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## 3 Modelling the elements of the CAP

The GTAP model of the world economy is used in this study to evaluate the effects of the CAP, both in the European Union and globally. This model has been widely applied to analyse trade policy issues, and can be used to produce counterfactual experiments. In this study the effects of the CAP are estimated by simulating its elimination.

An overview of the model (section 3.1) and database (section 3.2) is outlined in this chapter, followed by a discussion of the modelling strategy (section 3.3) and the simulations performed to evaluate the effects of the CAP as it existed in 2007 (section 3.4).

### 3.1 The GTAP model

GTAP model version 6.2 is used for this study.<sup>1</sup> The GTAP model is a comparative static model of the world economy. In the model, the world is divided into regions, in which consumers allocate income between private consumption, public consumption and savings.

Producers are divided into various sectors and are assumed to minimise costs subject to a constant returns to scale production technology. They combine intermediate inputs and a primary factor bundle in fixed proportions to produce their output. Skilled and unskilled labour, capital and land are combined using a constant elasticity of substitution (CES) function to form the primary factor bundle. Labour and capital are perfectly mobile between sectors within each economy. Agricultural land and land devoted to forestry can be transformed to a limited extent.

Each commodity imported by a country is assumed to be differentiated by the country of origin (according to the so-called Armington assumption). Commodity differentiation is expressed through a nested structure with a CES function between imported and domestically produced goods, and another CES function between

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<sup>1</sup> The model is available at <https://www.gtap.agecon.purdue.edu/models/current.asp>. Documentation of the model is found in Hertel (1997).

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imports from different origins. The elasticity of substitution between imported goods originating from different countries is twice the elasticity between domestic and aggregated imported commodities.

The supply of primary factors is fixed within each region, but is reallocated across activities within regions in response to changes in relative returns. The supply of land to agricultural production is controlled by a constant elasticity of transformation (CET) function. The fishing and mining sectors have a sector specific factor representing the value of the natural resources used in those sectors.

Goods and factor markets are assumed to be competitive and to clear in equilibrium. Returns to factors of production within each country are assumed to accrue as income to households in that country and, in turn, feed into consumption and savings. Households' average propensity to save is fixed in each country. Household savings in each country can be allocated to domestic and foreign investment. Aggregate world savings equals aggregate world investment, and rates of return on investments are equalized across all regions.<sup>2</sup>

At the macroeconomic level, government consumption and net (of depreciation) savings in each region are fixed nominal shares of regional income.<sup>3</sup> Household consumption varies in response to changes in regional income and prices. It is assumed that net investment is reallocated across regions to equalise the expected rate of return on regional investments.

All price changes are relative to a world index of returns to factors. This price index is the numeraire.

## 3.2 The database

The database employed in this study is GTAP version 7 (Narayanan and Walmsley 2008). Key features of this version include:

- a 2004 base year
- 113 regional economies
- 57 industries.

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<sup>2</sup> See Hertel (1997), for a discussion of the equations governing the international allocation of investment in GTAP.

<sup>3</sup> In addition, a private consumption tax shifter is endogenised to keep the ratio of tax revenue to regional income constant. This is designed to keep the ratio of government expenditure to GDP constant, thus avoiding undesirable effects of swings in government expenditure on model results.

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The database is composed of a set of detailed input–output tables linked by bilateral trade data. The trade data are combined with protection and transportation cost data to represent international trade linkages across regions.<sup>4</sup>

For the purposes of this study, the database is aggregated into 40 regional groups and 24 industries. As agricultural policy is the focus of this study, agricultural, forestry and fishing, and food processing industries are separately identified. Mining and manufacturing industries are aggregated into one group (‘manufacturing’) and all services sectors are aggregated into another group (‘services’).<sup>5</sup>

Within the 40 aggregated regional groups in the database, the EU15 member states are each represented individually, so that the CAP programs are modelled for each member. The NMS are aggregated in the database into a single region.<sup>6</sup>

For ease of presentation, results are further aggregated into nine regions — EU15, NMS, rest of Europe, Australia–New Zealand, East Asia, rest of Asia, North America, Latin America and Africa. Results are also aggregated into six industries — crops, livestock, forestry and fishing, food processing, manufacturing and services.<sup>7</sup>

