Changes in the structure of world trade in agri-food products: evidence from gravity modelling in a long term perspective, 1950-2000

Raúl Serrano and Vicente Pinilla[1]

1. Introduction

The second half of the 20th century saw profound changes in world trade, one of the most significant of which was the growth in the trade in manufactures between the developed nations. Since Krugman (1980) and Helpman and Krugman (1985), this process has been widely discussed in the economic literature. However, far less attention has been given to the far-reaching shifts in the pattern of agricultural and food trade driven by the rising share of high value-added products to the detriment of bulk products. These changes have had a considerable impact in many low income countries, which have faced serious problems in their efforts to switch from traditional commodities and specialize in other products that require more processing and add more value (FAO, 1995).

According to Coyle et al. (1998), these changes in the composition of agri-food trade were closely related with the evolution of income, levels of protectionism and other supply-side factors[2]. Other more recent papers, such as Sarker and Jayasinghe (2007), Grant and Lambert (2008), and Jayasinghe and Sarker (2008) look at the breakdown of the products concerned in agri-food trade, focusing on the analysis of Regional Trade Agreements.

The second globalization, as is well known, has gone hand in hand with rapid growth in per capita incomes, increasing industrialization and intense urbanization. This is reflected in the substitution of traditional for industrial products and rising consumption of high value added products and processed foods (Rae and Josling, 2003). As Askoy (2005a) argues, the markets for traditional exports to industrial countries have remained static because of both low income elasticities and product substitution.

There is a growing literature on this issue based on the version of the gravity model proposed by Bergstrand (1989), which examines the effects of per capita income growth on the volume of trade in different product types (Jensen, 2006; Silverstoys and Schumacher, 2006). Bergstrand

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[2] See also, Hathaway (1979).

showed that per capita income elasticity in the importing country can be used to classify the products traded as primary or luxury goods. This little-used approach is crucial for the purposes of our study, because it allows us to apply a key factor (income growth) to understand changes in the structure of agri-food trade.

Another issue that has aroused considerable interest is the impact of the supranational institutions set up to promote free trade. Since Rose (2004) and other papers such as Subramanian and Wei (2007), scholars have sought to establish whether membership of the GATT has affected products for which trade barriers have been lowered (i.e. manufactures) more than sectors where barriers have remained high (agricultural products)[3]. The key question that arises from this approach is whether these effects have also been uneven within the set of products making up agri-food trade.

The same question has been raised with regard to the effects of Regional Trade Agreements, which are particularly important in the case of agri-food products[4]. The proliferation of such bilateral agreements, a phenomenon dubbed the "spaghetti bowl" by Bhagwati and Panagariya (1999) and Baldwin (2006), has become a major alternative to the scant multilateral liberalization of agricultural trade. Numerous papers have addressed this matter, but there seems to be little consensus on the issues and the debate remains open, especially with regard to the most appropriate method of estimation[5].

Finally, Berkum and Mejil (2000) argue that other trends emerged in the latter decades of the 20th century which may also throw light on changes in the composition of agri-food trade. The trade in agricultural and food products has been significantly concentrated among a relatively small number of similar nations exchanging products that are to degree processed. In particular, the second half of the 20th century witnessed a process of polarization in the agro-industry of the United States and the European Union, which benefited from the creation of economies of scale and the opportunity to export differentiated products with the capacity to influence both supply-

3 For different country samples and alternative methods to estimate the possible trade effects achieved by the GATT, see Rose (2005), Subramanian and Wei (2007), Tomz, Goldstein and Rivers (2007), and Felbermayr and Kohler (2006).

4 See Dell'Aquila et al. (1999) and Diao et al. (2001), who have proved the existence of extraordinary growth in intra-regional trade in different geographical areas.

5 As Baier and Bergstrand (2007) argued in a recent paper, the basic problem of many earlier studies is that they use cross-sectional techniques that fail to produce stable results even after the problems inherent in estimations are corrected using instrumental variables. This is precisely the limitation highlighted by Sarker and Jayasinghe (2007, 102): "Traditional time-averaged and cross-sectional gravity models have the potential to entangle within and between effects. Future research should employ a panel data framework capable of disentangling these effects on agri-food trade is further enhanced."

side conditions and prices in international markets, thereby boosting intra-industrial exchanges within agri-food trade as a whole (Hartman et al.,1993, Gopinath, 2003 and Traill,1997).

These trends suggest that the standard Hecksher-Ohlin-Samuelson models cannot on their own explain the new pattern of agri-food trade, as many authors have in fact argued (van Tongeren et al, 2001; Surry, Herrard and Le Roux, 2002; Kim, Cho and Koo 2003; and Sarker and Surry, 2006). The application of models based on the New Trade Theory first proposed by Helpman and Krugman (1985) opens up new possibilities for the explanation of the factors determining international agri-food trade. Thus, scholars such as Feenstra et al. (1998 and 2001), Fidrmuc (2004) and Jensen (2006), who focus on the presence and analysis of the "home market effect", have provided a new empirical framework to establish the pattern of intra-industrial exchanges that drives overall trade in agricultural and food products.

In this context, our objective is to apply the gravity equation, a tool that has proved capable of capturing all of the changes mentioned above, to examine the principal causes underlying changes in the structure of international trade in agricultural and food products over most of the second half of the 20th century. This paper, then, analyzes the impact on trade of changes in the size of markets and income levels, as well as the liberalization processes affecting different kinds of agri-food products. This question has so far received little attention, and those papers that have addressed it lack the long-term perspective offered here. For the purposes of comparison, we have classified agricultural and food products in three standard groups: bulk products, plantation products and high value-added products and processed foodstuffs.

The results of our study reveal that the trade in high value added products and processed foodstuffs, which is highly concentrated in developed economies operating in liberalized regional markets, has grown faster than the trade in other agri-food products. It also shows that these products have benefited to some degree from intra-industrial trade. Meanwhile, we find evidence that the falling share of more basic commodities is closely related with the demographic transition in the developing world, low income elasticity of demand, and profound, ongoing intervention in the markets for such goods.

The structure of this paper is as follows. After this introduction, we begin by considering the key features of international trade in agricultural and food products. We then go on to present the gravity equation employed in the empirical analysis, as well as the sources and data used in the analysis. This is followed by a discussion of the main results. The analysis is then extended to disaggregated trade flows, and we end with a brief discussion of our main conclusions.

2. The composition of international markets in agricultural and food products, 1950-2000

The significant fall in the share of traditional agri-food, bulk and plantation products in international agricultural and food trade in the second half of the 20th century is perhaps the most striking aspect to emerge from any analysis of the structure of trade patterns in this period, in stark contrast with the trend for high-value products and processed foods like fresh fruit and vegetables, meat and dairy products, oils and other processed products

As is well known, this change in the composition of international agricultural and food trade has had asymmetrical effects on the trade of different regions. On the one hand, the less developed nations specializing in bulk products and unprocessed commodities have suffered, while high income countries have benefited by concentrating on high growth products (Askoy, 2005a and Serrano, 2007).

Table 1. Composition of international agri-food trade by product types

As may be observed in Table 1, traditional exports of bulk products (especially textile fibres and grains) and plantation products (e.g. sugar and tropical beverages) formed the bulk of agricultural and food trade in the first three decades of the 20th century, and in the 1950s they still accounted for some 60% (Aparicio, Pinilla and Serrano, 2009). Thereafter, however, they lost share, declining to some 45% of the total by the end of the period. In some papers it has been suggested that a combination of factors could explain this far-reaching transformation. These would include changes in diet associated with the level of per capita income and the opportunity to substitute traditional for industrial products, differentiated intervention policies and the influence of growth on the size of country markets, and with different levels of adaptation to new intra-industrial trade patterns.

