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LIBERALISATION OF AGRICULTURAL TRADE - GLOBAL IMPLICATIONS AND WHAT IT MEANS FOR THE EU

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Tiivistelmä: Maatalouskaupan vapauttamisen odotetaan muodostavan keskeisen osan WTO:n Dohan neuvottelukierosta sopimuksesta. Sen taloudellisia vaikutuksia arvioidaan tässä tutkimuksessa kansainvälistä taloutta kuvaavan numeerisen yleisen tasapainon mallin avulla. Tutkimuksessa simuloidaan laajaa vientitukia, tuontisuojaa ja julkisista varoista maksettua maataloustukia purkavaa politiikkapakettia. WTO reformin seurauksena maatalouden maailmankauppa kasvaa mallisimuloineissa tuoteryhmästä riippuen 10-25 %. Voimakkainta naudanlihan ja sokerin kohdalla. Tärkein kauppaa kasvattava tekijä on tuontisuojan purkaminen. Kiinteähintaisella BKT:lla tai henkeä kohden lasketulla kulutuksella mitattuna eniten kaupan vapauttamisesta hyötyisivät keskituloiset maat, EU, Keski- ja Itä-Euroopan -maat, sekä USA:ta ja Kanadaa lukuun ottamatta muut teollisuusmaat. Eniten hyötyvillä alueilla BKT kasvaa 0.1-0.3 % tuotannon tehostumisen seurauksena. Kulutus lisääntyy yleensä tulojen kasvua enemmän elintarvikkeiden hintojen laskiessa niitä tuovissa maissa, kun rajasuojaa alennettaan tai vaihtosuhteen vahvistuessa elintarvikkeita vievissä maissa.

Asiasanat: Maatalous, kauppapolitiikka, tullit, numeeriset tasapainomallit

Abstract: The liberalisation of agricultural trade is expected to become a key element of the agreement resulting from the WTO's Doha Round. The economic impacts of agricultural trade liberalisation are evaluated in this study using a global numerical general equilibrium model. A broad policy package including the elimination of export subsidies, tariff reductions, and cuts in publicly financed domestic support is evaluated. World trade is expected to expand in liberalised commodities by between 10 and 25 per cent. Growth will be most pronounced in beef and sugar trade. Tariff reductions are the most important factor boosting trade. Middle-income countries, the EU, the transition economies of central Europe and other industrial countries, excluding the USA and Canada, are likely to benefit most from the reform. The efficiency gains as measured by fixed-price GDP will be from 0.1 to 0.3 per cent in these countries. Usually, consumption increases more because of declining food prices in food-importing countries or because of improved terms of trade in food-exporting countries.

Key words: Agriculture, trade policy, tariffs, numerical general equilibrium modelling

Contents

1 Introduction

The WTO Ministerial Meeting in Doha in November 2001 set out a framework for progress on the ongoing negotiating round on removing trade barriers. The Doha meeting put together a working programme for the WTO's Millennium Round, a similar project having failed two years earlier in Seattle. As regards agriculture, the meeting's resolution states a commitment to a significant extension of market access, a reduction in all forms of export subsidies – with the aim of finally abolishing them – and a major reduction in domestic subsidies distorting trade.

This study evaluates the economic implications of the broad-based liberalisation of agricultural trade using the simulation results of the GTAP global numerical general equilibrium model. The study examines the overall global economic effects of trade liberalisation and, for the EU, more precise sector-specific consequences of the reform. The study is restricted to agricultural trade since it is anticipated that the negotiations will reach concrete results in that field. On the other hand, agricultural questions are also an interesting subject of analysis because the negotiations embrace an unusually wide spectrum of views on the matters for discussion. The EU appears to have ended up in a situation in the negotiations where it has very few allies supporting its positions (see Bjørnskov and Lind, 2002).

Limiting the study to the liberalisation of agricultural products is supported by the fact that industrial tariffs in developed countries have reached a relatively low level. Apart from Australia and New Zealand, average tariffs in industrial countries are a few percentage points of the value of the imports. For developing countries, the negotiating situation has to be assessed by recognising that the WTO negotiations are about tariff bindings that impose upper limits on import duties. For these countries, the bindings are well in excess of the duties that they levy in reality. Even considerable reductions in tariff bindings would not necessarily lead to changes in the foreign trade policy actually pursued by them as regards imports of industrial products (Francois et al., 2000). Probably no significant reductions in industrial tariffs from the point of view of world trade will result from the trade negotiations.

As regards services, the current material does not permit the study of the effects of the removal of trade barriers. For the free movement of services, it is often a question of removing barriers to foreign service providers establishing themselves in another country. By their nature, many services require physical proximity of operations. Thus it is more a question of direct investments and movement of the factors of production than foreign trade as such (Francois et al., 2000).

The study employs the GTAP model to evaluate the effects of the liberalisation of agricultural trade by simulating a policy shock in which export subsidies are eliminated completely, effective import duties are reduced by 36 per cent and the value of publicly financed domestic subsidies is reduced by 20 per cent. The 66 regions and 57 sectors in the material in the GTAP database have been aggregated for the model simulations into 11 regions and 17 sectors, where the emphasis in commodities is on agricultural and food industry products, and in regions on the key market areas for the EU.

The overall economic effects of the liberalisation of agricultural trade are measured in fixed-price GDP and fixed-price per capita consumption. In the model simulations, middle-income countries, the EU, central and eastern European countries and other industrial countries benefit most from trade liberalisation. Agricultural trade liberalisation leads to GDP growth in these regions of 0.1-0.3%. If fixed-price consumption is used as the measure of the success of the reform, the benefits are relatively greater than for GDP for all of the industrial world apart from North America, i.e. Canada and the USA.

In the model simulations, the volume of world agricultural trade grows as a result of the WTO reform in almost all product groups. Depending on the product, the growth in trade is between 10-25% and is most marked in beef and sugar. The most important factor increasing trade is the removal of import barriers. Reduced export subsidies cause a decline in world trade. Here a reduction in subsidised exports from the EU is clearly visible which is not entirely compensated by supply from other regions. To a limited extent, a cut in input subsidies has a trade-reducing effect and for many products it clearly increases it.

The study is structured as follows. Section two briefly sketches the situation of agricultural trade following the Uruguay Round. Section three examines the research method and material. Section four presents the simulation results and section five makes some final conclusions.

2 The agricultural trade policy environment following the Uruguay Round

In the period following the Second World War, world trade in industrial products has been liberalised under the aegis of the GATT in eight different negotiating rounds. Duties between the main industrial countries have declined from an average of around 40% after the war to under a tenth of that level. The GATT agreement[1] has provided a general set of trade rules and an agreement on procedures to amend these rules. The GATT Uruguay Round brought trade in agricultural products within the general trade rules. The conditions for international agricultural trade were laid down in the Uruguay Round's Agreement on Agriculture[2] under three main headings: market access, export competition and international agricultural subsidies.

The aim was to make *market access* more transparent by the tariffication of non-tariff trade barriers. Upper limits were imposed on customs duties by country. For developed countries it was agreed to reduce these in steps between 1995 and 2000 by 36 per cent. For developing countries the reduction was 24 per cent with an implementation period of ten years from 1995-2004. In tariffying non-tariff trade barriers, the level of border protection was measured in duty equivalents, which were defined as the difference between domestic producer prices and world market prices by product between 1986-89. For agricultural products, the difference between world market prices and domestic producer prices at the start of the period was generally much smaller than what the tariffs agreed upon committed the countries to (Ingco, 1995).

Because the GATT agreements commit the parties not to exceed the maximum tariffs agreed upon, rather than the level of duties actually in use, the tariff bindings were significantly higher than what the countries had in fact applied in their agricultural trade. An 'airy' tariffication of this type left countries with upward discretion in setting their import protection for typically highly protected sensitive products (Ingco, 1995).

So as to avoid tariffication leading to a reduction of trade, the intention being that the agreement would expand it, tariff quotas were agreed upon in connection with the market access-promoting measures. Tariff quotas are a two-tier tariff system, and constitute an oddity which runs counter to the spirit and aims of the agreement. Low tariffs are applied up to the quota import total, and high tariffs are imposed on imports beyond that level. Although the aim of the agreement

[1] The GATT (General Agreement on Tariffs and Trade) is an agreement between the states parties, and not an institution. Before the WTO was established, implementation and monitoring of the GATT was the responsibility of a Geneva-based secretariat. At the final meeting of the Uruguay Round, a formal organisation – the WTO – was set up, one of its tasks being to monitor the GATT agreement.

[2] URAA (Uruguay Round Agreement on Agriculture).

was to make trade barriers transparent, the tariff quota system introduced something quite different (see Francois et al., 2000).

Of the customs nomenclature for agricultural products, in the EU, for example, eight per cent are subject to quotas. Within the quota, the tariff level is on average 8% and outside it 49% (OECD, 2001). The use of quotas is most common in Iceland, Norway and Switzerland, but even in the USA the number of items falling within quotas represent 10% of the import nomenclature for agricultural products. Between 1995-98 the average utilisation rate of quotas in the OECD was 65 per cent. In the EU over the same period it was over 70%. The distribution of the fill rate of quotas displays two peaks: for over half the quotas the fill rate was over 80 per cent and around a quarter of quotas had a fill rate below 20 per cent.

By way of promoting *export competition* the agreement obliged parties to cut export subsidies for agricultural production by 36 per cent from the reference year value and the level of exports, which benefited from subsidies in the reference year, by 21 per cent. This was the most significant single measure in the Uruguay Round in reducing agricultural subsidies.

National support

The Uruguay Round also contained a commitment to maximum levels of domestic support in agriculture, and to a 20 per cent reduction in support ceilings over the period of the agreement. The agreement defines the level of support using the Aggregate Measurement of Support (AMS)[3]. The reference value used for AMS is the support levels for the years 1986-88. Both the EU and the USA included elements in this reference support that were not subject to reduction in the support reduction period.

AMS is composed of domestic (budget) subsidies and market price support. In crude terms, budget subsidies are income transfers from taxpayers to agricultural producers and market price support represents income transfers from consumers to agricultural producers. Budget-financed support is divided into three types: market-distorting support subject to reductions, minimally distorting support, which is not subject to reductions, and support linked to production cuts, which is also not subject to AMS restrictions. In WTO jargon, prohibited support is referred to as 'amber box', permitted support is 'green box' and support that is distorting but permissible under certain preconditions is 'blue box'.

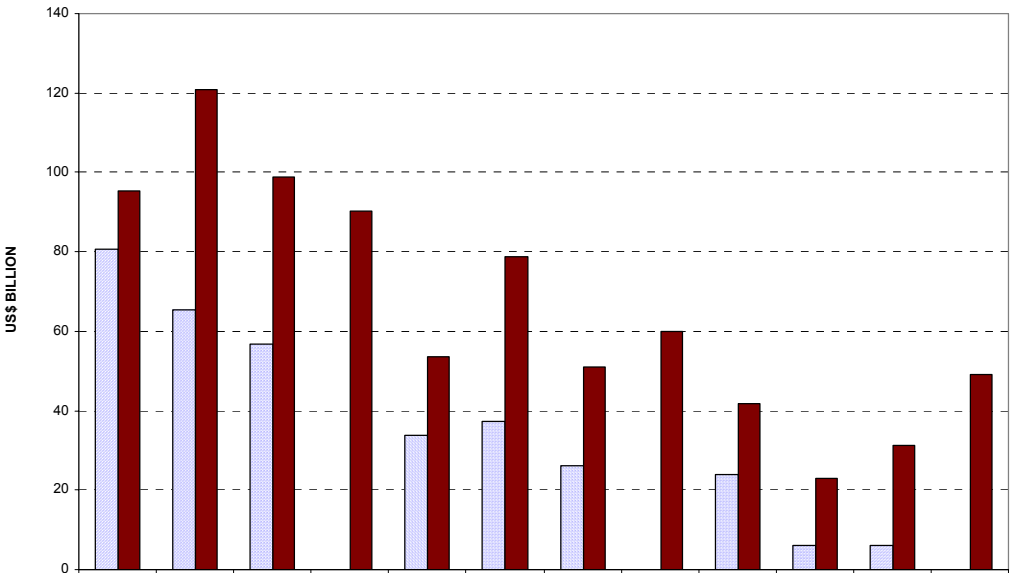
The GATT Agreement classifies as green box support public services directed at agriculture, food security, domestic food aid, income support not linked to pro-

[3] A good description of the details and concepts of the GATT's Uruguay Round Agreement on Agriculture can be found in IATRC (1994).

duction and support for pension arrangements as part of structural change programmes. Other permitted forms of support are investment support as part of structural change programmes and payments in connection with environmental programmes or regional support programmes. It is questionable whether the latter forms of support can be considered only moderately distorting (see Roberts et al., 2001).