The industry breakdown of output for each of the nine regions, and EU15 member states, is shown in table 3.1. Agriculture (the sum of crops and livestock) accounts for a small share of output in all regions when compared with manufacturing and services. It is particularly small in the EU15 (1.6 per cent) compared with Africa and rest of Asia (about 9 per cent), the NMS and rest of Europe (about 4.5 per cent) and, to a lesser degree, Australia–New Zealand (3 per cent). There is, nonetheless, some diversity in the size of agriculture within the EU15 — it comprises the largest share of output in Greece, Portugal and Spain.

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<sup>4</sup> Further details on the GTAP database are found on the GTAP website: <https://www.gtap.agecon.purdue.edu/databases/v7/default.asp>.

<sup>5</sup> In the aggregation process, ‘natural resources’ of the fishing and mining sectors are combined.

<sup>6</sup> The reference year in the database is 2004, and Romania and Bulgaria were not part of the European Union at that time. However, since we take the database to represent a 2007 CAP policy situation, Romania and Bulgaria have been included in the NMS aggregation.

<sup>7</sup> Appendix tables A.5 and A.6 indicate the mapping from the 113 regions and 57 industries in the original GTAP 7 to the aggregated database containing 40 regions and 24 industries, and to the aggregation used for reporting results, which contains nine regions and six industries.

**Table 3.1 Industry output share by region and EU15 member state**  
Per cent, 2004

<i>Country/Region</i>	<i>Crops</i>	<i>Live stock</i>	<i>Forestry &amp; fishing</i>	<i>Food processing</i>	<i>Manuf</i>	<i>Services</i>	<i>Total</i>
Australia-NZ	1.4	1.4	0.5	5.4	22.1	69.2	100
East Asia	1.9	0.9	0.7	4.1	38.4	54.1	100
Rest of Asia	6.6	2.3	1.0	6.2	37.0	46.8	100
North America	0.7	0.5	0.2	3.3	23.5	71.9	100
Latin America	3.8	1.7	0.5	8.9	37.5	47.7	100
Africa	7.0	1.7	1.3	7.2	33.7	49.0	100
Rest of Europe	2.7	1.8	0.6	5.2	31.5	58.1	100
NMS	3.0	1.5	0.6	9.1	37.1	48.6	100
EU15	1.0	0.6	0.2	5.4	31.4	61.4	100
<i>Austria</i>	<i>0.5</i>	<i>0.6</i>	<i>0.4</i>	<i>4.2</i>	<i>33.9</i>	<i>60.4</i>	<i>100</i>
<i>Belgium</i>	<i>0.9</i>	<i>0.6</i>	<i>0.1</i>	<i>6.5</i>	<i>38.0</i>	<i>53.9</i>	<i>100</i>
<i>Denmark</i>	<i>0.8</i>	<i>1.3</i>	<i>0.4</i>	<i>6.4</i>	<i>27.8</i>	<i>63.3</i>	<i>100</i>
<i>Finland</i>	<i>0.6</i>	<i>0.6</i>	<i>1.3</i>	<i>4.6</i>	<i>34.3</i>	<i>58.6</i>	<i>100</i>
<i>France</i>	<i>1.0</i>	<i>0.7</i>	<i>0.3</i>	<i>5.8</i>	<i>29.6</i>	<i>62.6</i>	<i>100</i>
<i>Germany</i>	<i>0.7</i>	<i>0.5</i>	<i>0.1</i>	<i>4.8</i>	<i>36.7</i>	<i>57.2</i>	<i>100</i>
<i>Greece</i>	<i>3.2</i>	<i>1.1</i>	<i>0.5</i>	<i>8.8</i>	<i>21.5</i>	<i>64.9</i>	<i>100</i>
<i>Ireland</i>	<i>0.4</i>	<i>1.3</i>	<i>0.2</i>	<i>6.1</i>	<i>42.2</i>	<i>49.7</i>	<i>100</i>
<i>Italy</i>	<i>1.4</i>	<i>0.6</i>	<i>0.1</i>	<i>5.2</i>	<i>32.7</i>	<i>60.1</i>	<i>100</i>
<i>Luxembourg</i>	<i>0.2</i>	<i>1.8</i>	<i>0.1</i>	<i>4.0</i>	<i>22.7</i>	<i>71.2</i>	<i>100</i>
<i>Netherland</i>	<i>1.5</i>	<i>0.8</i>	<i>0.1</i>	<i>6.4</i>	<i>29.9</i>	<i>61.2</i>	<i>100</i>
<i>Portugal</i>	<i>1.7</i>	<i>0.9</i>	<i>0.8</i>	<i>7.5</i>	<i>27.3</i>	<i>61.9</i>	<i>100</i>
<i>Spain</i>	<i>1.9</i>	<i>0.8</i>	<i>0.4</i>	<i>6.4</i>	<i>29.5</i>	<i>61.0</i>	<i>100</i>
<i>Sweden</i>	<i>0.3</i>	<i>0.4</i>	<i>0.6</i>	<i>4.0</i>	<i>33.8</i>	<i>60.9</i>	<i>100</i>
<i>United Kingdom</i>	<i>0.4</i>	<i>0.3</i>	<i>0.1</i>	<i>5.1</i>	<i>25.2</i>	<i>68.9</i>	<i>100</i>