As mentioned above, the key is the displacement of basic foodstuffs from diets in favour of high value-added products and processed foods. The most widely used argument to explain this starts by looking at the industrialized world: as the process advanced basic foodstuffs were substituted by other high value-added foods, like meat, dairy products, fruit and differentiated processed products. However, these changes in diet were not as intense on the world level as suggested on this view. As Table 2 shows, this process is characteristic of higher income countries, but in less developed economies the process of dietary transition so typical of the West occurred much more slowly than might be thought, and improvements in diet involved vegetable products above all (Popkin and Wen, 2007).

In general terms, developing countries enjoyed a spectacular demographic boom and fast population growth, which increased demand for basic foodstuffs like cereals, oilseeds, fats, vegetable oils and sugar at least until the 1990s. Thus, cereals consumption increased in countries like China, India, Brazil and the oil-producing nations, and demand for oilseeds grew rapidly in Asia as the livestock sector developed (FAO, 2002).

Meanwhile, demand for these products progressively slowed in the high income nations, with the exception of products used as cattle feed (Askoy, 2005a). In fact, per capita consumption of cereals, root vegetables and tubers, and oils, to name three key products, peaked in the 1970s, and these products were substituted in people's diets by other foods with a higher income elasticity of demand (Gelhlar and Coyle, 2001; Yates,1960; Yu et al. , 2002; Reimer and Hertel, 2004; Cranfield et al. , 1998; Regmi et al. , 2001).

According to Schmidhuber (2003) the most advanced nations had already completed the first, or "expansion", phase of dietary transition by the 1960s, consisting of fast growth in the availability of calories from cheap, mainly vegetable, foodstuffs (Teuteberg 1992; Grigg 1995; Delgado et al. 1999; Rosegrant and Paisner, 2000; Gehlhar and Coyle, 2001;Moreno et al., 2002 and FAO, 2002). The second phase, which occurred over the period of this study as income levels rose in the countries concerned, took longer, and is generally referred to as "substitution". This refers to a switch from calories obtained from basic carbohydrates to calories derived from animal products, oils, vegetables and sugar, all subject to a greater degree of processing. Among these changes, we may note increased consumption of poultry in both the industrialized and less developed countries, as well as a rising intake of fresh fruit, especially in the rich-world nations (FAO, 2003; Diopp and Jaffre, 2005).

Table 2. Evolution of per capita food consumption worldwide and by economic regions

Another factor that may have encouraged changes in the structure of trade in agri-food products was the replacement of certain raw materials and foodstuffs by synthetic substitutes. The chemicals industry had in fact already achieved partial substitution as early as the 1950s.

From an institutional standpoint, the high level of state intervention in agriculture may also have affected the composition of international trade in agricultural and food products. The industrialized nations of course fostered agriculture to achieve self-sufficiency in the production of food and raw materials (Lindert 1991; Diaz-Bonilla and Tin, 2002). It is widely accepted, meanwhile, that government intervention hindered trade flows in bulk and plantation products. The Nominal Protection Rate calculated for a representative sample of products supports this assertion. The results are shown in Table 3. As may be observed, the level of intervention in these products was high in comparison to others such as fruit, meat and dairy products, especially in Europe and Japan.

The combination of a protected market and technical progress thus created favourable conditions for the farmers of the developed world to ramp up output, with the result that some countries were able to attain a high level of self-sufficiency fairly early on. As Grigg (1985) and Federico (2005) have argued, output grew fast in the high income countries, outpacing the rate of population growth for many products, which allowed these nations to achieve food self-sufficiency. This phenomenon was especially marked in the case of the bulk products that made up a large share of international trade and were already highly protected (e.g. cereals, oilseeds and sugar).

Table 3. Nominal protection rate for a selection of agricultural and food products

This rise in output was not exclusive to the developed countries, and it also occurred, indeed with even greater intensity in the developing world. However, population growth in these countries ran in step with output growth, putting considerable pressure on the food supply, which made it necessary partially to redirect exports of bulk products back to the domestic market. According to Grigg (1985), per capita output stagnated over the period 1957-1977, in contrast with the unprecedented growth achieved in the developed world.

In contrast to the intense application of interventionist policies to bulk products, the trade in processed products was concentrated among a few countries that enjoyed the benefits of liberalized regional markets. According to Dayton and Henderson (1992), just 30 high income countries accounted for 90% of world imports of such products in the latter years of the last century. The proliferation of RTAs, especially between high-income countries, has gradually liberalized a substantial part of this trade.

Meanwhile, some scholars have argued that growth in the trade in processed products, mainly between the developed economies, was also driven by growth in intra-industrial trade. In the latter decades of the 20th century, a trend towards the concentration of the agro-industrial sector emerged in a few countries, indicating that these industries were able to benefit from economies of scale. In order to analyze this matter, we have calculated the intra-industrial trade index proposed by Grubel-Lloyd (1975) applied to trade data for processed agricultural and food products. Based on this analysis, we may observe an incipient intra-industrial trade, especially in the 1960s, which may have had some positive impact on the growth of agri-food trade. However, these flows were far smaller than in the manufacturing sector (Serrano and Pinilla, 2009).

Table 4

Finally, some scholars have stressed the development of new transport and preservation technologies, which may have encouraged trade in perishable and processed agricultural products (Wang et al. 2000 and Coyle et al. 2001).

To sum up, the products for which demand rose were those associated with a greater presence in people's diets and higher income elasticity, those that benefited from liberalized markets and some degree of intra-industrial trade, those that were not replaced by industrial or synthetic substitutes, and those that benefited from falling transport costs, all of which made relative gains in their share of the international trade in agricultural and food products.

3. Data description and gravity equation estimation

In order to establish the determining factors underlying changes in the structure of trade in agricultural and food products, we shall estimate a gravity equation based on data for bilateral trade flows published by the United Nations Statistics Division in the UN-COMTRADE database (2003). The sample includes trade between 40 countries[6], whose trade flows are representative of international trade flows in agri-food products[7]. This is, then, a "balanced data panel" comprising trade flows between 40 source countries x 39 importing countries x 38 years = 50,388 observations[8].

Export flows were reconstructed in volume terms between 1963 and 2000 per the CUCI-review 2 Classification for total agricultural and food trade (agri-food products included in groups CUCI 00-04), trade in bulk products (041-045 Bulk cereals, 00. Live animals, 22. Oilseeds, 26. Textile fibres), trade in plantation products (06. Sugar, 07. Coffee, tea, cocoa), and trade in processed and value-added foods (01. Meat and meat products, 02. Dairy products and

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6 Africa (Algeria, Cote d' Ivoire, Egypt, Morocco, Nigeria and Sudan); Asia (China India, Indonesia, Israel, Japan, Malaysia and Saudi Arabia); North America (Canada, Mexico and the United States); Latin America (Argentina, Brazil, Chile, Colombia, Ecuador, Nicaragua and Peru); Europe (Belgium-Luxembourg, Denmark, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Norway, Portugal, Spain and the United Kingdom); Oceania (Australia and New Zealand).

7 The sample is representative of over 95% of trade flows in the groups of processed and high value foodstuffs, but only around 50% of basic and plantation products. This bias therefore embodies a limitation in the study.