So as to get the USA and the EU on board, separate agreement was reached on so-called 'blue box' support, which is also excluded from the AMS restrictions. By its nature it is trade-distorting, but the parties committed themselves to measures reducing the level of subsidised production. Support is paid on the basis of fixed acreage or animal numbers and on 85% of production in the base period. In practice, 'blue box' support aims to maintain the agricultural production structure as it has evolved under high price subsidies. Only increased production reduces the amount of support per unit produced.

Market price support represents the difference between what producers receive and consumers pay in protected markets compared to a system of totally unrestricted market access. The price difference can be maintained by restricting market access, by subsidising exports to market excess production and by intervention purchases on the domestic market.



	EU 1986-88	EU 1995	EU 1997	EU 2000	Japan 1986-88	Japan 1995	Japan 1997	Japan 2000	USA 1986-88	USA 1995	USA 1997	USA 2000
AMS	81	65	57	0	34	37	26	0	24	6	6	0
PSE	95	121	99	90	54	79	51	60	42	23	31	49

Figure 2-1: AMS and PSE support in the EU, Japan and the USA

Figure 2.1 shows the path of the Aggregate Measurement of Support under the GATT Agreement and of PSE support as calculated by the OECD during the period of the Uruguay Round for the EU, Japan and the USA.[4]. For AMS, the averages for the years 1986-88 refer to the reference values based on which the countries pledged to reduce their subsidies by 20 per cent. For the EU and the USA, AMS subsidies for 1995 are considerably below the reference years' support level. The reason for this is that the EU did not apply acreage or livestock unit subsidies in the reference period. These were only introduced in the early 1990s to compensate for the reduction in other elements of support. Correspondingly, in the USA, much of the support paid to agriculture – the co-called deficiency payments – were converted first into blue box support and subsequently into a form of payment fulfilling the criteria of green box support (see e.g. Roberts et al., 2001). The EU's Agenda 2000 reform of the Common Agricultural Policy of 1999 is an example of support being converted from targeted AMS-type support to subsidy forms that are not subject to cutbacks.

Although the GATT Uruguay Round managed to link agricultural products to general trade rules, the results of the round in terms of trade liberalisation and reducing harmful trade subsidies were very limited. The significance of the round was to set out a negotiating framework for future trade negotiating rounds.

[4] Agricultural support is largely concentrated in the rich industrial countries. The share of agricultural subsidies paid by the EU, Japan and the USA is around 80 per cent (OECD, 2000).

3 Method and data

This study assesses the implications of the liberalisation of agricultural trade using simulations produced by a multi-regional numerical general equilibrium model. This methodology has established itself in evaluating trade policy-related issues of this type[5]. The GTAP model[6], which is used in this study, is a conventionally designed multi-regional numerical general equilibrium model (see Hertel, Ianchovichina and McDonald, 1997). The advantage of using it is the database produced by the GTAP project that supports the model. Version 5 of the database contains input-output sectoral descriptions for 66 regions or countries, including 57 commodities/sectors. This sectoral classification makes the GTAP well suited to evaluating the agricultural issues of the WTO negotiations because agricultural products and sectors based on natural resources are comprehensively represented in the model. The sectoral classification contains 12 agricultural sectors and 8 food-processing sectors.

Inter-regional economic linkages are described by bilateral trade flows between sectors. Apart from trade-flow material the database contains information on regional trade policy instruments and their effects on differences between world market and user prices. Apart from the services, the trade barrier data contains information on tariffs, quotas, anti-dumping duties and agricultural subsidies.

3.1 Main features of the GTAP model

The standard GTAP model (see Hertel and Tsigas, 1997) is a static, multi-regional numerical general equilibrium model with constant returns to scale production technology and perfect competition. Inter-regional links are described by bilateral trade flows. Pricing is characterised as perfect competition, although the commodities produced are regionally differentiated. The regional differentiation of commodities enables intra-industry trade to be taken into account. The GTAP model is produced and solved using GEMPACK software (Harrison and Pearson, 1996).

The GTAP model divides regionally available commodities into three groups. Tradable commodities are produced from primary and intermediate product inputs for domestic and foreign consumption and for use as intermediate product inputs. The primary factors of production – land, labour and capital – are non-tradable production factor endowments owned by regional households. Non-

[5] Francois and Reinert (1997) is a manual on the use of numerical models for evaluating trade policy.

[6] The GTAP model and several applications are available on the project's website: http:/www.agecon.purdue.edu/gtap. Hertel and Tsigas (1997) is a description of the theory of the model. Dimaranan and McDougall et al. (2002) is a description of version 5 of the database.

tradable means here that the factors of production do not move from one country to another.

There is also one regionally specific investment commodity in the model. In the model investments accumulate to the capital stock following the simulation period. In a static model, however, this period is outside the model's examination horizon. The purpose of this investment commodity in the model is to function as an investment target for expenditure allocated as savings.

The central elements of the model are formed from modelling the determination of (i) commodity market equilibrium, (ii) factor market equilibrium, (iii) household demand, (iv) investments and (v) public demand.

Commodity markets

In equilibrium, demand corresponds to supply in all commodity markets. Markets are assumed to be competitive, so that the price received by the producer corresponds to the marginal costs of production. Owing to taxes and subsidies, the prices paid by purchasers and received by producers differ. From the purchaser's perspective, domestically produced and imported commodities in the same product category are separate products. Imported commodities are also differentiated on the basis of production region. Tradable commodities are regionally differentiated and regional demand for them is derived from CES production or utility functions as in Armington (1969). The differentiation of imported commodities enables exports and imports of a commodity in an individual sector to appear simultaneously in the modelling of foreign trade.

Production factor markets

Demand for the factors of production comprises two main groups: intermediate products and primary inputs– labour, land and capital. In each sector the choice of the factors of production is based on minimising costs at a given level of production. The choice of the factors of production is limited by three-stage production technology[7]. At the first level aggregated primary factors of production and intermediate product inputs are used in a fixed relationship to each other (Leontieff technology). At the second level the primary factors of production are a CES aggregate of labour, land and capital. Correspondingly, each intermediate product group is a CES aggregate of a domestic and imported commodity. At the third level import commodities in each product group are an aggregate CES function of import commodities from various regions. The supply of primary factors of production is given at the regional level and they are not the subject of international trade.

[7] Dixon et al. (1995) analyse the use of multi-level CES functions in numerical general equilibrium models.

Household demand

Each region has a representative household. The total income of the region is distributed in constant shares into private consumption, public consumption and savings, based on a Cobb-Douglass-type regional utility function. The household buys commodities by product group, maximising its benefit at a given expenditure constraint. Private consumption is allocated to tradable commodities according to a constant elasticities in differences (CDE) utility function. The form of the CDE is a parsimonious way to parametrise, using a small number of parameters, the varying budget shares of commodities in consumption, and the possible complementarity between commodities. One advantage of describing consumer behaviour with the CDE function is that characterising the entire demand system with it requires information only on the commodities' own price and income elasticities. The properties and applications of the functional form are described by Hertel et al. (1991). The product groups are CES aggregates of domestic and imported commodities. Imported commodities used in consumption are correspondingly composed of CES aggregates of imported commodities from various regions.

Determination of investments

Regional investments and savings are separate decisions in the GTAP model. Regional investments are funded from the global savings pool. Each region saves a constant share of its income in this pool. Regional investments are determined by their relative yield. Regions where the relative yield on capital is growing receive a relatively larger share of the savings available for investments and vice versa.

In the GTAP model, regional savings depend on household expenditure decisions and regional investments on investment decisions taken based on the expected yield. Thus in equilibrium regional savings and investments can differ in magnitude. The balance of payments does not need to be balanced. The average yield on capital varies such that savings and investments are globally equivalent.

Public demand

Total public demand is determined as a constant share of the region's income. Demand for individual product groups is constant in terms of expenditure, being based on Cobb-Douglass expenditure functions. The allocation of public consumption between domestic and imported commodities is determined in the same way as for private consumption.

3.2 Sensitivity of the model simulations: uncertainty of the parameters and significance of contributory policy change factors

Evaluation of the economic policy options based on the model results is subject to various forms of uncertainty. Central to these is the uncertainty related to the size of the model's behavioural parameters. Also the range of the exogenous shocks affecting the determination of the model results may also only be known within certain limits. However, the simulations' sensitivity relative to the random fluctuation of the parameters or shocks can be analysed systematically (see DeVyust and Preckel, 1997).

The policy changes that are the target of the study often result from the interaction of many factors. Dividing the overall effects into the sum of the contributory factors is interesting, for example from the cost and effectiveness point of view or in evaluating otherwise the significance of the various contributory policy option factors. In a complex environment this tends not to be a trivial question. Harrison et al. (1999) have demonstrated how GEMPACK software can decompose the effects of several variables into their component parts in very general situations.

Systematic sensitivity analysis

Often the model's principal parameters or exogenous shocks are key to determining the simulation results, but usually the exact value of these is not known. The significance of this uncertainty to the simulation results can be evaluated by statistical methods. In the Monte Carlo method the value of the variables giving rise to the uncertainty is selected at random and the reliability of the results in relation to the uncertainty is characterised using the mean values and standard deviations of the simulation results. Precise results would require a large number of repetitions. An alternative way is to ask – at a given distribution of uncertain parameters or exogenous variables – what are the best observation points in a case with a limited number of simulations so that the parameters of the distribution of the simulation results can be calculated in a reliable way. This is what a systematic sensitivity analysis is about. The three main contributory factors in the method are:

- Evaluation or assumption of the distribution of uncertain parameters or variables,
- Design of a discrete approximation for this distribution and
- Solving the model at selected points of the discrete distribution and weighting of the simulation results according to the point probabilities of the simulation results.

One procedure for selecting the point values of specified parameters is Gaussian quadrature. Gaussian quadrature is a discrete counterpart to a multinomial continuous distribution, the first d moments of which are exactly matched with the continuous distribution. DeVyust and Preckel (1997) present the Gaussian method and evaluate its advantages over alternative ways of conducting systematic sensitivity analysis.

Systematic sensitivity analysis with GEMPACK can use Stroud's or Liu's quadrature, which has three first moments. If N variables fluctuate independently, there are 2N observation points in Stroud's quadrature and a maximum of 4N observation points in Liu's quadrature. In SSA calculations the model is solved in the case of Stroud's quadrature 2N times and in Liu's quadrature a maximum of 4N times (see Arndt and Pearson, 1996). In the methods using GEMPACK, it is assumed that the uncertain parameters or shocks follow a symmetrical distribution. The uncertainty can be evaluated either in relation to the exogenous shocks or parameters but not to both at the same time. In the case of several parameters or shocks one also has to assume that their variation is either completely independent or completely correlated.

Armington elasticities in foreign trade

In this study, in evaluating a policy simulation reducing agricultural trade barriers, foreign trade price reactions are key in determining the results. The robustness of the results is evaluated using a systematic sensitivity analysis by assuming the elastisticies of trade to be random variables. In the GTAP model foreign trade demand is characterised as a two-stage decision problem. This is depicted in figure 3-1. At the upper decision-making level a choice is made between a domestic and an imported commodity. Variations in the allocation of demand are affected by the relative price of the domestic product and the imported aggregate. The magnitude of the price reaction is determined by the substitution parameter σ_d. The aggregate import price is calculated as a CES function of individual import regions' prices. At the second decision-making level imported commodities are selected in relation to different regions of origin. This decision is affected by the relative prices of regional products, in which the magnitude of the price reaction is affected by the parameter σ_M. The expected values of the parameters used in the sensitivity analyses and the ranges assumed for them are given in the table in annex 2.

Decomposing simulations in respect of exogenous shocks

The results of policy simulations generally represent the compound effect of several exogenous shocks. When a policy change – or any change in an exogenous variable at issue in the model – is comprised of several contributory factors, it is natural to inquire what the relative significance of each partial component is. The problem of evaluating the relative significance of different factors can be illus-

trated in the case of one endogenous and several exogenous variables. If the relationship of the endogenous variable Z and the exogenous variables $X_1, X_2, \ldots, X_n$, can be represented by the non-linear function

$$Z = F\left(X_1, X_2 \ldots X_n\right), \tag{1}$$

then the change Z relative to the exogenous shocks X_i is represented by

$$dZ = F_1 dX_1 + F_2 dX_2 + \ldots + F_n dX_n,$$
$$\text{jossa } F_i = \partial F / \partial X_i \tag{2}$$

The partial derivates in equation (2) stress the effect of the exogenous variables precisely only in the neighbourhood of the reference point because the partial derivates are dependent on the point at which they are evaluated. There are various numerical methods for evaluating the outcome of equation (2) precisely, but decomposing the result requires the partial derivates to be evaluated beyond the range of the exogenous variables. Harrison et al. (1999) demonstrate that this is not a trivial problem. One way to estimate the contribution of different variables is to calculate the changes in Z in relation to individual X_i variables. In this case the magnitude of individual contributions depends on the order of calculation. In the case of a non-linear model the sign of the impact of an individual variable can alter depending on the order of calculation. One way to bypass this problem is to calculate the mean value over all the individual orders. Harrison et al. (1999) demonstrate that if the endogenous variable (Z) to be explained is a quadratic function of the exogenous variables ($X_1,\ldots,Xi$), the integral of the partial derivates is the arithmetic mean calculated over different orders.. They further demonstrate that if the partial derivates F_{i0} and F_{i1} specified by the vectors $\tilde{X}_0 = \left(X_{10}, X_{20}, \ldots, X_{n0}\right)$ and $\tilde{X}_1 = \left(X_{11}, X_{21}, \ldots, X_{n1}\right)$ describing pre-simulation and post-simulation values of the exogenous variables:

$$F_{i0} = \partial F\left(\tilde{X}_0\right) / \partial X_i \quad ja \quad F_{i1} = \partial F\left(\tilde{X}_1\right) / \partial X_i, \tag{3}$$

are interpreted to be linearly specified in relation to each other, the weights of F_i can be calculated as a general numerical integration problem.