Source: GTAP 7 database.

## Agricultural support

To account for increased decoupling of agricultural support around the world, the method for building the GTAP version 7 database differs from that used for earlier versions.

In particular, rates of domestic support (based on data from the OECD producer support estimate (PSE)) were not calculated on a sector-specific basis, as has been the case in the past. Instead, for the European Union, rates of subsidisation were *equalised* across all crop sectors. This strategy aims to reflect the idea that direct income support is increasingly paid independently of the type and volume of commodity produced. Box 3.1 summarises the steps taken to allocate assistance

across the available subsidy types in the database — output, intermediate input, labour and capital.<sup>8</sup>

### Box 3.1 Calculating domestic support in the European Union

Total support estimates for the EU member states in aggregate were taken from the OECD 2004 PSE database. The total was adjusted so that provisional estimates for crop payments were updated with actual payments reported by the EAGGF Guarantee section financial report 2004-05. The market price support component of the PSE was excluded from the calculations to avoid double counting with the tariffs in the GTAP database.

To disaggregate the subsidies received in each EU member state, each OECD payment was cross-referenced with the corresponding entry in the EAGGF financial report, where payments are specified by country. National payments were disaggregated using additional information about national support in each member country provided by the OECD.

Payments within each commodity group were then allocated across output, input, land and capital subsidies using the concordance in the following table.

#### Classification used in allocating PSE components<sup>a</sup>

<i>GTAP domestic support category</i>	<i>Description of PSE component</i>
Output subsidy	Output-based subsidies Miscellaneous subsidies
Intermediate input subsidy	Subsidies based on input use: variable inputs and on-farm services
Land subsidy	Subsidies based on area planted Subsidies based on historical entitlements Subsidies based on input constraints: variable inputs and set of inputs Subsidies based on input constraints: fixed inputs (crop sectors)
Capital subsidy	Subsidies based on overall farming income Subsidies based on animal numbers Subsidies based on input use: on-farm investment Subsidies based on input constraints: fixed inputs (livestock sectors)

<sup>a</sup> The OECD no longer uses this PSE component classification — a new system was implemented in 2007 (OECD 2008).

Under this classification, crop related payments are mostly allocated as payments to land, and payments for animal production are allocated under capital-based payments.

Domestic support rates for land and capital for crops as a group (containing eight GTAP crop sectors) were then calculated and used to distribute domestic support payments for each sector based on their value-added share.

Source: Narayanan and Walmsley (2008).

<sup>8</sup> There are no subsidies to agricultural labour allocated in the database in the European Union.