8 In order to obtain a balanced panel, trade flows with a value of 0 were substituted for a minimum trade figure ($100), following earlier studies such as Raballand (2003) and Silverstows and Schumacher (2003) with a similar specification to our gravity equation approach. The most common alternative consists of eliminating trade flows with a value of zero (Frankel, 1997 performs a comparative analysis of the two methods, finding scant differences between them). In this paper we have opted for the first because it allows us to utilize more sophisticated econometric methods to correct the recurring problems of estimation in existing studies. However, the exports of China, Cote d'Ivoire, Nigeria, Sudan, Saudi Arabia and Uruguay to other countries have been eliminated due to the acute shortage of data. Nevertheless, the exports of the remaining countries in the sample to these nations have been kept in the sample. Consequently, the sample is made up of the trade flows between 40 source countries x 39 importing countries x 38 years – (6 x 39 x 38 flows eliminated due to lack of data) = 50,388 observations.

eggs, 04. Processed cereals, 05. Fruit and vegetables, 08. Cattle feed, 09. Other foodstuffs, 11. Beverages, 12. Tobacco, 41. Animal fats, 42. Vegetable oils, 43. Processed oils).

The specification of the equation used in this study largely follows the work of Feenstra et al. (1998), Bergstrand (1985, 1989) and Anderson and van Wincoop (2003), in which a detailed derivation of the theoretical groundwork may be found. Here, we provide only a brief description of the variables, their signs and the expected results. Applying logarithms, the functional form of the equation is:

$$\begin{aligned} ln\, X_{ij} = {} & \beta_1 + \beta_2\, ln\,(Y_i) + \beta_3\, ln\,(Y_j) + \beta_4\, ln\,(Ypcp_i) + \beta_5\, ln\,(Ypcp_j) + \\ & + \beta_6\, lnDist_{ij} + \beta_7\, lnExcvol_{ij} + \beta_8\, lnRem_{ij} + \beta_9\, Border_{ij} + \\ & + \beta_{10}\, Lang_{ij} + \beta_{11}\, RTA_{ij} + \beta_{12}\, GATT_{ij} + \delta_i + \delta_j + \varepsilon_t \qquad (1) \end{aligned}$$

In the initial approach of the gravity equation, $\boldsymbol{X_{ij}}$ represents the volume of trade flows between two countries, $\boldsymbol{Dist_{ij};}$ the geographic distance between their capitals and $\boldsymbol{Y_i}$ $\boldsymbol{Y_j}$ the countries' market size, which is usually approximated by the value of Gross Domestic Product-GDP or population size. Separate interpretation of the latter variable is most interesting, as it allows observation of country's potential to export its products, which depends on its own average market size as measured by GDP, while foreign demand for these products will depend on the size of the importing country's GDP . Thus, the potential supply and demand of trade partners will be studied by including their respective GDPs in the model.[9]

As argued in Feenstra, Markusen and Rose (1998, 2001), the use of these variables also allows analysis of the adaptation of different types of goods to intra-industrial trade[10]. This theoretical framework for the gravity equation provides a method for verifying the home market (or reverse home market) effect for different trade sectors. According to the above authors, in the

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9 Xij : volume exports from country i to country j in year t, expressed in 1985 US dollars. The series for each group of products is deflated by the respective price indices (Serrano, 2007); Yi; Yj; actual GDP in year t expressed in 1985 US dollars [World Bank,World Development Indicators (WDI) data base, cd-rom, 2004]; Ypcpi, Ypcpj: per capita GDP of the exporting country and the importing country in year t, expressed in 1985 US dollars (WDI cd-rom, 2004); Distij: distance between the capital cities of the source country and the importing country (CEPPI data base); Excvolij: indicator of the volatility of exchange rates in year t. Estimation of the standard deviation of the first difference in the natural annual logarithm of the nominal bilateral exchange rate for the pair of countries in the ten-year preceding period t (exchange rate data are drawn from WDI cd-rom, 2004); Borderij: fictitious variable taking a value of 1 if the countries share a common border and 0 otherwise; Langij: fictitious variable taking a value of 1 if the countries share a common language and 0 otherwise; Remij: weighted relative distance by income levels following the methodology proposed and data given in Rose (2000); RTAij: fictitious variable taking a value of 1 if the country pair are members of regional trade agreements (EU, NAFTA, CER, APEC, MRECOSUR, ANDEAN, ASEAN, GSTP) and 0 otherwise; GATTij: fictitious variable to capture the impact of the different GATT rounds.

10 Feenstra (2004) discusses the theoretical framework of gravity models with product differentiation.

case of differentiated products (manufactures) and increasing returns to scale, exports are more sensitive to changes in the income of the exporting than of the importing country. This has been termed the home market effect. Trade in homogenous products, however, is more sensitive to the income of the importing country than to the domestic income of the exporter. The theoretical basis in this case is more easily reconciled with national product differentiation or reciprocal dumping trade models.

As mentioned above, the geographical distance between countries is usually presented as an obstacle to trade and treated as an approximation of transport costs. Various studies have focused on this argument, given that logistical infrastructure differs greatly between countries. Consequently, it is proposed to weight the distance between countries (***Remi**$_{ij)}$*) on the basis of their economic strength, income and population (Rose, 2000 and Feenstra, Markusen, and Rose 2001).

Following Bergstrand (1989), however, the equation used here includes countries' per capita GDP ($Ycpc_i$, Ycpcj). The inclusion of this variable in the model allows us to describe trade in different types of goods. According to this author, the interpretation of the coefficient of per capita income in the exporting country may be considered as an approximation to its factor endowment. This coefficient is positive in the case of capital-intensive goods and negative for labour-intensive goods. Likewise, the coefficient of per capita income in the importing country serves to define the type of good and will produce a positive sign for superior goods and a negative one for inferior goods.

As in the vast majority of studies, we also include multiple variables, such as geographical proximity (if the countries share a border) and cultural proximity (the existence of historical or cultural ties, such as a colonial relationship or a common language). The coefficients of all of these variables are expected to be positive. Following other authors (Cho, Sheldon, and McCorristo (2002) and Rose (2000)), meanwhile, the model includes different measures of the volatility of bilateral exchange rates (***Excvol**$_{ij}$*). The objective in the present case is to examine the impact of exchange rate uncertainty on trade flows. This coefficient is expected to display a negative sign (i.e. the greater the instability of exchange rates, the lower the growth of trade between two countries).

With regard to the institutional context, the specification of the gravity equation has been refined in many studies to take account of factors that may limit or stifle trade. Surprisingly, however, few such studies have made room for trade policies in the gravity equation, because of the difficulties posed by the lack of data, which is either very limited or non-existent. Nevertheless, many studies have introduced dummy variables to analyse the effect of regional liberalisation produced by the proliferation of regional trade agreements ($\boldsymbol{RTA_{ij}}$)[11] on the one hand, and the effects of the multilateral liberalisation of international markets ($\boldsymbol{GATT_{ij}}$) on the other.

In the case of RTAs, a positive sign is expected if the effect of trade creation between the members is greater than the effect of the diversion of trade upon imports from and exports to third countries. In the case of multilateral market liberalization, various dummy variables were included to explore the effects of membership of free trade associations, following the proposal made by Rose (2004). The aim is to examine the effects of the various rounds of the General Agreement on Tariffs and Trade (GATT). Both the result and the sign of this variable are uncertain, as stated mentioned in the introduction.

Lastly, in line with the recent work by Anderson and van Wincoop (2003), the equation includes "multilateral (price) resistance terms", which are proxied by the dummy variables $\boldsymbol{\delta_i}$ and $\boldsymbol{\delta_j}$. This article, which has been highly influential in recent studies, demonstrates that the omission of price indices leads to an erroneous specification of the empirical model, which may bias the results. We use country fixed effects ($\boldsymbol{\delta_i}$, $\boldsymbol{\delta_j}$) to account for the multilateral price terms (rather than a custom nonlinear least squares program), following the alternative proposed by Feenstra (2004). These variables reflect the effect of all singularities of the exporting and importing nations that might affect trade between two countries and are not captured by the remaining variables specified in the empirical model. Finally, the model includes the error term (ε_t) which is assumed to be log-normally distributed.