3.3 Data used

In the study, the 66 regions and 57 sectors in version 5 of the GTAP database were aggregated[8] for the model simulations into 11 regions and 17 sectors, with

[8] The sectoral and regional aggregations made from the GTAP5 database are described in the annex to the study.

the main emphasis on agricultural and food industry products. The significance of the regions in the study for world trade in the main food product categories in 1997 is detailed in table 1. In version 5 of the database, production subsidies are divided up in accordance with OECD statistics and allocated to both input and output subsidies. This is different from the earlier versions of the GTAP database, where all subsidies other than export subsidies were classified as ad valorem subsidies to production. Export subsidies are included in the database on the basis of WTO notifications.

Table: 3-1: Regions' % shares of world trade in foods, 1997

	Wheat	Feed grains	Oilseed products[1]	Sugar[1]	Other vegetable products	Beef[1]	Other meat products[1]	Dairy products[1]	Processed foods	Average
Australia and New Zealand	15.8	2.1	0.7	6.7	3.5	32.8	4.5	28.3	2.7	5.8
USA	30.7	54.6	27.8	0.8	15.7	27.2	23.0	4.8	15.1	19.1
Canada	24.9	6.2	5.3	1	1.8	7.2	10.1	2.0	4.0	5.1
Mercosur[2]	11.1	13.3	22.7	18.4	10.3	10.8	9.4	3.0	6.0	10.2
Mediterranean region[3]	1.2	0.6	1.9	0.6	7.3	0.6	1.1	0.7	2.6	3.1
Middle-income countries[4]	0.9	0.8	15.0	34.1	22.1	1.4	8.3	1.6	15.9	14.8
Developing countries[4]	0.2	10.8	11.5	15.2	25.0	3.2	6.7	0.8	13.7	13.8
European Union[5]	11.1	7.8	9.8	17.1	8.1	12.5	25.5	46.3	26.9	19.0
Central and eastern European countries (CEECs)[6]	1.1	1.9	1.7	2.9	0.9	1.3	9.2	4.4	2.5	2.5
Countries of the former Soviet Union (CIS)	3.0	1.8	1.9	2.9	4.0	2.6	0.9	3.7	2.8	2.8
Other industrial countries	0.0	0.0	1.7	0.4	1.2	0.5	1.2	4.4	7.8	3.8
Commodity's share of world trade (%)	4.5	3.7	12.7	3	22.0	4.2	6.5	4.3	39.1	
Average tariffs in world trade (%)	21.9	32.2	8.8	30.0	8.3	24.5	16.7	45.1	13.5	15.6

Source: GTAP 5 database, own calculations.
[1] Primary production and processing added together. For dairy production only trade in processed products.
[2] Customs union of Argentina, Brazil, Paraguay and Uruguay. Chile and Bolivia are associate members.
[3] Northern African countries in the GTAP database and Turkey.
[4] Middle-income countries in south-eastern Asia and Latin America (excl. Mercosur).
[5] Calculations do not internal trade in the European Union.
[5] Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovakia and Slovenia.

The last column in the table represents the share of the region in total trade in foods. The row after individual commodities' share of trade by region gives the percentage shares of each commodity of world food trade. The last row gives percentage average tariff levels applied to commodities in world trade.

By market shares, the USA and the EU are almost equally large suppliers of foods to world markets. Their share of world trade in agricultural products and foods is around a fifth. However, the regions differ in the structure of the commodities they supply. The USA is the principal supplier of cereals and oilseeds.

In beef markets, too, its share is almost as large as that of the Australia-New Zealand region, which is the largest supplier to world markets in this commodity group. The European Union is the principal world trade supplier of processed foods and dairy products and other meat products.

The distribution of world trade in foods is presented in the penultimate line of the table. The bottom line gives the average tariff levels applied to trade in commodities. Processed foods represent the most significant group in terms of value of trade. Their value of all trade is around 40 per cent. This is a very heterogeneous commodity category, spanning trade in fruits, vegetables, nuts and fibres. The third most import category is oilseed products and the fourth white meat production.

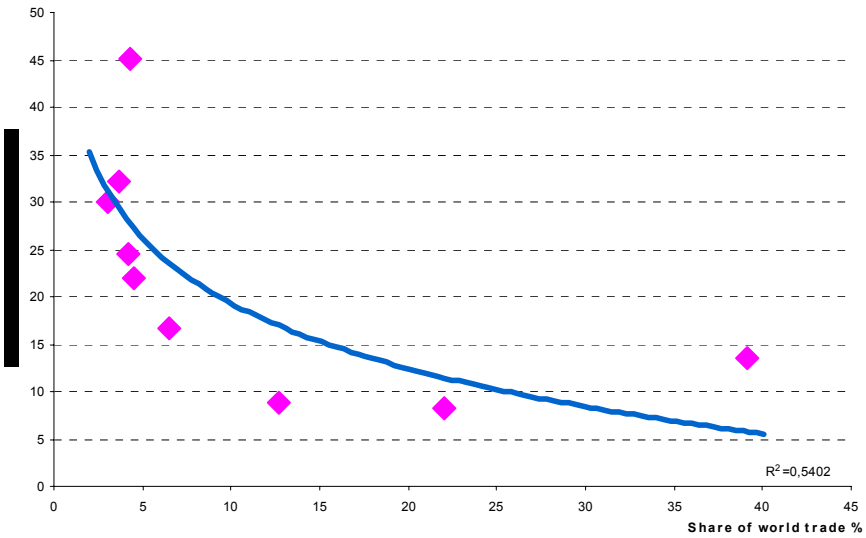


Figure 3-1: The correlation between import protection and world trade

The average tariff level levied on the three largest commodity groups in world food trade is lower than the trade share-weighted mean for trade in foods as a whole, which for the present material is 15.6%. Those products that are subject to relatively low tariffs account for a significant share of the world's food trade. The correlation between trade barriers and the share of world trade is illustrated in figure 3-2, which shows that trade shares and tariff levels have a clear negative dependency. Over half of the variation in trade shares can be 'explained' by variations in tariff rates.

In addition to being protected by high external tariffs, agriculture is also subsidised by national support. Table 3-2 illustrates the significance of agricultural

subsidies. In industrial countries, the share of agricultural production of GDP is only 1-3 per cent. In middle-income countries this share is between 5 and 10 per cent and in developing countries the share of agriculture is almost 20 per cent of GDP. The share of industrial countries[9] of world agricultural production is just over a quarter, but their share of world trade in agricultural products is over half. In 1997 the aggregate value of agricultural subsidies in the world was 80 billion US$. The value of subsidies paid is almost sixfold the agricultural income received in countries like Australia and Canada.

Capital or land use-based input subsidies are a significant form of subsidies. In 1997 almost 65 billion US$ were paid in input subsidies and their share of all subsidies was over 80 per cent. The share of commodity subsidies of all subsidies was over 10 per cent and they were paid to the tune of around 10 billion US$. The share of export subsidies was only around 7 per cent of all subsidies, representing in excess of 5 billion US$.

Table 3-2: Agriculture and agricultural subsidies: key figures

	Australia and New Zealand	United States	Canada	Mercosur -countries	Mediter-ranean countries	Middle-income countries	Develo-ping countries	Euro-pean Union	CEE count-ries	CIS count-ries	Other indust-rial count-ries	To-tal/Avera ge
Share of agricultural production of GDP (%)	3.4	1.2	2.2	9.6	5.8	8.0	18.2	2.4	6.9	2.7	1.4	4.0
Share of world agri-culture[1] (%)	1.3	9.4	1.1	10.5	6.7	11.8	34.4	15.7	1.9	1.4	5.8	100.0
Share of world agri-cultural trade (%)	8.9	23.0	6.2	10.4	3.5	12.7	14.0	14.2	2.5	3.3	1.2	100.0
Share of world agri-cultural subsidies (%)	0.5	22.1	1.9	0.8	1.1	3.3	1.6	57.6	1.6	1.0	8.4	79954.0[2]
Input subsidies	0.5	20.9	1.7	0.0	1.3	3.9	0.0	63.5	0.6	0.0	7.5	64885.0[2]
Commodity subsidies	1.0	40.5	4.5	6.1	0.9	0.0	12.9	5.3	7.8	7.7	13.2	9791.0[2]
Export subsidies	0.4	2.3	0.0	0.3	0.2	1.2	0.1	81.9	2.4	1.0	10.1	5278.0[2]
Subsidies relative to value added (%)	3.1	17.4	11.3	0.6	1.3	2.5	0.4	25.6	6.6	6.0	13.5	8.2
World subsidies rela-tive to region's agri-cultural income[3] (%)	592.5	78.8	579.3	73.9	114.8	75.3	26.7	44.4	409.2	586.2	160.9	

[1] As measured by GDP
[2] Million 1997 US$
[3] Total world subsidies divided by GDP in agriculture for the region
Source: GTAP 5 database, own calculations

The EU was the largest payer of agricultural subsidies. Its share of subsidies paid was almost 60 per cent. The second largest subsidiser of agriculture was the USA, its share of world subsidies paid to agriculture being around 20 per cent. The third region whose relative share of subsidies is larger than its relative share of world agricultural income is the region of other industrial countries. In the ma-

[9] In the calculations in this study these include Australia and New Zealand, the USA, Canada and the EU.

terial in the model, Norway, Japan and Switzerland are the principal countries in this regional aggregate.

In the EU subsidies are concentrated on input and export subsidies. The EU's share of these is larger than its share of all subsidies in the world. In the region of the rest of the world, subsidies are concentrated on export and commodity subsidies. On the other hand, the USA pays around 40 per cent of all commodity subsidies in the world.

AGENDA 2000

The baseline year in the GTAP 5 database is 1997. Inter-regional trade flows and GDP for the entire economy are from that year. For trade and economic policy instruments, the information in the database is more recent. For the EU, it was not possible to take the Agenda 2000 reform into account in the database. The reform was only agreed upon in mid-1999. From the point of view of the WTO negotiations, however, the reform is central because it represents a typical transition from subsidy types that the GATT agreement proscribes, to subsidies that are not subject to restrictions under current practice.

The Agenda 2000 reform represents a continuation of the agricultural reforms implemented by the EU previously. These sought to move the emphasis of agricultural support from high producer prices maintained via trade policy instruments to quantitatively limited subsidies based on livestock numbers and acreage. The reform was motivated by three factors. Firstly it is a means of preparing for the EU's eastern enlargement, which will put pressures on the costs of maintaining high producer prices. Secondly, it helps to convert agricultural support into a system that is less vulnerable to the decisions of the WTO negotiating round. The third reason for the reform is that without it the EU would not have been able to honour its agricultural trade commitments under the previous trade liberalisation round, the so-called Uruguay Round.

For cereals, the intervention prices maintained by agricultural policy measures are cut in the Agenda 2000 reform by a total of 15 per cent in the period 2000-2001. This is partially offset by an increase in acreage allowances. Acreage allowances are defined as tonnes per hectare on the basis of historical crop levels. The acreage-based support for oilseeds and protein plants is reduced to the same level as for cereal subsidies.

Beef intervention prices are cut by a total of 20 per cent in the period 2000-2003. Part of the price reductions are compensated via subsidies based on livestock units, paid for a fixed number of livestock. With the price cuts, a slaughter premium is introduced.