The distribution of payments across output, input, land and capital subsidies by commodity is presented in table 3.2. Only a small share is allocated as either an output or intermediate input subsidy.<sup>9</sup> The exceptions are output subsidies to the oil seeds sector (due to large payments to olive oil production) and crops nec (due to large payments to tobacco production), and input payments to the other animal products sector (due to payments for pest and disease control).<sup>10</sup> The largest share of payments in the crop sectors is allocated as land-based payments, and the largest share in the livestock sectors is allocated as capital-based payments.

**Table 3.2 EU15 domestic support payments by commodity and type<sup>a</sup>**  
Per cent

<i>Commodity</i>	<i>Output</i>	<i>Input</i>	<i>Land</i>	<i>Capital</i>	<i>Total</i>
<b>Crops</b>					
Paddy rice	0	0	89.1	10.9	100
Wheat	0	0.2	91.8	8.0	100
Cereal, grains nec	0	0.4	90.9	8.8	100
Vegetables, fruit, nuts	2.2	0.5	88.6	8.8	100
Oil seeds	69.5	0	27.0	3.4	100
Sugar cane, sugar beet	0	0	91.5	8.5	100
Plant based fibres	0	0	89.1	10.9	100
Crops nec	10.5	0	81.4	8.1	100
<b>Livestock</b>					
Bovine cattle, sheep, goats, horses	0	7.3	3.3	89.4	100
Animal products nec	0	12.1	24.5	63.4	100
Raw milk	0	9.0	18.7	72.3	100
Wool, silk-worm cocoons	0	26.1	40.6	33.3	100
<b>Total</b>	<b>7.8</b>	<b>3.2</b>	<b>52.3</b>	<b>36.7</b>	<b>100</b>

<sup>a</sup> This table does not include net taxes — ‘zero’ cells in this table represent net taxes.

Source: GTAP 7 database.

It is worth noting some important aspects of the allocation process.

- Land and capital subsidies to the livestock sectors (including cattle, sheep, goats and raw milk) were not equalised. The database *only* represents decoupling for the crop sectors. This is consistent with payments to livestock remaining more coupled than those to crops (chapter 2).

<sup>9</sup> The GTAP database contains negative net subsidies (that is, net taxes) for some output and intermediate input subsidies.

<sup>10</sup> The shares presented in the table mask large differences in absolute values. For example, the share of intermediate input payments in the wool sector is high, but the overall level of payments is very small and therefore the shares can be misleading. This is also the case for payments to the rice, sugar cane and beet, and plant fibres sectors.

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- OECD payments data used in the allocation process exclude market price support, but include some rural development expenditure. Therefore, the database amounts are not strictly confined to CAP direct income payments.
  - No output or intermediate input subsidies were equalised, including for the crop sector. This is consistent with some commodity-specific support remaining, discussed in chapter 2.
  - Although decoupling means ‘equal payment per unit of land or capital’, irrespective of the activity undertaken, the effect of the subsidy on an activity is determined by the intensity with which it uses land and capital.

Although efforts have been made to represent a greater degree of decoupling in the database, the subsidy rates are still different across commodities and, therefore, distortionary cross-commodity effects can still be expected. This is consistent with the fact that, on average, 20 per cent of direct payments in the European Union remain coupled to production.

### **3.3 Modelling strategy**

The database enhancements noted above build on the considerable volume of past developments using earlier versions of the database aimed at better modelling different elements of the CAP. Some examples include El Mekki et al. 2000, Francois 2001, Van Meijl and Van Tongeren 2001, Bach et al. 2000 and Francois et al. 2000. Many of the developments implemented by GTAP users in earlier versions of the database have been adopted in the latest version. For example, the equalisation of land subsidies across commodities to represent decoupling in version 7 was adopted in Frandsen et al. (2002) and Brockmeier and Pelikan (2006).

Previous studies have also changed elements of the GTAP model itself to capture better some of the unique characteristics of agricultural production and the CAP. For example, Balkhausen et al. (2007) use a nested land allocation structure so that land substitutability is differentiated between different crop sectors. Bach et al. (2000) and Brockmeier and Pelikan (2006) include an EU budget constraint to model the net transfer of income between countries in the European Union.