4. Results.

We have used the panel data technique to estimate the equation. This allows variations between the units observed to be taken into account, along with temporal changes in the units. Three types of data panel estimation are proposed. The first is the estimation of ordinary least squares (OLS) with the grouped panel, while the second and third take into account the time variation, by including random effects and fixed effects, respectively.

The LM Breuch-Pagan test for random effects was employed (see column 2, table 1) to determine which of the three models is most efficient. This allows us to choose between OLS estimation of the grouped panel and estimation with random effects. Following the application of the Breuch-Pagan test, it was concluded that random effects are significant, and it is therefore

[11] See, for example, Frankel (1997), Frankel and Wei (1993), Bayoumi and Eichengreen (1993), and Sapir (1997).

preferable to use the estimation which includes them rather than the grouped panel estimation. In order to show that the estimation of fixed effects is a more appropriate method than the MCO, we performed the F test (Greene, 2000) for the significance of fixed effects. This test shows that the FEM estimation is more appropriate than the MCO estimation for the grouped panel. Meanwhile, the Hausman test showed that the estimators for random and fixed effects differ substantially, and that the fixed effects model explains the sources of variations more effectively and is therefore more appropriate than the random effects model.

In addition to these technical considerations, there are also theoretical reasons to prefer the fixed effects estimation (Feenstra, 2004, 161-163). Anderson and van Wincoop (2003) derived a specification of the gravity equation using a model that implied the presence of "multilateral (price) resistant terms", which they approximated using fixed effects by country following Feenstra (2004)[12].

At first sight, the gravity equations appear to function properly both for total (aggregate) agri-food trade and for the different groups of products considered, explaining 49.2% of variations in the case of the models including the random effects and 18.7% in the case of the fixed effects models. All of the variables take the expected sign. This is positive except for distance (as an approximation to transport costs) and exchange rate volatility, which is negative. As is usual in the estimation of the equation, richer nations, those with larger markets, those that share a language and those that belong to RTAs and joined the GATT after the Uruguay Round generally trade more with each other.

Despite modelling temporal and spatial heterogeneity, our model poses problems of heteroskedascity according to a Wald test (Green, 2000), as well as problems of autocorrelation according to the Woolridge test (Wooldridge, 2001). The Breusch-Pagan test, used to identify problems of contemporaneous correlation in the residuals of the fixed effects model, likewise confirms the need to correct this problem. These problems of contemporaneous correlation, heteroskedascity and autocorrelation can be solved jointly and were resolved by the estimation of panel-corrected standard errors (PCSEs)

Table 5. Results of the gravity equation. International agri-food trade broken down by product groups

Columns 1-4 in Table 5 reflect both the coefficient and the significance of the variables depending on the method selected (PCSE-FE). Having solved the specification problems affecting the estimators, the models function appropriately, explaining 51.7% of variations in

12Baier and Bergstrand (2007) conclude that fixed effects provide the best approximation to analyze trade treaties.

trade. All of the variables take the expected sign and are statistically significant. Let us now consider the main results obtained.

In the first place, the results of the coefficients (Yi Yj), which refer to the size of countries' markets, are found to be a key factor in the evolution of bilateral trade flows in agricultural and food products. The positive effect of the importing nation's market size is particularly important (see rank 4 of Table 5). Among all of the product groups, the effect was particularly relevant for bulk products, followed by high value-added products and processed foods. In the first case, this effect can be related with the demographic boom in the period, which translated into a sharp increase in human consumption worldwide and, very probably, with rising demand for cereals and oilseeds for an expanding livestock sector. In the second case, it may be explained by the increasing participation of these products in diets, especially in higher income countries.

Meanwhile, we may also note the smaller relative effect of this variable on the group of plantation products, which confirms our idea that demand for these commodities stagnated due to the substitution of products such as coffee, tea and sugar.

The effects of increases in the size of domestic markets are not significant in aggregate terms. Interestingly, however, the negative sign and statistical significance of bulk products would seem to imply that domestic output was basically directed to meet demand from a growing domestic market. This was common in developing economies, which were undergoing a demographic explosion and started from a very low level in the consumption of these products. Bulk products therefore display both a positive effect due to export demand and a negative effect due to the pressure of domestic demand.

Meanwhile, the absence of the home market effect (i.e. a higher coefficient in the presence of changes in the size of the exporting country's market than in the importing country), or of effects for the set of agricultural products or any of the groups suggests that the growth of intra-industrial trade was not a determining factor to explain the evolution and changes in the composition of agri-food trade.

The result obtained for the coefficient of per capita income in the importing country ($Ypcp_j$) is negative and statistically significant for total agri-food trade but displays a larger negative effect for the group of bulk products. Therefore, the low income elasticity of demand for imports goes some way to explaining their relatively slow growth.

Meanwhile, the effects on the exporting country take the opposite sign for the majority of the groups considered. Thus, an increase in the level of income had a positive impact on export capacity. In the comparison by products types, this effect was once again greater for the group of bulk products (followed by plantation products and high value added products and processed foodstuffs). As mentioned above, these groups were the products that received the greatest support from sector policies in high income countries and that adapted best to the technological advances ushered in by the green revolution. Numerous studies have shown the major growth achieved in agricultural productivity through technological innovation and described how farming has become a capital intensive industry in many economies (Grigg 1985 and Federico 2005).

From an institutional standpoint, we may, note the increasingly regionalized nature of trade in agricultural and food products. The creation of the EU and EFTA generated trade creation effects as the Western European nations joined these organizations. In the case of the EU, these effects touched all of the products considered, while in the EFTA they affected basically the group of processed products. In the last decade of the 20th century, meanwhile, we may note the significant trade creation effect achieved by the APEC for products of all kinds, contrasting with the scant success of NAFTA and the CER.

Within the group of low income countries, a strong effect is found (for all groups) following the launch of the Global System of Trade Preferences (GSTP) and ASEAN, driving trade in agri-food products among the member nations, in contrast to earlier efforts such as MERCOSUR or ANDEAN, which failed to achieve a similar impact.

Finally, we have sought to verify the importance of membership of the GATT, as Rose (2004) argues, through the disaggregation of agri-food trade. In light of our results, it would appear that this trade received only a small boost after the Uruguay Round (1986-94). The fictitious variable $GATT_{94\text{-}00}$ displays a positive, significant coefficient for exchanges of plantation products and high value-added products and processed foods.

The key results of this section may be summed up as follows. In the first place, the group of high value-added products and processed foodstuffs benefited most from the growth in world income. Secondly, trade in the commodities group was affected simultaneously by an expansive effect brought about by the increase in the demand for imports and a negative effect due to the growth in domestic markets. Thirdly, as Coyle et al. (1998) argued, the low income elasticity of demand for imports of basic agricultural commodities is essential to understanding their limited presence of bulk products in international markets. Finally, the proposed aggregation provided no evidence that the home market effect is relevant to explain changes in the composition of trade for agri-food products taken as a whole.

5. Sensitivity analysis

In this section we shall estimate the gravity models for four trade flow sub-samples classified on the basis of the level of income per capita of the countries concerned in order to throw further light on the key ideas discussed in the preceding section, explain changes in the composition of agri-food trade and test the sensitivity of our results to changes in the sample. The first sub-sample consists of the most developed countries (North-North). The second comprises trade flows originating in high income countries and bound for developing countries (North-South), and the third trade flows originating in developing countries destined for the developed world (South-North). The fourth and final sub-sample comprises trade flows between developing economies (South-South).