Table 3-3: Import tariffs, export and production subsidies in the EU

	EXPORT SUBSIDIES		IMPORT PROTECTION TUONTISUOJA		PRODUCTION SUBSIDIES	
	1999	*Agenda 2000*	*1999*	*Agenda 2000*	*1999*	*Agenda 2000*
Wheat	9.9	0	12.4	0	36.7	41.8
Feed grains	39.8	18	44.2	21.7	34.7	42.5
Oilseeds	0	0	0	0	52.3	47.9
Other crops	1.2	1.2	6.9	6.9	1.5	1.5
Raw sugar	76.6	76.6	76.6	76.6	-2.8	-2.8
Raw milk[1]	0	0	0	0	8.2	20.9
Cattle	82.5	56.4	111.2	81	18	29.7
Other animals	15.6	15.6	0.8	0.8	8.3	8.3
Natural resources	-0.6	-0.6	0.1	0.1	0.5	0.5
Processed beef products	68.8	44.7	53	31.1	0.6	0.6
Other processed meat products	12	12	18.7	18.7	0.7	0.7
Processed dairy products	83.4	62.8	116.3	92.1	1	1
Vegetable oils and fats	0	0	0	0	0.4	0.4
Sugar products	76.6	76.6	39.1	39.1	0.8	0.8
Processed foods	-0.1	-0.1	9.9	9.9	-9	-9
Manufacturing	-0.4	-0.4	3.8	3.8	-2.1	-2.1
Services	-0.6	-0.6	0	0	-2.5	-2.5

[1]Milk supplied from farms to dairies, which is not an internationally tradable commodity.
Source: GTAP 5 database, Francois and Strutt (1999) own calculations.

Reform of the dairy sector will only start in 2005, when producer prices will be cut by 15 per cent over three years. This will be partially compensated by direct subsidies, the allocation of which is based on historical milk quotas. In addition to general subsidies, support will be increased by means of so-called national envelopes on a differentiated, country-by-country basis. At the same time, milk quotas will be increased by 1.5 per cent in the period 2005-07. By 2007 the milk quota will increase overall by 2.4%, because the quota for five EU countries is set to increase from the beginning of the millennium.

Table 3-3 presents the EU's import protection, export subsidies and production subsidies as of 1999, and an estimate of the situation following Agenda 2000. The Agenda itself has implications for import protection and export subsidies for cereals, cattle rearing, beef and processed dairy products. The reform will cause export subsidies to decrease, but production subsidies will increase.

The effects of the Agenda 2000 reform on export subsidies and import protection have been derived by simulating the reform's effects using the GTAP model. In the simulations producer prices have been exogenised and export subsidies and import protection have been adjusted so as to yield the requisite producer prices.

The change in production subsidies is assumed to be exogenous and to determine them the author's own calculations are used; these are dealt with in more detail in the publication Vaittinen (2001). Table 3-3 shows that, for cereals, beef and processed dairy products, the Agenda 2000 reform shifts the focus of agriculture policy from import protection to production subsidies.

For wheat the resultant situation is one in which trade policy instruments are not applied at all to support the agricultural sector. On the other hand, the value of acreage-based production subsidies increases to over 40 per cent of the value of production. For beef, production subsidies increase by 10 percentage points. Milk production has been supported by marketing primary processed products such as milk powder and butter to the world by means of export subsidies.

These subsidies will be replaced by direct support for raw milk production within the prevailing milk quotas. In terms of its effects on production, the change in the subsidy structure is almost neutral in respect of all sectors. Cereal production will decrease by a few per cent, beef production will remain more or less unchanged and milk production will increase slightly (see Vaittinen, 2001). The study does not seek to evaluate the proposal made in the Agenda 2000 mid-term review to move over to WTO-style 'green box' support, i.e. support with a minimum distorting effect on production.

4 Liberalisation of agricultural trade

This section evaluates the effects of the liberalisation of agricultural trade using the GTAP model. The effects are evaluated by simulating a policy shock in which export subsidies are abolished altogether, effective import tariffs are reduced by 36 per cent and the value of domestic support is cut by 20 per cent. The starting point used for the trade policy actions is the design of the trade policy instruments prevailing following the Uruguay Round. The analysis does not evaluate possible reductions in industrial tariffs or the removal of trade barriers in trade in services.

In the model analyses, import protection is interpreted as regional commodity-specific tariff equivalents. The complex regulatory system introduced under the Uruguay Round is not modelled, rather cuts in import protection are analysed in the standard way (cf. Hertel et al., 1999).

In a similar framework, Hertel, Anderson, Francois and Martin (1999) have analysed a more comprehensive trade reform. In their analysis, they concentrate on characterising the general features of trade liberalisation and focus less on sectoral and regional effects than in the present study. In their regional aggregation the European Union is combined into western Europe, and they do not take account of the effects of EU policy changes on trade policy instruments.

The study evaluates the liberalisation of agricultural trade in a policy package in which it is assumed that export subsidies are abolished altogether, import protection is reduced by 36% and production subsidies are cut by 20%. The effects of a policy shock of this type are evaluated in two ways. Firstly the aim is to evaluate the relative significance of different elements of the policy package so as to shed light on the discussion on the role of various subsidy components in the liberalisation of agricultural trade. In parallel, the significance of the uncertainty relating to the magnitude of the parameters determining the sensitivity of foreign trade reactions to the simulation results is evaluated.

In econometric studies, estimates of the substitution elasticities of imported commodities are relatively low. On the other hand, experience shows that the effects of trade policy reforms on changes in the terms of trade are small, which points to substantial price elasticity in the demand for commodities (see Dimaranan et al., 2002). Also, Gelhar's (1994) study, which evaluates the structural implications of changes in the supply of the factors of production, shows that high elasticities are used to explain changes in the structure of trade.

4.1 Macro effects by region

Table 4-1 details the overall economic effects of the liberalisation of agricultural trade. These can be found in relation to changes in imports and exports in fixed-price GDP terms. The change in welfare is evaluated by the change in consumption as measured by the equivalent variation[10]. The variations in the terms of trade are also given. The results are reported as percentage change deviations from the reference equilibrium.

Table 4-1: Overall economic effects of the liberalisation of agricultural trade by region

	Australia and New Zealand	United States	Canada	Mercosur countries	Mediterranean countries	Middle-income countries	Developing countries	European Union	CEE countries	CIS countries	Other industrial countries
Fixed-price GDP (% change)	-0.01	0	0.02	0.05	0.08	0.23	0.08	0.13	0.14	-0.05	0.15
Expected value standard deviation	0	0	0.01	0.01	0.01	0.03	0.01	0.01	0.02	0.01	0.02
Fixed-price imports (% change)	2.34	0.46	0.27	2.07	1.13	1.33	1.36	0.13	1.2	0.11	0.8
Expected value standard deviation	0.27	0.06	0.05	0.25	0.18	0.1	0.22	0.06	0.18	0.19	0.06
Fixed-price exports (% change)	0.66	0.41	0.23	1.49	1.31	1.19	1.37	0.3	1.06	0.05	0.77
Expected value standard deviation	0.1	0.06	0.04	0.27	0.2	0.09	0.22	0.05	0.19	0.15	0.09
Terms of trade (% change)	1.44	0.11	0.04	0.6	-0.34	-0.11	-0.03	-0.01	0.17	0.06	-0.12
Expected value standard deviation	0.18	0.02	0.02	0.06	0.03	0.02	0.02	0.02	0.04	0.06	0.02
Fixed-price consumption (% change)	0.28	0.02	0.05	0.13	0.04	0.35	0.12	0.18	0.29	-0.08	0.26
Expected value standard deviation	0.03	0	0.01	0.01	0.02	0.04	0.01	0.01	0.03	0.01	0.02

At the overall economic level the effects of the liberalisation of agricultural trade are relatively limited. The most significant changes as measured by fixed-price GDP are found for the middle-income country group, the EU, CEE countries and other industrial countries. GDP grows in these regions by 0.1-0.2% relative to the reference equilibrium. The terms of trade improve in the CEE countries, remain fairly stable in the EU region and weaken somewhat for other industrial countries. The change in consumption as measured by the equivalent variation is greater than the increase in GDP.

The change in fixed-price GDP in the model analyses measures the increased efficiency in the allocation of resources, i.e. the return yielded by the factors of production. The benefit resulting from the change in the terms of trade indicates

[10] Equivalent variation is a monetary measure of change in welfare. It evaluates the change in welfare as measured by consumption expenditure as a result of policy action if the commodities consumed had to be paid for at the prices existing before the policy.

the increase in income resulting from an increased amount of imported commodities at a given domestic output. In addition to the change in income resulting from the increase in production, the equivalent variation takes into account the effect of the change on consumer prices. If - owing to the altered policy – consumers obtain the basket of commodities they want at a lower cost than before, consumption can be increased at a given level of incomes. If consumption grows by more than GDP, consumption possibilities outstrip incomes at new relative prices.

In the EU, the benefits of the liberalisation of agricultural trade result largely from increased efficiency in the allocation of resources. The terms of trade weaken somewhat, but per capita private consumption grows 0.05 per cent more than overall incomes. In other industrial countries GDP grows at roughly the same rate as in the EU. The terms of trade weaken slightly more, but the increase in consumption relative to the increase in incomes is almost double at 0.26 per cent. This effect can be considered fairly significant considering the small size of the agricultural sector in these countries (cf. table 3-2). In CEE countries the improved terms of trade have a slightly positive effect on the increase in welfare. There the change in consumer prices has a more pronounced effect in increasing consumers' welfare.

The effect measured in GDP in the USA, Canada and Australia-New Zealand regions is almost imperceptible. For the USA and Canada part of the explanation is that agriculture is an extremely small sector relative to overall production. In the USA its share of GDP is just over one per cent and in Canada only around two per cent. Although both countries support agriculture from budget funds and protect it from outside competition with import protection, the order of magnitude in these countries is nonetheless different than in the EU and other industrial countries (cf. table 3-2).

The strongest effects on the terms of trade from the liberalisation of agricultural trade are seen for the Australia-New Zealand and Mercosur regions. With the improved terms of trade, welfare in these countries measured by consumption or the equivalent variation grows more than fixed-price GDP. Welfare measured by the equivalent variation increases relatively most in the Australia-New Zealand region, in middle-income and developing countries and in other industrial countries.

For Australia and New Zealand, the improvement in the terms of trade is the key factor behind the growth in welfare. Fixed-price GDP remains almost unchanged. This region has traditionally engaged in agricultural production on market terms; import protection or export subsidies have not had a significant role in agricultural trade. With the liberalisation of trade, production is geared towards those sectors which, with the removal of trade barriers, have greatest impact in increasing world trade.

It is noteworthy that, whatever measurement is used, the overall macroeconomic effects on the United States are almost imperceptible even though, of the countries participating in the trade negotiations, it has been one of the staunchest proponents of agricultural trade liberalisation. The country's terms of trade improve somewhat and agricultural production increases. However, with subsidies directed at production, this leads to inefficient use of resources, which in turn explains the macroeconomic outcome. It may be that no such reform, mechanically reducing import protection on all commodities, will take place and that in practice some products and sectors are required to adjust more than others. In their calculations, Hertel et al. (1999) also analyse a policy scenario limited to agricultural liberalisation which in its order of magnitude and direction yields a similar result for North America.

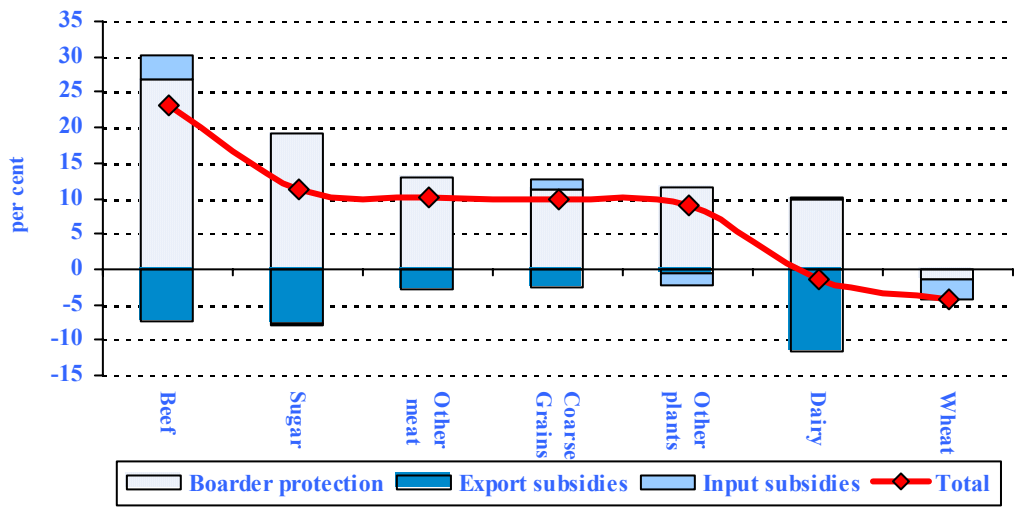


Figure 4-1: Impacts of trade liberalization on world trade in agricultural products - decomposed by policy measure

4.2 Implications for world trade

Figure 4.1 details the global trade implications of agricultural reform for the main agricultural commodities. The effect of the reform on world trade is decomposed for export subsidies, import protection and import subsidies. In interpreting the individual elements in the diagram, one must realise that they are conditional for the other partial components to be realised simultaneously. For example, the abolition of export subsidies reduces world trade in beef by around seven per cent, on condition that import protection and production subsidies are reduced as has been done in this exercise.