Others have used an agriculture-specific version of the GTAP model to, among other things, separate out farm households from aggregated household demand (Hertel and Keeney 2005), or a combination of agriculture-specific partial equilibrium models with the GTAP model, to capture the effects of specific characteristics of agricultural policy in a general equilibrium framework (see, for example, European Commission 2007 and Huang et al. 2004).

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In this paper, the standard GTAP model is used. Rather than making adjustments to the model itself, the modelling simulations have been designed to represent the likely magnitude of the effects of specific elements of the CAP on standard variables in the model. In this way, the specificities of the CAP can be accounted for without making significant changes to the model itself.

## Setting up the simulations

The objective of this study is to produce up-to-date estimates of the global effects of the CAP, using a representation of the CAP as it existed in 2007. The effects of the CAP are estimated by simulating its elimination. This creates a counterfactual which represents the global economy without the influence of the CAP, against which impacts on welfare, production and trade flows can be assessed, globally and within economies.

Four modelling scenarios are undertaken (they are discussed in more detail below):

1. direct payments
2. export subsidies
3. border protection
4. the total CAP.

The design of the simulations takes into account the complexity of the CAP described in chapter 2, and data availability. Although the programs within the CAP are part of an integrated policy and cannot be disassociated from each other, the main programs have been modelled separately in order to interpret the role and contribution of each of them.

Quantitative modelling is limited to what can be measured using the available data. Rural development payments (Pillar II) were not modelled for the following reasons.

- Although some rural development spending is included in the GTAP database, it is not separately identified. Rather, it is included in the agricultural support data allocated across GTAP subsidies and equalised across crop commodities (as outlined above) and, as such, is treated in the same way as direct payments. Without altering the structure of the database or introducing additional behaviour into the model to represent spending on rural development, this makes Pillar II difficult to model.
- Even with detailed and accurate data on rural development spending, the likely effects of these payments are complex and uncertain, as discussed in chapter 2.

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In cases where the effects are clear, they may still be difficult to evaluate because of a lack of information about the value of the benefits of the externality, such as improved environmental and animal welfare outcomes.<sup>11</sup>

In addition, cross-compliance requirements of direct payments are not modelled as they are difficult to represent in the model, especially in light of the fact that they are designed to enhance the enforcement of legislation that already exists. As Pillar I funding is being linked to cross-compliance measures that involve externalities which are difficult to evaluate (for example, adherence to environmental and animal welfare standards), it is difficult to assess the entire contribution of Pillar I to welfare in the European Union, or to the world as a whole.

### **3.4 Simulations**

The four simulation scenarios are set out below.

#### **Simulation 1: Direct income payments**

Given the importance of direct income payments in the CAP budget and their evolution, both in size and nature, it was judged important to model this taking into account the most recent data available. Therefore, direct payments were modelled by adapting policy scenarios to the relevant information available for 2007 (as described in chapter 2).

The magnitude of the policy scenario for direct payments was determined by the average rate of assistance (rather than an absolute dollar amount) observed in 2007 for each member country across all agricultural commodities, measured as the share of payments in gross agricultural output (chapter 2). The scenario, therefore, is the impact of eliminating the rate of assistance observed in 2007. For example, as shown in chapter 2, the rate of support for France was 12.5 per cent. An amount of payments equivalent to 12.5 per cent of output is therefore removed.

In scaling the simulated rate of support to 2007 levels, the profile of payments across types of subsidies — input, output, land and capital — in the database is retained.<sup>12</sup> This is shown in table 3.3. Notably, about 80 per cent of the payments

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<sup>11</sup> A recent GTAP conference paper by Van Meijl et al. (2009) makes a first attempt at explicitly modelling Pillar II payments.

<sup>12</sup> The negative net subsidies (that is, net taxes) that are recorded for some output and intermediate input subsidies are not shocked.