Table 6 reflects the evolution and direction of trade flows among the countries forming part of our sample, showing, on the one hand, the high and persistent concentration of trade between the economies of the north both in terms of those product groups that lost share in total agri-food trade and those that gained share and, on the other, the characteristic flow of agri-food trade in the first globalization (South-North), which has progressively declined. Finally, we may note the enormous concentration of exchanges of processed products (high value-added foodstuffs and processed agricultural products) in the developed world.

Table 6. Changes in the direction of agri-food trade flows, 1963-2000

We follow the same methodology as in the preceding section here with regard to the functional form of the gravity equation, the sources and the selection process. Consequently, we do not consider it necessary to repeat the detailed explanation of the process carried out. As in the preceding case, the panel estimation method with PCSE-FE was selected. Table 7 shows the results of the gravity equation for the trade flows. We shall here briefly describe only the most relevant results.

We believe that the results obtained provide a clearer understanding of the growth observed in the trade in high value-added products and processed foodstuffs, which was concentrated in exchanges between the developed economies. In the first place, the general growth in demand for its imports, which was much higher than for other groups, was very important. Thus, the coefficients for variable Yj, whether the export destination was North or South, are highly significant both economically and statistically (see N-N, S-N, S-S flows).

Table 7. Results of the gravity equation. International agri-food trade broken down by product groups and economic regions

In the second place, exports are elastic with regard to domestic income (home market effect) in the group of high value-added products and processed foodstuffs for export flows originating in advanced economies and destined for less developed nations. This result coincides with the research mentioned in the introduction to this paper with regard to the progressive concentration of the agri-food industry in a few high income countries, where it benefited from economies of scale and was able to boost exports[13].

In the third place, processed foodstuffs benefited from liberalized regional markets. In trade flows between the high income nations in which trade was concentrated, the coefficients of the variables EU, EFTA and APEC reflect positive signs and are statistically significant, clearly demonstrating that RTAs did in fact create trade. This is, then, a very significant result that explains the increasing importance of this group in total agri-food trade.

Meanwhile, the slow growth in exports of plantation products is related, in the first place, with the low income elasticity of demand for imports in their traditional markets. As may be observed in column 7 of table 7, the coefficient for per capita income in the developed countries ($Ypcp_j$) is negative and statistically significant (-1.602).

Furthermore, it seems clear that this trade was constrained by highly protected markets. The traditional producer regions thus faced protected markets and failed to liberalize their own regional markets until well into the period (see the positive, statistically significant result for GSTP). In this regard, the coefficient for $GATT_{94\text{-}00}$ is striking. This variable reflects the effects of the Uruguay Round, showing a greater positive effect than for other product groups both in aggregate terms and for S-N and S-S trade flows, which in itself suggests that these were highly protected until that time.

In the last group, there are various reasons for the sharp fall in the participation of basic commodities in the trade in agricultural and food products. In the first place, as we have already explained, exports were constrained by pressure from the sharp growth in the population of the poorer regions. The coefficients for variable (Y_i), which measures the growth in the size of the exporting country's market, are negative and statistically significant, especially where exports originate in developing countries [see S-N flows (-4.806) and S-S flows (-4.444), columns 3 and 4 of table 7)].

Finally, the low income elasticity of demand for imports in the higher income countries was a key factor. As may be observed in column 3 of table 7, the coefficient for per capita income in the developed countries (Ypcpj) is negative and statistically significant (-2.307). As explained

13 A number of different papers have shown that intra-industrial trade contributed to the growth in trade figures. For example, Cox et al. (1999) showed that trade in dairy products, which was highly concentrated in the developed countries and especially in the EU, was a part of this trade.

above, we believe this result reflects on the one hand the rapid process of replacement of certain products such as textile fibres by industrial substitutes and, on the other, dietary substitution by high value foodstuffs affecting products like cereals.

6. Concluding Remarks

This study links up with the empirical literature on the factors conditioning the evolution of trade in agricultural and food products in the second half of the 20th century. Our main contribution is that we focus on the factors determining the evolution of trade in different groups of agri-food products, an issue that had not been addressed from a long-term perspective such as that taken here in any of the preceding studies.

In general, the study uses the gravity equation methodology and analysis of panel data to investigate the different factors accelerating or slowing growth in aggregate agri-food trade and three categories of agricultural and food products. Specifically, the study focuses on explaining the change in the composition of agri-food trade and highlighting the causes for the rapid growth in trade in higher value-added products to the detriment of those products that had traditionally formed the basis for the trade in agricultural products. As explained in the introduction, this is no small matter given the difficulties experienced by less developed nations in adapting their output to these changes.

The key results from the empirical analysis are as follows: In the first place, the study shows that the right econometric specification of the gravity equation includes fixed effects and corrects problems in the estimators using PCSE. The results are robust for different specifications and country sub-samples. Furthermore, the methodology has shown itself to be an effective tool to explain changes in trade patterns affecting very different product groups.

Secondly, we have seen how the extraordinary economic growth of the second half of the 20th century translated into an improvement in nutrition internationally and drove profound changes in consumption patterns. However, we have also seen that this improvement in diets had uneven effects on international trade. While the increase in the consumption of high value-added products and processed foods was strongly reflected in trade, the growth in demand for commodities had less impact on the level of exchanges.

In terms of changes in the composition of agri-food trade, we have shown that the growth in the trade in high value-added products and processed foodstuffs was closely related with the expansion in the world population and rising per capita incomes, while the declining share of commodities may be partially explained by domestic market constraints related with the demographic boom in the less developed economies, which held back their export capacity.

In the third place, the low income elasticity of demand for certain products, as shown in earlier studies, acted as a brake on the expansion of trade in commodities destined for the developed world. We believe the approach and equation employed throw greater light on the significant structural changes that occurred during the period (industrialization, urbanization, etc.) and, therefore, the worldwide nutritional transition. In this regard, any cross-sectional analysis that might, for example, include only the income variable, such as those contained in existing studies, would lead to the conclusion that the differential behaviour of the income elasticity of demand for exports was the only variable that would explain the rise or fall of the different products making up international agri-food trade. As we have seen, however, the implications are more complex and reflect two basic effects, namely the constraints on exports due to the pressure on the supply of foodstuffs in countries undergoing rapid population growth, and the low income elasticity of demand for imports of the most basic agricultural products.

We obtain a more nuanced view from the disaggregated analysis of trade flows by economic regions, which also lends robustness to our results. On the one hand, exports of high value-added products and processed foodstuffs from the developed world to other countries were influenced by the presence of a home market effect that was closely related with the progressive concentration of the agri-food industry in the developed world.

On the other, the group of high value-added products and processed foods benefited from greater trade liberalization, as we have seen. Thus, trade flows between high income nations, where this group was concentrated, benefited from the progressive liberalization of regional markets. The contrast with the traditional export groups that characterize South-North trade flows, the markets for which remained tightly controlled, suggests that closed markets were a key factor in the decline in these trade flows compared to the rise in the trade in high-value added products.