In the model's simulated estimate of the liberalisation of world trade, the volume of world trade grows with the exception of dairy products and wheat production. Depending on the product, the growth in trade is between 10 and 25%, and is most pronounced for beef and sugar. The most important factor boosting trade is the removal of import protection. A cut in export subsidies has the effect of reducing world trade. In practice this reflects a drop in subsidised exports from the EU. A cut in import subsidies has the effect of increasing trade in beef and feed grains and decreasing trade in other crops and wheat.

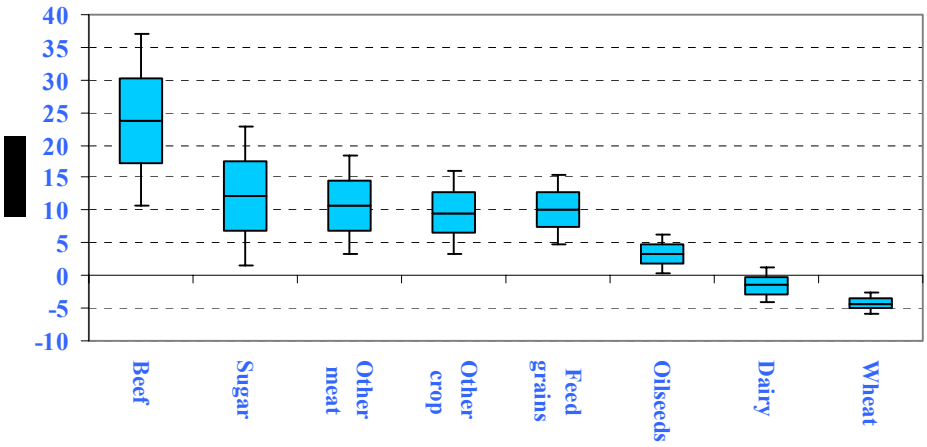


Figure 4-2: Volume of world trade –dispersion of trade and with varying demand parameters

Because the reform at issue is one that alters the price structure of foreign trade, the key point in evaluating its effects is how regional demand reacts to changes in relative prices resulting from the policy. This depends on the parameters determining behaviour, but there is uncertainty as regards these. The method described in section 3.2 attempts to set out the effects of this uncertainty.

The results in figure 4.2 take account of the uncertainty relating to the parameters governing price reactions in foreign trade. The figure presents the expected value and dispersion of changes in production when the foreign trade parameters are interpreted as random variables within a certain range. The central line in the bars in the figure represents the expected value of the volume of world trade by commodity, the upper and lower parts of the bar one standard deviation and the 'whiskers' two standard deviations from the expected value in the simulations, in which the parameters of trade are allowed to vary randomly.

The uncertainty regarding the magnitude of the behavioural parameters affecting trade flows has a significant effect on the range of the results. Nonetheless one can say that it is only in trade in dairy products where one cannot be certain of the reform's impact on the direction of the change in the volume of trade.

The dispersion of the results is greatest for beef and sugar production, but the expected values of the changes are so great that the direction of the effect is unambiguous. Relatively speaking the uncertainty is greatest in trade in dairy products. The range of the changes in trade is fairly small because the anticipated change is minor. The uncertainty related to the expected value of the production of oilseeds and sugar is almost equally large and the second most significant. In the case of sugar this is especially significant because the change in the expected value is fairly large.

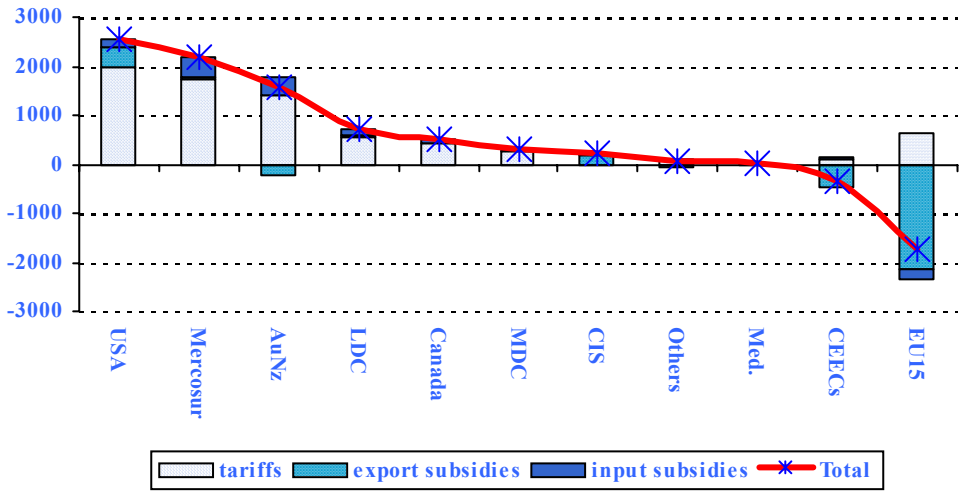


Figure 4-3: Change in beef exports by region – million US$ at 1997 prices

Distribution of effects by commodity and region

In the following the regional distribution of the commodity-specific changes in foreign trade are examined. The examination comprises four commodities which are especially significant for the EU's trade in foods. The commodities concerned are beef, sugar, feed grains and dairy products.

In the figures presenting regional changes in commodity exports, the effects of trade liberalisation are decomposed by policy measure for export subsidies, import protection and input subsidies. The magnitude of the policy effects in respect of individual policy components shows the effect of a multilateral measure

when the actions of all regions are taken into account for the instrument concerned. One must also remember that the estimated effects are conditional for the simultaneous realisation of the other policy measures.

The effects on exports by region are arranged by order of magnitude. In the study, the EU's trade only takes account of external trade with other regions. In the figures illustrating exports by commodity, the aggregate overall effect is represented by a line because stacking the bars that isolate the individual effects only produces the overall effect if all the effects are in the same direction.

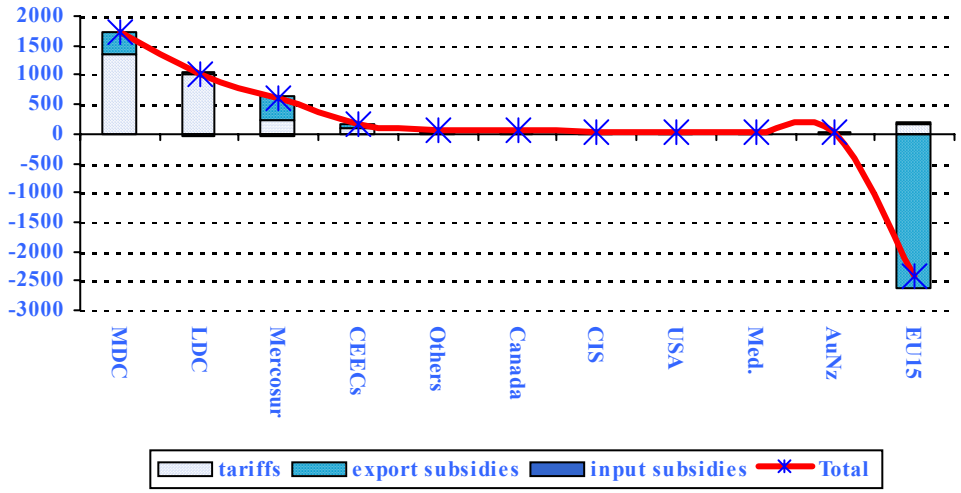


Figure 4-4: Change in sugar exports by region - million US$ at 1997 prices

The USA, Canada and Mercosur are the main beneficiaries of exports from the growth in trade in beef. For beef, market access, i.e. lower tariffs, is of central importance in increasing world trade. In fact it is the most significant trade factor for all regions increasing their exports. The EU and other industrial countries are the principal recipients of these exports (cf. annex 3a). The abolition of export subsidies is significant only for the EU, where it explains the majority of the reduction in exports. The model calculations show that the USA gains the majority of the markets lost by the EU. Reduction of tariffs in other industrial countries improves the EU's competitiveness in their markets but this is not sufficient to compensate the opposite impact of reductions in export and input subsidies.

For sugar, the number of regions for which trade liberalisation has a significant effect is smaller. Exports of sugar grow most for middle-income and developing countries and the Mercosur region. Lower export subsidies are of some significance for middle-income countries and especially for the Mercosur region, for which the increase in trade is most pronounced owing to the EU's reduced competitiveness. For developing and middle-income countries, access to EU markets

because of lower tariffs is the most significant factor increasing trade (cf. annex 3b). For the EU the reduction in export subsidies explains almost all of the reduction in trade.

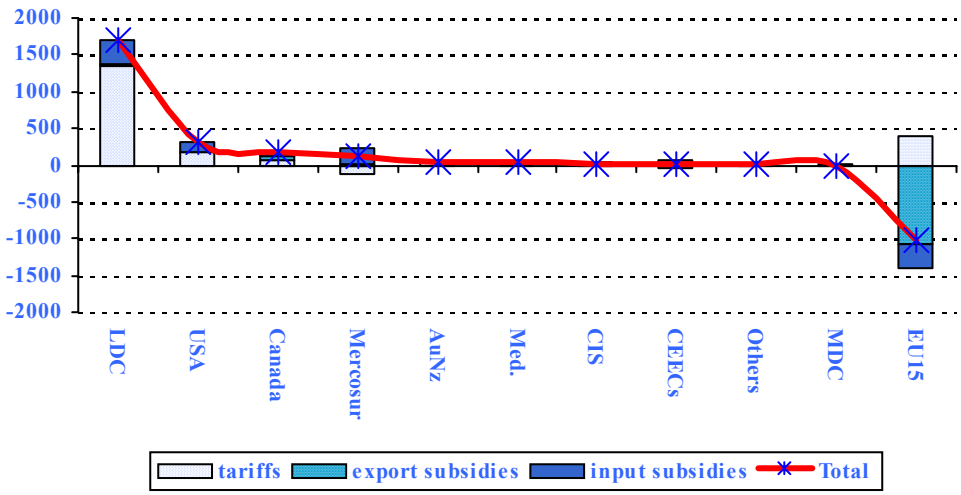


Figure 4-5: Change in exports of feedgrains by region - million US$ at 1997 prices

In feed grains exports the incidence of impacts is even more polarised than in the case of sugar. Exports from the EU decrease and exports from developing countries increase. Here, reduced input subsidies have some influence on the level of exports from developing countries. The reduction in EU exports is largely explained by the abolition of export subsidies. But it is mainly developed countries like the USA that fill the gap left by the EU's exports (cf. annex 3c). However, the USA's exports of feed grains to the rest of the industrial world decline so sharply that its overall exports remain almost unchanged. The strong growth in exports by developing countries is mainly directed towards middle-income countries, where the growth in trade is explained by the reduction in import protection.

In dairy products, the changes in exports are not as polarised as for feed grains. Nonetheless the EU is once again the clear loser and the Australia-New Zealand region is clearly the greatest beneficiary, unequivocally gaining market areas at the expense of the EU (cf. annex 3d). In this case the cut in EU export subsidies has a significantly positive effect on exports of Australian dairy products. Dairy products are the only one of the groups examined where exports decline significantly in an area other than the EU. In this case other industrial countries, where Switzerland occupies a central role, see a decline in exports.

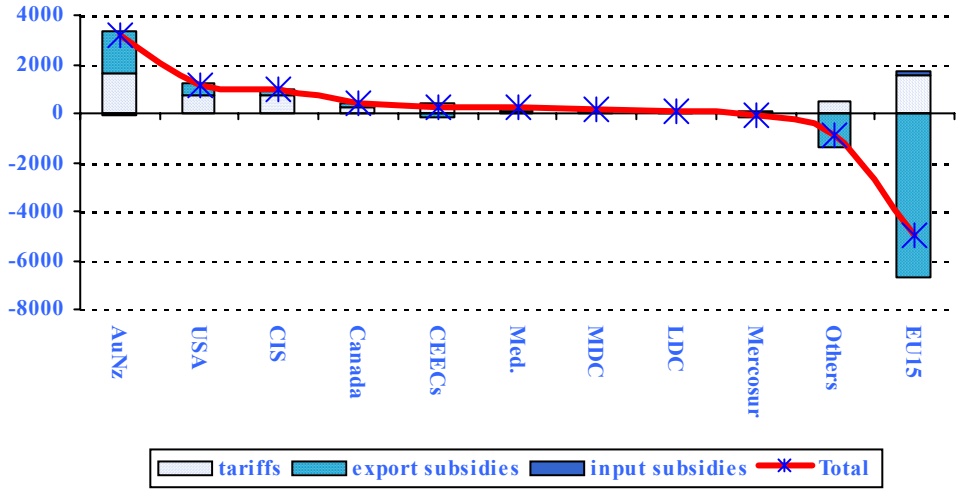


Figure 4-6: Change in exports of dairy products by region - million US$ at 1997 prices

4.3 Implications for EU agriculture

This section examines the effect of the WTO reform on EU agricultural production. The production implications are evaluated both in relation to the significance of various measures and taking into account the uncertainty in the trade parameters. For the main commodities, the production implications are also evaluated in relation to the market outlook based on the FAPRI (2002) scenarios for changes in production for various agricultural commodities.