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are treated as land and capital subsidies. The remainder are treated as industry subsidies and subsidies on intermediate inputs.<sup>13</sup>

The profile of payments across agricultural commodities in the database is also retained, with the exception of the fruit and vegetables sector, which is not shocked. The fruit and vegetables sector has received little support in the form of direct payments in the past, and is unlikely to have received large direct payment subsidies in 2007.<sup>14</sup>

As direct payments are comparatively small in the NMS (with the emphasis being more on rural development spending in these countries), the direct payments scenario is only applied to EU15 members.<sup>15</sup>

Nearly 80 per cent of direct payments are distributed to farmers in France, Germany, Spain, Italy and the United Kingdom (table 3.3). Although small relative to the size of the EU15 economies — direct payments represent only 0.33 per cent of EU15 GDP — direct payments can be large relative to the output of some agricultural sectors. In France for example, direct payments represent 12.5 per cent of the value of gross agricultural output.

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<sup>13</sup> The level of payments in the database reflects the implementation method of the SPS — historic or regional — chosen by each EU member state. The influence itself of the method of payment (historic or regional) is not modelled.

<sup>14</sup> As noted in chapter 2, this situation is changing under a 2008 CAP reform of the fruit and vegetable sector, where land used for the production of fruit and vegetables will become eligible for payments under the SPS, replacing existing support mainly in the form of operational funds to producer organisations.

<sup>15</sup> This situation will change once the phasing in of direct payments to the NMS is completed by 2013 (2016 for Bulgaria and Romania).

**Table 3.3 Proportions of total CAP direct payments by subsidy type**  
Per cent

<i>Country</i>	<i>Output</i>	<i>Input</i>	<i>Land</i>	<i>Capital</i>	<i>Total</i>
Austria	0.0	0.0	1.0	0.7	1.7
Belgium	0.0	0.0	0.3	1.0	1.3
Denmark	0.0	0.0	1.8	0.6	2.5
Finland	0.0	0.0	0.7	0.6	1.3
France	0.0	3.1	8.8	8.5	20.3
Germany	0.1	0.0	11.0	7.5	18.7
Greece	3.7	0.0	2.0	2.8	8.5
Ireland	0.0	0.2	0.4	2.4	3.0
Italy	2.7	0.0	5.1	5.2	13.0
Luxembourg	0.0	0.1	0.1	0.4	0.5
Netherlands	0.0	0.0	0.6	0.7	1.4
Portugal	0.1	0.2	0.7	0.9	1.8
Spain	3.2	0.4	2.5	4.5	10.6
Sweden	0.0	0.1	1.1	0.7	2.0
United Kingdom	0.0	1.4	5.5	6.6	13.5
<b>Total</b>	<b>9.8</b>	<b>5.4</b>	<b>41.6</b>	<b>43.2</b>	<b>100.0</b>

*Source:* Simulation shocks based on 2007 data and GTAP 7 database subsidy structure.

## **Simulation 2: Export subsidies**

The European Union provides subsidies for exports of some agricultural products, and indirectly supports agriculture with export subsidies for many processed food products. In the database, these subsidy rates are applied equally to EU exports to all destination countries (although the total value of subsidy paid differs by member state depending on their structure of trade). The rates of subsidy are based on data obtained in the financial report of the EAGGF (Narayanan 2009). There are no export subsidies on intra-EU trade.

Simulation 2 involves reducing the rate of subsidy on exports to zero for agricultural and food processing goods in all EU countries as they appear in the GTAP database, with a reference year of 2004. In doing so, it is assumed that the rates of subsidy have not changed between 2004 and 2007. In practice, export subsidies move in line with changes in the gap between world and domestic prices of agricultural goods, and this gap narrowed between 2004 and 2007. However, movements over that period are not necessarily representative of the average trend. For example, in 2008-09 export subsidies increased due to lower world prices. The assumption of no change is therefore considered to be a reasonable approximation of the average level.

Table 3.4 presents the export subsidy rates in the database. It shows that processed food receives the largest subsidies in terms of values and rates. Sugar and dairy products are the most subsidised exports; their subsidy rates are estimated at around 6 and 26 per cent of the value of exports respectively.

**Table 3.4 EU export subsidy rates by commodity**  
Per cent of export value

<i>GTAP Commodity</i>	<i>Subsidy rate</i>
Cereal grains nec	2.11
Vegetables, fruit, nuts	0.13
Bovine meat products	2.30
Meat products nec	0.65
Dairy products	5.64
Processed rice	3.64
Sugar	25.97
Food products nec	0.52
Beverages and tobacco products	0.03

*Source:* Calculated from the GTAP 7 database.