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Tables

Table 1

Composition of international agri-food trade by product types

(US dollars, 1980)

Group	1952-59	1959-66	1966-73	1973-80	1980-87	1987-94	1994-00
Bulk products	**38.83**	**39.11**	**36.36**	**35.87**	**34.62**	**30.72**	**28.52**
Bulk cereals	15.47	16.41	15.28	17.02	16.63	13.82	12.58
Textile fibres	12.75	11.02	8.59	6.55	5.52	4.88	4.02
Live animals	7.56	8.19	8.77	8.30	8.27	8.22	7.79
Oilseeds	3.05	3.49	3.71	4.00	4.19	3.80	4.14
Plantation products	**24.63**	**21.23**	**20.64**	**17.63**	**17.36**	**18.23**	**17.37**
Coffee, tea and tobacco	11.48	11.61	11.86	10.92	10.18	11.01	9.69
Sugar	13.14	9.62	8.77	6.72	7.18	7.22	7.68
High value-added products and processed foodstuffs	**36.55**	**39.67**	**43.00**	**46.49**	**48.02**	**51.05**	**54.11**
Fruit and vegetables	8.45	10.54	12.38	13.64	12.47	13.07	12.39
Fresh and prepared meat	4.16	8.27	8.62	8.88	9.15	9.63	10.32
Dairy products and eggs	0.79	4.41	4.63	5.27	5.76	5.16	4.93
Animal feed	7.78	2.45	2.99	3.66	4.61	5.50	5.48
Other processed foods	1.72	0.93	1.10	1.28	1.80	2.64	3.61
Processed cereals	0.72	0.84	1.10	1.35	1.85	3.44	4.56
Beverages	6.13	5.58	5.34	4.87	4.41	3.69	3.72
Tobacco	3.69	3.69	3.55	3.59	3.09	2.78	3.13
Vegetable oils and fats	3.10	2.96	3.29	3.96	4.89	5.14	5.96
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Source: Own work based on FAO (1947-2000) and FAOSTAT (2004)

Table 2

Evolution of per capita food consumption worldwide and by economic regions

(Kilocalories/per capita/per day)

Group	**1961-65**	**1973-77**	**1985-89**	**1996-00**
Bulk cereals				
World	1170.42	1223.72	1364.24	1349.98
Developed nations	1112.96	1007.10	993.18	1011.22
Developing nations	1196.52	1307.08	1485.84	1446.50
Root vegetables and tubers				
World	177.46	173.18	136.34	142.50
Developed nations	173.58	149.78	137.74	136.92
Developing nations	179.24	182.24	135.86	144.06
Sugar and sweeteners				
World	177.46	173.18	136.34	142.50
Developed nations	360.64	429.80	432.10	412.80
Developing nations	121.92	144.36	176.98	192.70
Meat				
World	117.38	139.44	169.56	203.98
Developed nations	245.54	312.28	351.30	332.42
Developing nations	58.56	72.94	110.04	167.38
Dairy products				
World	133.78	133.60	143.20	150.96
Developed nations	306.94	326.84	338.98	328.26
Developing nations	54.32	59.24	79.06	100.46
Fruit				
World	54.06	58.46	65.44	74.84
Developed nations	72.10	83.88	93.34	92.30
Developing nations	45.82	48.66	56.28	69.84
Vegetable oils				
World	120.90	153.16	211.16	249.14
Developed nations	210.56	283.00	360.74	399.08
Developing nations	79.80	103.20	162.16	206.44
Other				
World	337.66	328.8	344.02	359.56
Developed nations	516.52	580.28	590.92	522.58
Developing nations	255.56	231.94	263.02	313.20
Total				
World	2308.64	2434.06	2673.92	2772.42
Developed nations	2998.84	3172.96	3298.30	3235.58
Developing nations	1991.74	2149.66	2469.24	2640.58

Source: Own work based on FAO (1947-2000) and FAOSTAT (2004)

TABLE 3.

Nominal protection rate for a selection of agricultural and food products

Product	Japan	Europe-7	USA	Canada	Australia	China	India	Egypt	Colombia
Cereals									
1967-71	2.44	1.37	0.75	0.71	0.81	1.19	1.31	1.06	1.35
1976-80	4.26	1.31	0.72	0.75	0.75	0.98	0.84	0.86	1.26
1985-89	7.86	1.40	0.69	0.69	0.75	0.91	0.98	2.36	1.44
1994-98	9.18	1.09	0.73	0.66	0.88	0.88	0.80	1.03	1.21
Oilseeds									
1967-71	1.58	1.20	0.90	0.84	1.25	1.13	1.34	1.40	1.36
1976-80	2.60	1.12	0.92	0.94	0.92	0.95	1.23	1.40	1.30
1985-89	5.37	1.33	0.78	0.72	0.98	0.97	1.30	3.19	1.67
1994-98	8.70	0.87	0.83	0.98	1.18	0.95	1.20	1.67	1.18
Textile fibres									
1967-71	n.d.	0.76	0.76	0.78	1.07	1.28	0.79	0.90	1.06
1976-80	n.d.	0.70	0.85	0.48	0.96	0.93	0.69	0.93	0.91
1985-89	n.d.	0.57	0.79	0.37	1.04	0.71	0.78	1.49	0.75
1994-98	n.d.	0.52	0.82	0.30	2.27	0.72	0.70	1.36	0.96
Coffee, tea and tobacco									
1967-71	n.d.	n.d.	n.d.	n.d.	n.d.	0.75	0.62	n.d.	0.66
1976-80	n.d.	n.d.	n.d.	n.d.	n.d.	0.60	0.38	n.d.	0.44
1985-89	n.d.	n.d.	n.d.	n.d.	n.d.	0.59	0.55	n.d.	0.57
1994-98	n.d.	n.d.	n.d.	n.d.	n.d.	0.46	0.33	n.d.	0.68
Sugar									
80-82*	3.00	1.50	1.40	1.25	1.05	1.15	0.80	0.65	n.d.
Meat									
1967-71	1.05	0.86	0.57	0.57	0.57	0.54	0.41	0.89	0.92
1976-80	1.43	0.83	0.50	0.54	0.43	0.47	0.38	0.86	0.79
1985-89	1.25	0.80	0.55	0.64	0.49	0.43	0.59	1.80	0.58
1994-98	2.14	0.72	0.50	0.58	0.44	0.37	0.42	0.96	0.56
Dairy products									
1967-71	1.12	1.03	1.05	0.88	1.01	1.02	1.37	1.08	1.22
1976-80	1.35	0.98	0.85	1.02	0.89	0.85	1.00	1.51	1.01
1985-89	1.53	1.02	0.84	1.20	0.93	0.67	0.76	4.03	0.81
1994-98	1.47	0.85	0.72	1.05	0.95	0.49	0.46	0.70	1.15
Fruit and vegetables									
1967-71	0.99	0.87	0.90	0.52	1.17	0.73	0.70	0.76	0.89
1976-80	1.95	1.03	0.85	0.42	1.22	0.61	0.49	0.85	0.76
1985-89	2.40	0.98	1.01	0.52	1.09	0.64	0.62	1.18	0.49
1994-98	3.31	0.89	0.82	0.43	1.12	0.59	0.51	0.42	1.06

Source: Own work based on FAOSTAT (2004)

Note: Europe consists of a weighted sample of 7 countries (France, Germany, Italy, the Netherlands, Portugal, Spain and the United Kingdom).

* Data from Tyres and Anderson (1992).

Table 4.

Evolution of the Gruber-Lloyd Index of intra-industrial trade for a sample of processed agricultural products

	1963-65	**1973-77**	**1985-89**	**1996-00**
Argentina	0.005	0.007	0.014	0.292
Australia	0.046	0.077	0.093	0.127
Brazil	0.001	0.015	0.012	0.022
Canada	0.306	0.302	0.311	0.373
China	0.158	0.138	0.116	0.195
Egypt	0.108	0.059	0.132	0.188
Europe-9	0.193	0.245	0.290	0.366
India	0.013	0.007	0.021	0.070
Japan	0.112	0.117	0.054	0.058
USA	0.105	0.159	0.209	0.248
World	0.165	0.220	0.265	0.326

Source: Own work based on FAO (1947-2000) and FAOSTAT (2004)

Table 5.