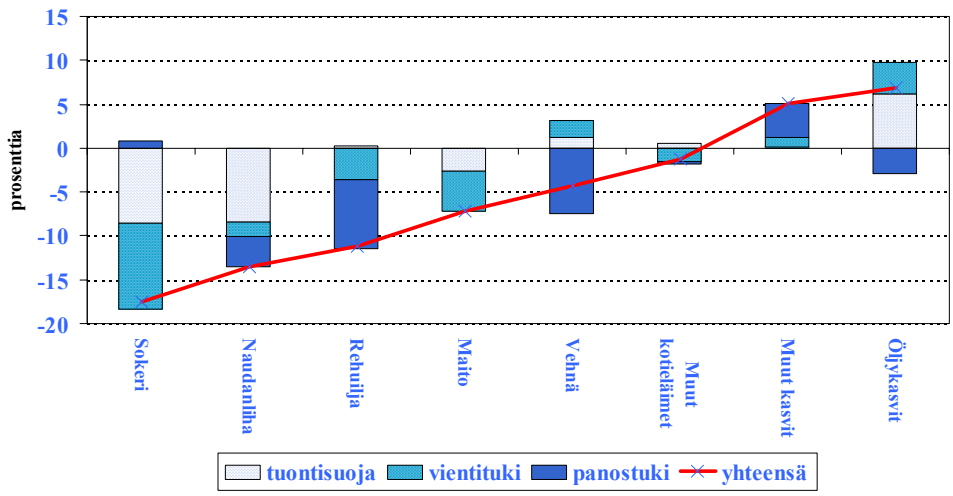


Figure 4-7: Change in agricultural production in the EU – by policy components

As a result of the reform under review, production declines in the EU in all agricultural sectors apart from oilseeds and other crop production. The most pronounced decline in production is in sugar, beef and feed grains. According to the simulation results, sugar production declines by almost 20 per cent, beef production by almost 15 per cent and feed grain production by around 10 per cent. According to the calculations, production of milk, which is central for overall agricultural production, declines by around seven per cent. The fall in production for individual commodities, however, is attributable to a number of factors.

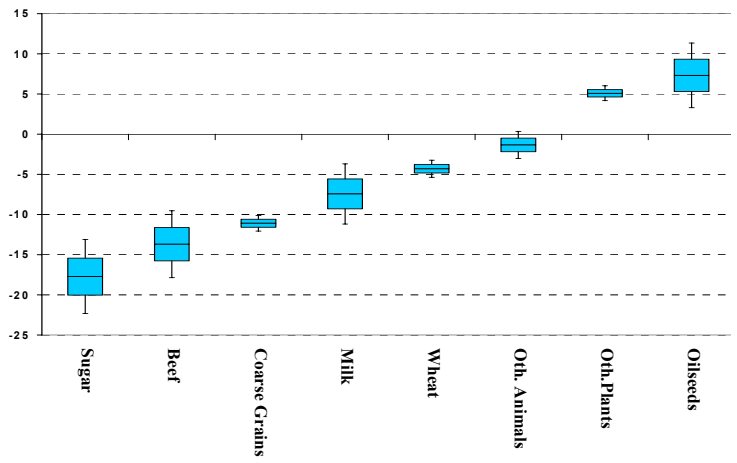


Figure 4-8: Dispersion of changes in production – with varying foreign trade parameters

The significance of export subsidies in the decline in sugar and milk production is relatively large. The reduction in input subsidies is most significant for cereal products. In sugar production, the increase in competition from imports is a relatively more important reason for the decline in production than it is in milk production. Of the seven per cent decline in milk production, over four per cent is explained by the reduction in export subsidies, whereas the change in border protection explains just over two per cent.

For cereals and beef, the reduction in input subsidies is the principal factor depressing production. In the case of wheat the significance of lower input subsidies is so great that without the reduction in support production might stay almost unchanged or even increase. Although the reduction in input subsidies also has a substantial impact on the change in beef production, competition from imports is nonetheless the key factor prompting the decline in production.

Although agricultural production declines in the EU region for almost all commodities, oilseed and other crop production increases as a result of resources being freed up from declining agricultural sectors. Oilseed production represents only 1.5 per cent of the total value of EU agricultural production. But in terms of

total agricultural production an increase in other crop production is significant because this segment represents around 40% of the value of EU agricultural production. Overall agricultural production only declines by just under two per cent as a result of the WTO reform, even though the drop in production for individual products is significant.

The significance of the uncertainty of the parameters for the anticipated changes in production is less than its significance for trade flows. This is natural since in agricultural products trade represents a relatively minor share of overall production. Also, the reform under review falls well short of free trade.

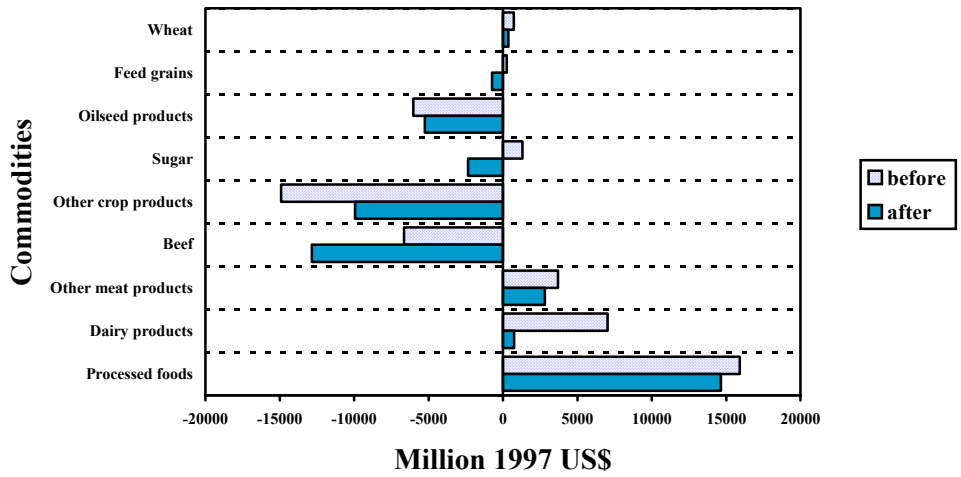


Figure 4-9: Net exports from the EU before and after the agricultural trade reform

The dispersion around the expected values is greatest for sugar, beef, milk and oilseeds. Even here, the size of two standard deviations is less than five per cent for all products. For beef, the change in anticipated production to within two standard deviations is somewhere between 12 and 16 per cent. The corresponding figures for milk production are 6 and 9. For no product does the expected value of the observations as arranged in order of magnitude come within the first standard deviation of the observation immediately preceding or immediately following it in order of magnitude. Taking the dispersion around expected production into account does not alter the ranking of sectors when arranged in respect of deviation in production.

For cereal products and other crops the fluctuation in production around the expected value due to the magnitude of the parameters is very modest. In terms of evaluating changes in production for these commodities in the trade liberalisation scenario, the uncertainty caused by trade reactions has a very moderate effect.

In foreign trade, the EU goes from being a net exporter of feed grains and sugar to being a net importer. And for beef net imports double. Correspondingly, net imports of other crops almost halve due to increased domestic supply.

4.4 The future of EU agricultural production in relation to the WTO reform

The GTAP model used in this study is a comparative-static analytical tool for carrying out policy evaluations based on 'what if' scenarios by comparing the economic situation before and after a policy measure. The simulation results should be understood as deviations from the trend path of the economy. In this section the calculations derived are compared to the long-term trend outlook using the scenarios of the state of agriculture 10 years ahead produced by the FAPRI international agricultural research institute.

FAPRI, the US-based Food and Agricultural Policy Research Institute, publishes an annual 10-year scenario of international agricultural projections for world trade and individual producer segments. The basic trend path in the institute's publications builds on the most widely used macroeconomic projections and assumptions regarding the implementation of agricultural policy.

According to the WTO negotiating timetable, a new negotiating agreement should be reached during 2005. In the previous round, industrial countries were given six years and developing countries 10 years to implement the agreement. In a similar way, a new trade agreement could be implemented in 2006 and the necessary actions could be completed by 2011.

Because the near-term perspective is not pivotal to the present study, just some of the long-term growth assumptions in FAPRI's (2002) world economic scenario are set out here. GDP growth in the world economy is assumed to be around 3.5 per cent annually. Growth in the developed industrial countries is assumed to be slower than this, around 2.5 per cent annually. The transition economies of eastern Europe are assumed to grow by around 1.5 percentage points faster than average growth in the world economy in the review period up to 2012. In the rest of the world growth is assumed to be around 4.5 per cent on average, i.e. somewhat slower than in the transition economy countries but two percentage points above the industrial countries. The economies of China and India are expected to grow particularly rapidly in the macroeconomic analyses. In China growth is expected

to continue at over seven per cent and in India average growth is forecast at six per cent.

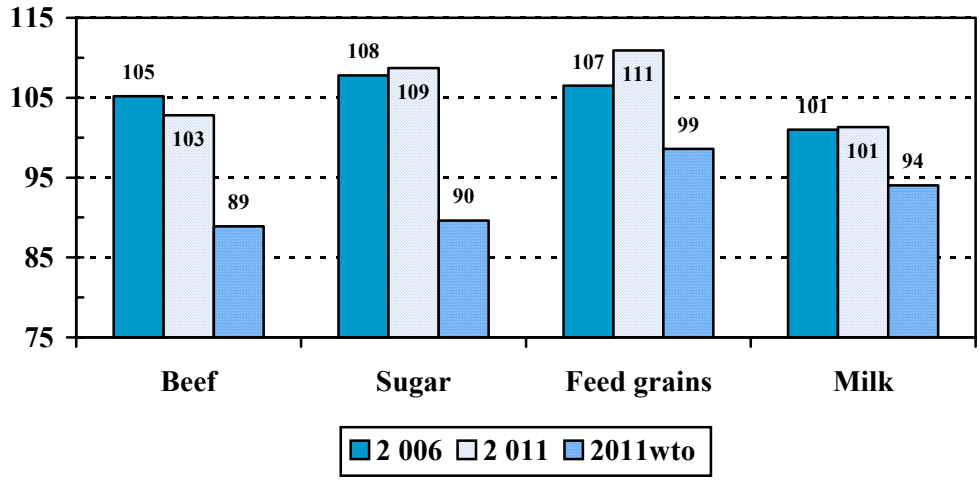


Figure 4-10: Agricultural production in the EU following trade liberalisation relative to the FARPRI scenarios

The FAPRI trend path for agricultural policy assumes that international agreements currently in force will remain in place throughout the review period. The obligations of the WTO Uruguay Round are assumed to remain in place up to the end of the period. The analyses contain no forecasts of the impact of the new round. The impact of the Chinese and Taiwanese membership of the WTO has also been taken into account in the outlook for agricultural markets.

EU agricultural policy under Agenda 2000 – including the forthcoming dairy sector reform in 2005-2007 – are factored into the analysis. On the other hand, the impact of the new US agricultural budget has not been factored in because it had not been adopted at the time of drawing up the scenario.

Figure 4-10 examines the results of the agricultural trade model simulations relative to the FAPRI agricultural production scenario for the EU for four commodities. The figure examines those commodities where according to the model simulations production will decline most in the EU region. Production in the last production year identified in the figure, which in the FAPRI report is 2001, is set at 100. The production level in 2006 is FAPRI's forecast. For beef, for example, it is assumed to be 5 per cent above the 2001 level. Correspondingly, production of sugar in 2006 is assumed to be around 8 and that of feed grains 7 per cent above the 2001 level. Milk production is assumed to remain more or less unchanged compared to the reference year level.

In 2001 domestic consumption of beef in the EU declined by 10 per cent. Exports remained at the previous year's level, when they fell by around 30 per cent due to new outbreaks of BSE. Exports are assumed to pick up in future, thus a small increase in overall production is anticipated by 2006. But beef production is assumed to be only three per cent above the present level at the end of the review period.

EU sugar production in 2001 was depressed owing to adverse weather conditions. The increase in production is explained in the analysis largely as a return to normal production conditions. The increased production will mainly go for exports, which are assumed to more than double in the review period.

The increased demand for feed grains in world markets is explained principally by China's increasing needs. FAPRI forecasts that the EU will capture the majority of the growing export markets for barley as it increases its market share at the expense of Australia and Canada. In the basic scenario, increased exports are the main factor explaining the higher production of feed grains in the EU. At the end of the review period production is assumed to be 11 per cent higher than in 2001.

In the review period, global milk production grows by over 12 per cent. Most of this growth takes place in North and South America. Most of the production goes to satisfying domestic demand, whereas increased production in Australia and New Zealand goes for exports. The EU's production level is restrained by quota limitations.