### **Simulation 3: Border protection**

Protection from imports is an integral part of the CAP package that affects the allocation of resources and trade in the global economy. Incorporating border protection measures has been a focus of GTAP since its inception. These policy instruments have been included in the GTAP database as ad valorem equivalents (AVEs) at the detailed product level, with the data sourced from the Market Access Maps (MAcMap) database and aggregated to the GTAP commodity level by using import weights (Narayanan and Walmsley 2008).

AVEs are a way of converting specific tariffs and tariff rate quotas (TRQs) into equivalent ad valorem rates, so that different trade barrier instruments can be compared directly. Specific tariffs are converted to AVEs by dividing the duty by the unit value of the good. TRQs are more problematic, as they cannot be accurately summarised as an AVE (Bouet et al. 2008). In MAcMAP, TRQs are converted using a methodology which reflects the marginal level of protection as well as the quota rents involved. The level of protection of marginal imports is calculated as:

- the inside quota tariff rate if the quota is non-binding
- the outside tariff rate if the quota is binding but the outside quota tariff rate is not prohibitive

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- the average of the inside and outside quota tariff rates if the quota is binding and the outside quota tariff rate is prohibitive.

The quota rent is calculated according to a formula that links the quota, the unit value, the trade value, the marginal level of protection, and the inside quota tariff rate.

A shortcoming of using AVEs in a CGE model is that the effects of prohibitive tariffs on some tariff lines are underestimated, as the corresponding import flows will be zero (or close to zero) and therefore not captured in the database (or have a very small weight). Prohibitive outside quota tariff rates may not be properly accounted for either. This, for example, could be a problem for EU imports of beef, sheep meat and dairy products from Australia and New Zealand which have a prohibitively high out of quota tariff rate.

Simulation 3 involves reducing the ad valorem tariff equivalents on imports of agricultural and food processing goods observed in the database for all EU countries to zero. In doing so, it is assumed in this study that rates have not changed between 2004 and 2007 — a reasonable assumption since border protection policies in the European Union have not changed much over this period.<sup>16</sup>

The trade weighted average AVE rates imposed by the European Union on imported agricultural and food processing goods by region of origin are shown in table 3.5 (no tariffs are applied on intra-EU trade). Border protection measures are concentrated on imports of crop products and, in particular, processed foods, which indirectly protects the related agricultural sectors. There is a strong pattern of tariff escalation, where tariff rates increase with the degree to which products are processed.

The average rate of tariffs faced by an exporting region is determined by the mix of its exports to the European Union. This results in a high variation in the average rates faced by different exporters. The trade weighted average tariff on agricultural products imported from Latin America exceeds 21 per cent, while products imported from African countries face an average tariff of less than 10 per cent. The aggregation here masks variation by importing partner and individual commodity. See appendix tables A.7 and A.8 for greater detail on tariff rates in the GTAP database.

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<sup>16</sup> The main exception is the implementation of the Economic Partnership Agreement between Europe and some African, Caribbean and Pacific (ACP) countries, but its impact is limited.

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## Simulation 4: Total CAP program

Simulation 4 involves applying all three scenarios above simultaneously, in order to assess the overall impact of the CAP.

**Table 3.5 Trade weighted average ad valorem equivalent tariff rates on EU imports**

Per cent

<i>Exporting regions</i>	<i>Crops</i>	<i>Livestock</i>	<i>Food processing</i>	<i>Average</i>
Australia-NZ	4.36	0.37	16.62	11.89
East Asia	16.52	0.64	17.02	15.94
Rest of Asia	4.73	0.93	19.38	10.86
North America	9.55	1.82	16.17	11.93
Latin America	19.43	8.32	23.96	21.37
Africa	2.10	0.05	19.86	9.34
Rest of Europe	6.00	0.42	13.31	10.69
Total	10.94	1.75	18.76	14.62

*Source:* Calculated from GTAP 7 database.