Results of the gravity equation. International agri-food trade broken down by product groups

	PCSE-FE Model				Fixed Effects Model				Random Effects Model			
Ln X_{ij}	Total (1)	Bulk. (2)	Plantation (3)	Foodstuffs (4)	Total (5)	Bulk. (6)	Plantation (7)	Foodstuffs (8)	Total (9)	Bulk. (10)	Plantation (11)	Foodstuffs (12)
$\ln Y_i$	-0.572*	-2.795***	-0.265	-0.081	-0.795***	-2.827***	-0.362***	-0.326***	0.548***	0.221***	0.683***	0.590***
	(0.333)	(0.236)	(0.260)	(0.306)	(0.084)	(0.097)	(0.089)	(0.082)	(0.041)	(0.046)	(0.050)	(0.041)
$\ln Y_j$	2.137***	2.457***	0.958***	1.684***	1.972***	2.531***	0.757***	1.479***	1.151***	1.198***	0.943***	1.017***
	(0.220)	(0.183)	(0.204)	(0.214)	(0.069)	(0.079)	(0.073)	(0.067)	(0.035)	(0.039)	(0.042)	(0.035)
$\ln Ypcp_i$	1.566***	3.461***	1.529***	1.011***	1.987***	3.554***	1.738***	1.417***	0.690***	0.748***	0.228***	0.707***
	(0.419)	(0.298)	(0.321)	(0.362)	(0.101)	(0.116)	(0.107)	(0.099)	(0.052)	(0.057)	(0.062)	(0.051)
$\ln Ypcp_j$	-0.974***	-1.233***	0.572**	-0.229	-0.869***	-1.290***	0.682***	-0.077	-0.010	-0.212***	0.435***	0.207***
	(0.223)	(0.198)	(0.226)	(0.230)	(0.079)	(0.090)	(0.083)	(0.077)	(0.039)	(0.043)	(0.047)	(0.038)
$\ln Excvol_{ij}$	-0.030*	-0.043**	-0.007	0.001	-0.049***	-0.071***	-0.002	0.001	-0.063***	-0.118***	-0.027***	-0.012*
	(0.016)	(0.018)	(0.017)	(0.014)	(0.008)	(0.009)	(0.008)	(0.008)	(0.008)	(0.009)	(0.008)	(0.007)
$\ln Dist_{ij}$	. . .	. . .	. . .	. . .	…	…	…	...	-0.956***	-1.074***	-0.937***	-1.140***
									(0.079)	(0.087)	(0.100)	(0.080)
$\ln Rem_i$	-0.001	-0.023	0.015	0.003	0.011	-0.032**	0.036***	0.021	0.059***	0.083***	0.065***	0.054***
	(0.006)	(0.014)	(0.022)	(0.009)	(0.013)	(0.015)	(0.014)	(0.012)	(0.013)	(0.015)	(0.013)	(0.012)
$Border_{ij}$	. . .	. . .	. . .	. . .	…	…	…	...	0.297	1.196***	1.253***	0.128
									(0.371)	(0.407)	(0.470)	(0.373)
$Lang_{ij}$	. . .	. . .	. . .	. . .	…	…	…	...	1.411***	1.779***	1.359***	1.366***
									(0.218)	(0.239)	(0.276)	(0.219)
UE_{ij}	0.319***	0.401***	0.717***	0.308***	0.396***	0.550***	0.932***	0.353***	0.394***	0.688***	1.114***	0.374***
	(0.062)	(0.135)	(0.143)	(0.061)	(0.068)	(0.078)	(0.072)	(0.066)	(0.066)	(0.077)	(0.070)	(0.064)
$EFTA_{ij}$	0.459***	0.164	0.478**	0.490***	0.782***	0.153	0.863***	0.867***	0.742***	0.028	0.695***	0.815***
	(0.097)	(0.218)	(0.207)	(0.110)	(0.153)	(0.175)	(0.162)	(0.149)	(0.153)	(0.177)	(0.161)	(0.148)
$APEC_{ij}$	0.313**	0.664***	0.262*	0.539***	0.465***	0.898***	0.219**	0.809***	0.420***	0.814***	0.201**	0.810***
	(0.153)	(0.206)	(0.146)	(0.167)	(0.091)	(0.104)	(0.096)	(0.088)	(0.091)	(0.106)	(0.096)	(0.088)
$NAFTA_{ij}$	-0.099	0.060	0.187	-0.254	-0.162	-0.011	0.138	-0.558**	-0.187	-0.057	0.074	-0.594*
	(0.132)	(0.181)	(0.326)	(0.158)	(0.331)	(0.379)	(0.350)	(0.322)	(0.332)	(0.385)	(0.350)	(0.322)
CER_{ij}	-0.152	0.170	-0.108	-0.248	-0.067	0.370	-0.144	-0.343	0.302	1.054	0.538	0.033
	(0.122)	(0.277)	(0.362)	(0.167)	(1.038)	(1.189)	(1.097)	(1.010)	(0.904)	(1.032)	(0.991)	(0.884)
$MERCOSUR_{ij}$	-0.221	0.121	0.781*	-0.028	-0.726**	0.262	0.798***	-0.569**	-0.641**	0.436	0.951***	-0.473*
	(0.233)	(0.331)	(0.451)	(0.245)	(0.281)	(0.322)	(0.297)	(0.274)	(0.283)	(0.327)	(0.298)	(0.274)
$ANDEAN_{ij}$	0.0227	0.160	-0.064	0.579**	0.046	-0.013	-0.515**	0.736***	0.071	-0.145	-0.551**	0.705***
	(0.204)	(0.349)	(0.499)	(0.268)	(0.229)	(0.263)	(0.243)	(0.223)	(0.228)	(0.263)	(0.241)	(0.221)
$ASEAN_{ij}$	1.166**	3.450***	1.867***	0.950	1.148	4.179***	2.404***	0.669	1.296*	3.840***	2.731***	0.933
	(0.474)	(0.779)	(0.596)	(0.593)	(0.756)	(0.866)	(0.799)	(0.735)	(0.707)	(0.812)	(0.760)	(0.688)
$GSTP_{ij}$	0.805***	0.721***	0.501***	0.654***	1.289***	0.911***	0.587***	1.149***	1.075***	0.379***	0.300***	0.970***
	(0.169)	(0.159)	(0.146)	(0.189)	(0.055)	(0.063)	(0.058)	(0.053)	(0.052)	(0.060)	(0.055)	(0.050)
$Gatt_{62\text{-}94\ ij}$	0.059	-0.063	0.114	0.034	-0.011	-0.254***	0.162***	-0.010	-0.020	-0.330***	0.098**	-0.008
	(0.093)	(0.110)	(0105)	(0.091)	(0.043)	(0.049)	(0.045)	(0.041)	(0.041)	(0.048)	(0.044)	(0.040)
$Gatt_{94\text{-}00\ ij}$	0.177	0.096	0.378***	0.183**	0.206***	-0.159***	0.674***	0.263***	0.129***	-0.432***	0.600***	0.202***
	(0.109)	(0.131)	(0.142)	(0.108)	(0.050)	(0.058)	(0.053)	(0.049)	(0.049)	(0.056)	(0.052)	(0.047)
Constant	-30.62***	-0.53	-25.47***	-34.11***	-25.26***	-1.54	-20.59***	-27.06***	-26.14***	-20.05***	-28.53***	-24.92***
	(4.663)	(3.819)	(5.226)	(4.112)	(1.369)	(1.467)	(1.447)	(1.331)	(1.070)	(1.196)	(1.269)	(1.061)
Number obs	50.388	50.388	50.388	50.388	50.388	50.388	50.388	50.388	50.388	50.388	50.388	50.388
R-Squared	0.517	0.555	0.547	0.544	0.187	0.092	0.184	0.216	0.492	0.424	0.420	0.531