The final bar in figure 4-10 relates the expected outcomes of the model simulations for each commodity to the 2011 production levels, assuming that the FAPRI scenario is realised. The figure also assumes that the reform is initiated from the start of 2006 and that its effects will be seen in full in the production figures for 2011.

When the results of the model simulations are related to the FAPRI scenarios and comparing production in 2011 and 2001 in the case of the WTO reform, beef production falls most. Production in this sector would be 11 per cent below the 2001 production level. Sugar production would also be around ten per cent below the reference year level. Production levels of feed grains would be almost the same as in 2001. Milk production would fall by around six per cent below the present level.

Comparing the expected consequences of the WTO reform to the production outlook in the EU, in no sector are production levels assumed to ten per cent lower than at the moment. For sugar and beef it can be said that the market situation in the reference year was to some extent abnormal. But for feed grains the impact of the reform is diluted by the positive market outlook.

5 Finally

The main achievement of the GATT Uruguay Round was that it brought trade in agricultural products within the GATT trade rules. As a result agricultural trade restrictions were only partially abolished and under the agreement agricultural subsidies have changed in character, with a greater share of direct aid in place of the previous border protection. The OECD's PSE indicator shows that, with the exception of the EU, subsidies by the three largest agricultural subsidy payers in 2000 were higher than they were on average in 1986-88. This year was used in the URAA agreement as the reference year for AMS subsidy cuts.

Domestic agricultural is generally protected by high external tariffs. In several industrialised countries it is subsidised from budget resources. In 1997 the aggregate value of agricultural subsidies in the world was US$ 80 billion. Capital or land use-related input subsidies are the major form of subsidies. Their share of the total value of subsidies was over 80 per cent. The EU was the largest single payer of agricultural subsidies, paying almost 60 per cent of the world's agricultural subsidies. The second-largest subsidiser of agriculture was the USA, with an approximate 20 per cent share of world agricultural subsidies paid. Agricultural subsidies paid by other industrial countries are also relatively more than their share of world agricultural income.

Using the GTAP model, the study evaluates the effects of agricultural trade liberalisation by simulating a policy shock in which export subsidies are abolished entirely, effective import tariffs are reduced by 36 per cent and the value of domestic support paid from public funds is reduced by 20 per cent.

The overall economic effects of the liberalisation of agricultural trade have been measured by fixed-price GDP and fixed-price per capita consumption. In the model simulations the main beneficiaries of trade liberalisation are the middle-income country group, the EU, central and eastern European countries and other industrial countries. Agricultural trade liberalisation grows GDP in these regions by 0.1-0.2%. The GDP impact on the USA, Canada and the Australia-New Zealand region is almost non-existent. For the USA and Canada, part of the explanation is that agriculture is a very small sector relative to overall production. The GDP significance of agriculture is also small in the EU and the group of other industrial countries. But in these regions large-scale agricultural aid in its present shape has led to very inefficient agricultural production.

If fixed-price consumption is used as the yardstick of the reform's success, the benefits are relatively greater than if measured by GDP for all other parts of the industrial world apart from North America, i.e. Canada and the USA. It should be noted that whatever measure is used the overall economic/whole economy effects in the United States are almost non-existent even though of the negotiating coun-

tries it has been one of the strongest proponents of agricultural trade liberalisation. The country's terms of trade improve somewhat and agricultural production increases. Because of production subsidies the inefficient use of resources increases, which in turn explains the overall economic outcome.

With the improved terms of trade, the Latin American countries belonging to the Mercosur customs union and the large group of middle-income countries also benefit from the liberalisation of trade. The effects are also positive for developing countries, although they are relatively small. This is partly because developing countries only have a relatively small share of the world food trade to begin with and they hardly increase their share of this trade.

In the model simulations, the volume of world agricultural trade grows in almost all product groups. Depending on the product, trade grows by between 10 and 25%, and grows most strongly for beef and sugar. The most important factor increasing trade is the abolition of import protection. Lower export subsidies decrease world trade. A prominent factor here is lower subsidised exports from the EU, which is not fully compensated by supply from other regions. Lower input subsidies have a less pronounced trade-reducing impact, and for several products actually increase trade.

The study analyses the regional distribution of changes in foreign trade by commodity and for four commodities in particular, these being beef, sugar, feed grains and dairy products. For all these products, the EU is the region whose share of world trade shrinks, and typically a number of regions profit from the EU's lost market areas. Most of the growing trade in beef goes to the USA, Australia - New Zealand and Mercosur regions. For sugar, fewer regions increase their markets. Sugar exports increase most in middle-income and developing countries and in the Mercosur region. In trade in feed grains, the incidence of changes in exports is if anything even more restricted than for sugar. In the model simulations the USA makes up for falling exports from the EU, but exports from developing to middle-income countries increase also. The changes in exports of dairy products are not as concentrated as for feed grains. The Australia – New Zealand region is clearly the main beneficiary, unequivocally gaining market areas lost by the EU.

As a result of the liberalisation of agricultural trade studied, production declines in the EU in all agricultural sectors apart from oilseeds and other crops. The most pronounced production decline is in sugar, beef and feed grains. Production of oilseeds and other crops increases because resources are released from declining agricultural sectors. From the point of view of EU agriculture as a whole, oilseeds are of minor importance. On the other hand, other crops account for around 40% of the value of agricultural production. Increased production in this sector is highly significant for overall EU agricultural production, which declines by an

average of close to two per cent, even though production in individual sectors declines by almost 20 per cent.

The study's model simulations are designed to be comparative-static. It is natural to interpret the results as deviations from the economy's trend path. At the end of the study the simulation results are compared to the scenario of the outlook for agricultural production in the EU produced by FAPRI. The study assumes that the WTO reform will be implemented over a six-year period from 2006 and concluding in 2011. Compared to the production levels forecast by FAPRI, beef production declines most relative to production in 2001. The beef production level would be 11 per cent lower than in 2001. Sugar production would also be around 10 per cent lower than the reference year level. Feed grain production would be at almost the same level as in 2001 and milk production around six per cent below current production.

References

Armington P. A. (1969): 'A Theory of demand for Products Distinguished by Place of Production', IMF Staff Papers 16: 159-78.

Arndt C. - K. R. Pearson (1996): 'How to Carry Out Systematic Sensitivity Analysis via Gaussian Quadrature and GEM-PACK, GTAP Technical Papers no. 3, Center for Global Trade Analysis, Purdue University.

Bjørnskov C. - K. M. Lind (2002): 'Where Do Developing Countries Go After Doha? An Analysis of WTO Positions and Potential Alliances, Working Paper no.2/2002, Danish Research Institute of Food Economics.

Dixon, P. B.- B. R. Parmenter - A. A. Powell - P. J. Wilcoxen (1995): Notes and Problems in Applied General Equilibrium Economics, North Holland: Amsterdam.

Dimaranan, Betina V. - Robert A. McDougall (2002): Global Trade, Assistance, and Production: The GTAP 5 Data Base, Center for Global Trade Analysis, Purdue University. http://www.gtap.agecon.purdue.edu/databases/v5/v5_doco.asp.

Dimaranan et. al., (2002): Ch 20: Behavioural Parameters in Dimaranan, Betina V. and Robert A. McDougall (2002). Global Trade, Assistance, and Production: The GTAP 5 Data Base, Center for Global Trade Analysis, Purdue University.

DeVyust E. A. - P. V. Preckel (1997): 'Sensitivity Analysis Revisited: A Quadrature Based Approach' Journal of Policy Mode-ling, vol. 15, pp.175-185.

El Mekki A., A.- B., H. de Frahan - H. van Meijl - L. Salvatici, F. van Tongeren, - P., J., J., Veenendaal (2000): 'Assessment of the Usefulness of GTAP for Analysing Reforms of the Common Agricultural Policy', in Søren E. Frandsen and Michael H.J. Stæhr (ed.): Assessment of the GTAP Modelling Framework for Policy Analyses from a European Perspective, Statens Jordbrugs- og Fiskeriøkonomiske Institut Rapport nr. 116, Copenhagen. http://www.sjfi.dk/publ/116.pdf

FAPRI (2002): World Agricultural Outlook, Iowa.

Francois, J. F. - K. A. Reinert (ed.) (1997): Applied Methods for Trade Policy Analysis: A Handbook, Cambridge University Press.

Francois, J. F. - A., Strutt (1999): 'Post Uruguay Round Tariff Vectors for Gtap Version 4', manuscript, http://www.intereconomics.com/francois/GTAPv4UR.ZIP.

Francois, J., L. Kerkelä - M. Rombout - R. Vaittinen (2000): 'Assessment of the Usefulness of GTAP for Analysing Multilateral Trade Liberalisation', in Søren E. Frandsen and Michael H.J. Stæhr (ed.) Assessment of the GTAP Modelling Framework for Policy Analyses from a European Perspective, Statens Jordbrugs- og Fiskeriøkonomiske Institut Rapport nr. 116, København. http://www.sjfi.dk/publ/116.pdf

Gelhar, M. (1994): "Economic Growth and Trade in the Pacific Rim: An Analysis of Trade Patterns." Unpublished thesis , Purdue University.

Harrison, W. J. - K. R. Pearson (1996): 'Computing Solutions for Large General Equilibrium Models Using GEMPACK', Computational Economics vol. 9: 83-127.

Harrison, W. J.- M. J. Horridge - K. R. Pearson (2000): 'Decomposing simulation results with respect to exogenous shocks', Computational Economics, vol. 15: 227-249.

Hertel, T. W. - M. E. Tsigas (1997): 'Structure of GTAP', in Hertel T. (ed.) Global Trade Analysis: Modeling and Applications, Cambridge University Press.

Hertel, T. W. - K. Anderson - J. F. Francois - W. Martin (1999): 'Agriculture and Non-agricultural Trade Liberalization in the Millennium Round, http://www.agecon.purdue.edu/gtap/access_member/resources/download/9.pdf

Hertel T. W. - E. Ianchovichina - R. McDonald (1997): 'Muti-Regional General Equilubrium Modeling' in Francois, J. F., and K. A. Reinert (ed.), Applied Methods for Trade Policy Analysis: A Handbook, Cambridge University Press.

Huff K. - K. Hanslov - T. W. Hertel - M. E. Tsigas (1997): 'GTAP behavior Parameters' , in Hertel T. (ed.) Global Trade Analysis: Modeling and Applications, Cambridge University Press.

IATRC (1994): 'The Uruguay Round Agreement on Agriculture: An Evaluation'. International Agricultural Trade Reseach Consortium, Commissioned Paper no.9. http://agecon.lib.umn.edu/iatrc/cp9.pdf

Ingco, M. (1995): 'Agricultural Trade Liberalization in the Uruguay Round: One Step Forward One Step Back? Supplementary Paper for the Conference on the Uruguay Round and the Developing Countries, 26-27 January 1995, Washinton DC: World Bank.

Jensen, H. G. - S. E. Frandsen - C. H. Bach (1998): 'Agricultural and Economic-Wide Effects of European Enlargement: Modeling the Common Agricultural Policy, SJFI Working Paper no. 11/1998. http://www.sjfi.dk/wp/wp11.pdf

Josling T. - S. Tangerman (1999): ’Implementation of the WTO Agreement on Agriculture and Developments for the Next Round of Negotiations’, European Review of Agricultural Economics vol. 26: 371-388.

OECD (2000): Agricultural Policies in OECD Countries: Monitoring and Evaluation, OECD: Paris.

Roberts, I.- T. Podbury - M. Hinchy (2001): Reforming Domestic Agricultural Support Policies through the WTO, ABARE: Canberra.

Vaittinen R. (2001): 'WTO:n kauppaneuvottelujen merkitys EU:n maataloudelle', VATT Discussion Papers , 251, Helsinki.