Note: Columns 1-5 Prais-Winsten estimation with PCSE and fixed effects. 6-11 Estimations performed on the fixed effects model and columns 11-15 on the random effects model. Total represents aggregate agri-food trade comprising. Bulk. represents bulk products. Plantation represents Plantation products. Foodstuffs represents high value-added processed foods. Processed represents other processed products. All of the variables are in logarithms except the binary variables (Common Border, Language and RTAs). Standard errors are presented in brackets. ***, ** and * denote 1, 5 and 10 percent of the level of statistical significance, respectively.

Table 6.

Changes in the direction of agri-food trade, 1963-2000

(Regional classification based on income per capita, share of trade flows in percentage terms)

Bulk and plantation products

Period	North-North	North-South	South-North	South-South	Total
1963-66	58	9	30	4	**100**
1967-73	62	7	28	3	**100**
1974-80	65	11	21	3	**100**
1981-87	64	16	18	3	**100**
1988-94	68	12	17	3	**100**
95-2000	64	14	17	5	**100**

High value-added products and processed foodstuffs

Period	North-North	North-South	South-North	South-South	Total
1963-66	80	7	13	1	**100**
1967-73	80	7	12	1	**100**
1974-80	78	11	9	2	**100**
1981-87	76	12	10	2	**100**
1988-94	80	8	9	3	**100**
95-2000	77	8	10	5	**100**

Source: Own work based on FAOSTAT (2004) and UN-COMTRADE (2003)

Table 7.

Results of the gravity equation. International agri-food trade broken down by product groups and economic regions

	Bulk Products PCSE FE				Plantation products PCSE FE				High value-added, processed foods PCSE FE			
	N-N (1)	**N-S** (2)	**S-N** (3)	**S-S** (4)	**N-N** (5)	**N-S** (6)	**S-N** (7)	**S-S** (8)	**N-N** (9)	**N-S** (10)	**S-N** (11)	**S-S** (12)
lnY$_i$	-1.615***	0.155	-4.806***	-4.444***	-1.516**	-1.094**	-0.005	-2.980***	-0.828**	1.261**	-1.191	-5.183***
	(0.585)	(0.448)	(0.829)	(0.878)	(0.704)	(0.516)	(0.808)	(0.909)	(0.322)	(0.614)	(0.764)	(0.954)
lnY$_j$	0.751*	2.132***	3.267***	1.211***	2.885***	1.391***	2.745***	1.510***	1.762***	1.151***	3.371***	2.809***
	(0.455)	(0.377)	(0.675)	(0.429)	(0.496)	(0.324)	(0.540)	(0.515)	(0.366)	(0.338)	(0.630)	(0.544)
lnYpcp$_i$	2.125***	-0.330	5.770***	5.576***	2.990***	1.112*	0.883	4.704***	1.011***	-0.864	2.633***	6.949***
	(0.686)	(0.527)	(0.870)	(0.858)	(0.762)	(0.640)	(0.844)	(0.818)	(0.368)	(0.763)	(0.806)	(0.837)
lnYpcp$_j$	0.246	-0.346	-2.307***	0.116	-0.955*	0.593*	-1.602**	-0.620	-0.027	0.789**	-1.968***	-0.951*
	(0.507)	(0.398)	(0.785)	(0.467)	(0.570)	(0.332)	(0.754)	(0.492)	(0.387)	(0.364)	(0.711)	(0.503)
lnExcvol$_{ij}$	-0.057**	0.017	-0.031	0.023	-0.065**	0.018	0.019	-0.001	-0.007	0.042*	0.043	0.076**
	(0.028)	(0.025)	(0.045)	(0.041)	(0.030)	(0.025)	(0.034)	(0.036)	(0.009)	(0.025)	(0.035)	(0.036)
lnRem$_i$	-0.016	-0.003	-0.979	-1.942**	-0.004	0.036	-0.010	-1.618**	0.002	0.006	0.119	-2.386***
	(0.011)	(0.019)	(0.684)	(0.658)	(0.013)	(0.037)	(0.627)	(0.758)	(0.008)	(0.020)	(0.584)	(0.794)
EU	0.623***				0.644***				0.446***			
	(0.150)				(0.137)				(0.062)			
EFTA	0.028				0.494**				0.261**			
	(0.236)				(0.208)				(0.099)			
APEC	-0.128	0.311	0.917***	0.729*	-0.206	0.286	0.280	0.400	0.155**	-0.178	0.299	1.468***
	(0.142)	(0.313)	(0.318)	(0.397)	(0.234)	(0.225)	(0.257)	(0.324)	(0.077)	(0.242)	(0.259)	(0.420)
NAFTA	0.591***	0.313	-0.260		0.313**	1.021	-0.977**		0.006	0.233	-0.294	
	(0.157)	(0.377)	(0.399)		(0.154)	(1.058)	(0.458)		(0.109)	(0.280)	(0.226)	
CER	0.409				-0.124				-0.063			
	(0.279)				(0.374)				(0.181)			
MERCOSUR				-0.271				0.586				-0.627**
				(0.325)				(0.460)				(0.251)
ANDEAN				0.008				-0.115				0.551**
				(0.346)				(0.498)				(0.262)
ASEAN				2.897***				1.664***				-0.230
				(0.771)				(0.604)				(0.778)
GSTP				0.396**				0.398**				0.428**
				(0.165)				(0.174)				(0.208)
Gatt$_{62-94}$	-0.050	0.083	-0.489**	-0.072	-0.055	0.240	0.219	-0.105	0.110	0.244	-0.125	-0.317*
	(0.277)	(0.579)	(0.204)	(0.183)	(0.251)	(0.171)	(0.170)	(0.565)	(0.137)	(0.163)	(0.156)	(0.174)
Gatt$_{94-00}$	-0.107	0.346*	-0.084	0.609***	-0.213	0.784***	0.501**	0.544**	0.148	0.291	0.356*	0.572**
	(0.724)	(0.185)	(0.250)	(0.202)	(0.296)	(0.196)	(0.212)	(0.257)	(0.145)	(0.190)	(0.202)	(0.231)
Constant	-10.70	-34.15***	11.32	…	…	…	-52.62***	…	…	-68.82***	-45.64***	12.149
	(11.447)	(8.545)	(12.523)				(11.136)			(12.276)	(11.363)	(11.939)
Nº observ.	14.440	15.200	10.640	10.108	14.440	15.200	10.640	10.108	14.440	15.200	10.640	10.108
R-Squared	0.592	0.476	0.545	0.396	0.608	0.472	0.546	0.353	0.812	0.469	0.501	0.478

Note: Prais-Winsten estimation with PCSE and fixed effects. N-N: North-North Trade, trade between high income countries; N-S: North-South Trade, exports of high income to low income countries; S-N: South-North Trade, exports from low income to high income countries; S-S: South-South Trade, trade between low income countries.

All of the variables are in logarithms except the binary variables (RTAs). ***, ** and * denote 1, 5 and 10 percent of the level of statistical significance, respectively.