ANNEXES

Annex 1a: Regional aggregation in the study

Abbreviation	Description
AUZ	Australia and New Zealand
USA	United States
CAN	Canada
MCR	Mercosur countries
MED	Mediterranean countries
MDC	Middle-income countries
LDC	Developing countries
EU15	European Union
CEA	Central and eastern European countries
FSU	CIS countries
ROI	Other industrial countries

GTAP aggregation key

GTAP abbreviation	Name of region	Abbreviation of aggregated region	GTAP abbreviation	Name of region	Abbreviation of aggregated region
AUS	Australia	AUZ	FIN	Finland	EU15
NZL	New Zealand	AUZ	FRA	France	EU15
CHN	China	LDC	DEU	Germany	EU15
HKG	Hong Kong	ROI	GBR	United Kingdom	EU15
JPN	Japan	ROI	GRC	Greece	EU15
KOR	Korea	MDC	IRL	Ireland	EU15
TWN	Taiwan	MDC	ITA	Italy	EU15
IDN	Indonesia	LDC	LUX	Luxembourg	EU15
MYS	Malaysia	MDC	NLD	Netherlands	EU15
PHL	Philippines	MDC	PRT	Portugal	EU15
SGP	Singapore	ROI	ESP	Spain	EU15
THA	Thailand	MDC	SWE	Sweden	EU15
VNM	Vietnam	LDC	CHE	Switzerland	ROI
BGD	Bangladesh	LDC	XEF	Rest of EFTA	ROI
IND	India	LDC	HUN	Hungary	CEA
LKA	Sri Lanka	LDC	POL	Poland	CEA
XSA	Rest of South Asia	LDC	XCE	Rest of Central European Assoc	CEA
CAN	Canada	CAN	XSU	Former Soviet Union	FSU
USA	United States	USA	TUR	Turkey	MED
MEX	Mexico	MDC	XME	Rest of Middle East	MED
XCM	Central America, Caribbean	MDC	MAR	Morocco	MED
COL	Colombia	MDC	XNF	Rest of North Africa	MED
PER	Peru	MDC	BWA	Botswana	LDC
VEN	Venezuela	MDC	XSC	Rest of SACU (Namibia,RSA)	LDC
XAP	Rest of Andean Pact	MDC	MWI	Malawi	LDC
ARG	Argentina	MCR	MOZ	Mozambique	LDC
BRA	Brazil	MCR	TZA	Tanzania	LDC
CHL	Chile	MCR	ZMB	Zambia	LDC
URY	Uruguay	MCR	ZWE	Zimbabwe	LDC
XSM	Rest of South America	MDC	XSF	Other Southern Africa (Ang,Maur)	LDC
AUT	Austria	EU15	UGA	Uganda	LDC
BEL	Belgium	EU15	XSS	Rest of Sub-Saharan Africa	LDC
DNK	Denmark	EU15	XRW	Rest of World	LDC

Annex 1b: Commodity aggregation in the study

Abbreviation	*Description*	*Abbreviation*	*Description*
Wheat	Wheat	BeefProd	Beef products
Feedgrns	Feed grains	OthMeat	Other meat
Oilseeds	Oilseeds	MilkProd	Milk products
OthCrops	Other crops	VOF_Prod	Vegetable oils and fats
SugarCB	Sugar cane, sugar beet	SugProd	Sugar products
Milk	Milk	ProcFood	Processed foods
Cattle	Cattle	MnfProd	Manufacturing production
OthAn	Other animals	Svces	Services
NatRes	Natural resources		

GTAP aggregation key

GTAP abbreviation	*Description*	*Abbreviation of aggregated commodity*	*GTAP abbreviation*	*Description*	*Abbreviation of aggregated commodity*
PDR	Paddy rice	ProcFood	LUM	Wood products	MnfProd
WHT	Wheat	Wheat	PPP	Paper products, publishing	MnfProd
GRO	Cereal grains nec	Feedgrns	P_C	Petroleum, coal products	MnfProd
V_F	Vegetables, fruit, nuts	OthCrops	CRP	Chemical, rubber, plastic prod	MnfProd
OSD	Oil seeds	Oilseeds	NMM	Mineral products nec	MnfProd
C_B	Sugar cane, sugar beet	SugarCB	I_S	Ferrous metals	MnfProd
PFB	Plant-based fibres	OthCrops	NFM	Metals nec	MnfProd
OCR	Crops nec	OthCrops	FMP	Metal products	MnfProd
CTL	Bovine cattle, sheep and goats	Cattle	MVH	Motor vehicles and parts	MnfProd
OAP	Animal products nec	OthAn	OTN	Transport equipment nec	MnfProd
RMK	Raw milk	Milk	ELE	Electronic equipment	MnfProd
WOL	Wool silk-worm cocoons	NtRes	OME	Machinery and equipment nec	MnfProd
FOR	Forestry	NtRes	OMF	Manufactures nec	MnfProd
FSH	Fishing	NtRes	ELY	Electricity	MnfProd
COL	Coal	NtRes	GDT	Gas manufacture, distribution	MnfProd
OIL	Oil	NtRes	WTR	Water	MnfProd
GAS	Gas	NtRes	CNS	Construction	MnfProd
OMN	Minerals nec	NtRes	TRD	Trade	Svces
CMT	Bovine cattle, sheep and goat	BeefProd	OTP	Transport nec	Svces
OMT	Meat products nec	OthMeat	WTP	Sea transport	Svces
VOL	Vegetable oils and fats	VOF_Prod	ATP	Air transport	Svces
MIL	Dairy products	MilkProd	CMN	Communication	Svces
PCR	Processed rice	ProcFood	OFI	Financial services nec	Svces
SGR	Sugar	SugProd	ISR	Insurance	Svces
OFD	Food products nec	ProcFood	OBS	Business services nec	Svces
B_T	Beverages and tobacco products	ProcFood	ROS	Recreation and other services	Svces
TEX	Textiles	MnfProd	OSG	PubAdmin/Defence/Health/Educat	Svces
WAP	Wearing apparel	MnfProd	DWE	Dwellings	Svces
LEA	Leather products	MnfProd			

Annex 2: Armington parameters used in foreign trade systematic sensitivity analysis

	$\sigma_D/2$	σ_D	$2\times\sigma_D$	$\sigma_M/2$	σ_M	$2\times\sigma_M$
Wheat	4.4	8.8	17.6	8.8	17.6	35.2
Feed grains	4.4	8.8	17.6	8.8	17.6	35.2
Oilseeds	4.4	8.8	17.6	8.8	17.6	35.2
Other crops	4.4	8.8	17.6	8.8	17.6	35.2
Beef	4.4	8.8	17.6	8.8	17.6	35.2
Other meat	4.4	8.8	17.6	8.8	17.6	35.2
Dairy products	2.2	4.4	8.8	4.4	8.8	17.6
Sugar	4.4	8.8	17.6	8.8	17.6	35.2

Annex 3: Absolute change in beef exports and percentual distribution of change by region

	% share of region of total change in exports											
Region of origin	Australia and New Zealand	United States	Canada	Mercosur countries	Mediterranean countries	Middle-income countries	Developing countries	European Union	CEE countries	CIS countries	Other industrial countries	Total absolute change Mill. 1997 US$
Australia and New Zealand	0.0	-9.7	-2.2	0.0	-0.2	6.3	-12.5	92.1	0.4	0.9	25.0	1561
United States	0.0	0.0	1.2	0.7	19.9	15.3	-0.9	22.7	0.7	2.4	37.9	2566
Canada	0.1	12.8	0.0	0.3	0.4	12.0	-2.5	54.7	1.0	0.8	20.6	499
Mercosur countries	0.0	-0.1	0.0	7.2	1.3	0.3	3.3	82.9	0.2	0.2	4.6	2185
Mediterranean countries	0.3	1.3	0.2	0.0	14.9	1.7	13.3	53.6	0.5	0.6	13.5	40
Middle-income countries	0.3	6.9	0.2	7.9	2.3	2.5	10.3	59.4	0.5	0.6	9.2	307
Developing countries	0.0	0.1	0.0	0.0	2.9	3.8	6.2	78.1	0.2	4.9	3.7	719
European Union	0.3	2.8	0.4	0.9	33.8	2.2	9.2	0.0	5.3	35.1	10.0	-1726
CEE countries	-0.1	-0.2	0.0	0.0	-0.9	-0.3	3.5	93.4	5.1	-3.5	3.0	-340
CIS countries	0.0	-0.1	0.0	0.0	0.8	0.2	0.4	7.5	4.0	86.3	1.0	222
Other industrial countries	1.3	11.9	1.1	2.4	4.4	18.8	29.7	15.5	3.5	-4.1	15.6	52

Annex 3b: Absolute change in sugar exports and percentual distribution of change by region

	% share of region of total change in exports											
Region of origin	Australia and New Zealand	United States	Canada	Mercosur countries	Mediterranean countries	Middle-income countries	Developing countries	European Union	CEE countries	CIS countries	Other industrial countries	Total absolute change Mill.1997 US$
Australia and New Zealand	4.4	80.6	-57.6	0.0	27.1	-165.2	86.2	12.5	12.7	-1.6	101.0	23
United States	1.2	0.0	8.6	0.9	15.2	16.1	2.0	45.5	0.4	1.2	8.8	28
Canada	1.0	71.0	0.0	0.0	0.0	2.6	-0.1	18.4	0.0	0.0	7.0	46
Mercosur countries	0.0	7.6	0.1	3.1	54.9	1.5	23.4	3.5	3.1	3.1	-0.2	620
Mediterranean countries	0.9	9.2	0.4	-0.1	25.6	0.0	8.6	58.9	1.8	0.6	-5.8	25
Middle-income countries	0.0	21.6	0.7	1.4	10.6	7.8	15.0	23.6	1.6	5.8	11.8	1733
Developing countries	0.0	5.1	0.1	0.1	4.8	0.2	15.1	68.7	0.7	0.8	4.4	1017
European Union	0.1	0.6	0.1	0.1	55.1	1.2	21.3	0.0	3.1	9.0	9.5	-2425
CEE countries	0.0	2.2	0.0	-0.1	27.4	0.0	2.2	33.2	16.3	18.7	0.2	147
CIS countries	0.0	1.1	0.0	0.0	6.7	-3.1	-0.6	17.1	49.8	29.4	-0.4	38
Other industrial countries	0.2	0.8	0.2	0.1	63.9	4.2	23.6	7.2	0.1	0.8	-1.0	51

Annex 3c: Absolute change in feed grain exports and percentual distribution of change by region

	% share of region of total change in exports											
Region of origin	Australia and New Zealand	United States	Canada	Mercosur countries	Mediterranean countries	Middle-income countries	Developing countries	European Union	CEE countries	CIS countries	Other industrial countries	Total absolute change Mill.1997 US$
Australia and New Zealand	-0.1	-0.1	0.0	-0.4	-1.5	-7.0	119.7	-2.3	0.0	0.0	-8.2	45
United States	0.1	0.0	-2.1	2.2	73.1	115.9	10.0	-14.9	-1.6	0.1	-82.7	302
Canada	0.1	41.9	0.0	-2.1	29.7	-5.3	36.5	0.0	0.0	0.0	-0.9	178
Mercosur countries	0.0	6.1	0.1	-77.8	124.0	17.6	21.8	-11.3	-4.8	0.2	24.3	110
Mediterranean countries	0.7	5.0	0.7	-0.6	88.9	-2.2	-1.1	11.8	0.1	0.7	-3.8	40
Middle-income countries	-2.1	-40.3	-3.0	-4.0	-5.7	281.2	-38.4	-65.2	-0.9	-2.3	-19.3	-16
Developing countries	0.0	0.1	0.0	-0.1	0.2	107.9	-7.5	-0.1	0.0	0.1	-0.5	1706
European Union	0.0	5.4	0.0	2.1	58.6	1.7	14.5	0.0	14.1	2.5	1.1	-1019
CEE countries	0.1	4.1	0.1	0.1	67.4	-7.2	-33.1	2.9	-99.2	16.7	148.3	19
CIS countries	0.4	0.4	0.0	0.0	87.1	-13.5	2.8	-2.9	-12.3	37.1	0.9	26
Other industrial countries	0.6	5.1	0.6	0.1	27.5	-0.6	4.1	17.2	5.1	33.9	6.4	7

Annex 3d: Absolute change in dairy exports and percentual distribution of change by region

	% share of region of total change in exports											
Region of origin	Australia and New Zealand	United States	Canada	Mercosur countries	Mediterranean countries	Middle-income countries	Developing countries	European Union	CEE countries	CIS countries	Other industrial countries	Total absolute change Mill.1997 US$
Australia and New Zealand	0.8	7.5	2.2	1.0	16.2	13.0	8.9	23.9	0.2	4.2	22.0	3204
United States	0.5	0.0	15.3	0.5	6.7	23.2	5.1	11.0	0.2	1.9	35.8	1180
Canada	0.3	21.4	0.0	-0.2	31.3	5.7	1.9	27.2	0.7	0.8	10.9	398
Mercosur countries	-0.1	-42.1	-6.3	281.0	-4.7	-85.7	-2.5	-28.3	-0.1	-12.7	1.6	-47
Mediterranean countries	0.2	5.6	1.2	-0.2	71.5	1.4	2.1	17.5	0.4	1.2	-1.1	207
Middle-income countries	0.6	13.2	2.9	-0.2	3.9	37.8	12.3	40.8	0.6	2.2	-14.1	178
Developing countries	0.3	10.7	1.3	-0.1	13.5	6.1	33.0	45.3	3.6	1.6	-15.2	119
European Union	0.9	7.9	1.5	3.1	28.8	16.4	14.6	0.0	2.7	14.4	9.9	-4943
CEE countries	-0.7	3.8	0.5	0.4	29.8	-3.2	-0.8	70.3	-2.4	6.0	-3.6	249
CIS countries	0.0	5.9	0.9	0.2	1.2	0.3	0.5	55.8	6.6	15.8	12.7	953
Other industrial countries	1.0	11.1	4.3	0.9	1.6	9.0	0.2	61.8	0.8	1.7	7.6	-902

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