Price and Welfare Effects of Agricultural Liberalization with Imperfect Competition in Food Industries and Trade

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Abstract

Liberalization of the agricultural sector will prove critical to success or failure of the Doha negotiations. On the one hand, tariff and subsidies reduction will allow developing countries to specialize in the agricultural sector, following their comparative advantages. On the other hand, the fall in agricultural prices will improve the consumer welfare of the rich countries. Most of the studies about trade liberalization assume perfect competition in the food industry and we think that it is misleading. Farmers do not sell directly theirs produces to consumers. The role of the food processing industry, as an intermediary, must be taken into account and this sector may be the real winner of the trade liberalization. The purpose of this paper is to examine the consequences of an imperfect competition in the food processing market on the gains of trade liberalization. The framework of analysis is a general equilibrium model with a multi-region and multi-sector specification that follows the standard theoretical specifications of trade focused CGE models. The base year is 1997 and most of the data come from the database of the Global Trade Analysis Project (GTAP), version 5.3. Several comparative static analyses are carried out from this benchmark. We simulate several trade liberalization

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scenarios. Following an unilateral perspective, simulations is run in order to estimate the consequences of the announcement of the European Commission (December 2002) to cut by half its different restrictions to trade (tariffs, production and export subsidies) from the year 2006. *Key words* Computed General Equilibrium, Imperfect Competition, Trade Liberalization, Agrifood Industries.

Introduction

Will agricultural trade liberalization and a reduction in domestic support in OECD countries benefit consumers in these countries and producers in poorer developing countries? Or in other words, who stands to gain from trade concessions in the agri-food sector and reforms projected in the European Union (EU) and possibly the US? Conventional wisdom has consumers gaining from the rollback of public intervention devices causing price distorsions, exactly in the same way as dismantling domestic price supports or international trade distorsions in any other sector and establishing free trade is a welfare enhancing policy. This traditional argument in favor of free trade has recently been supplemented with another one concerning LDCs: a number of international organizations and non governmental organizations (NGO) have argued that agricultural trade liberalization and dismantling domestic support of agriculture in OECD countries would benefit poorer countries, whose farmers are currently suffering from unfair competition –or indeed dumping—from OECD countries' farmers; ridding the world of export subsidies, protection and price support for agriculture in rich countries would result in higher world prices for most agricultural commodities, hence would make farming more profitable for LDC farmers.

However, this result is highly dependent on a number of crucial assumptions, the most critical one being that of perfectly competitive structures in all markets concerned. Indeed, most existing studies of agricultural policy reforms and agri-food international trade liberalization have been carried out in frameworks that either ignore the food industry and all intermediaries by simply assuming that agricultural products are sold directly to final consumers, or take account of the existence of a chain of intermediaries between agriculture and final consumers, but assume the latter to be perfectly competitive sectors, so that their presence makes little difference in terms of outcomes of reforms, any price change at the production stage being passed through to final consumers.

In this paper, we endeavor to analyze and quantitatively evaluate the price and welfare effects of various reform scenarios for agricultural policies and trade policies in OECD countries in a framework that explicitly takes account of the existence of food industries and other intervening services between primary production and final consumption of foodstuffs –transportation, conditioning and packaging, storage, wholesale and retail trade. For this purpose, we build a multi-sector, general-equilibrium model in which these sectors are represented and embedded in economies featuring other sectors (manufacturing and service industries) that are also characterized by imperfect (monopolistic) competition. We then consider various assumptions with regard to the competitive structure of the food industry and

systematically compare the reform outcomes under these sets of assumptions. In Section one, we motivate our analysis by briefly recalling the world food context and prospects as well as the current debates surrounding agricultural policy reform in the European Union (EU) and agri-food trade in the Doha Round negotiations, before reviewing a number of recent analyses of agricultural trade and/or domestic liberalization and summarizing the major conclusions. Section two describes our model and its calibration. In Section three, we compare the results of two reform scenarios under six different assumptions with respect to the competitive structure of the food industries: in addition to the benchmark case in which all sectors are perfectly competitive, we consider four different forms of imperfect competition, by crossing the type of competition (monopolistic or Cournot oligopolistic competition) with the market entry conditions (existence or absence of barriers to entry in the food industry), and the assumption of oligopsony behavior of the food industry. The major conclusions are summarized in Section four.

1 The world agri-food context and debates over agriculture trade protection and domestic policies

1.1 Earlier reforms

Whereas trade in agricultural and food products had traditionally been kept out of the realm of international trade negotiations and liberalization, things started to change with the Uruguay Round of the GATT and the Marrakech Agreements: for the first time in the post-Second world war period, the liberalization of agricultural trade, accompanied by a strict classification of domestic support measures –the so-called "boxes"– was put on the agenda and fiercely fought; the outcome of the negotiations, known as the "Blair house compromise" between the US and the EU, was a modest opening up of EU and US domestic markets to agricultural imports (with a minimum of 5% of domestic demand), the changeover, in the EU, from variable import duties to ad valorem fixed right, as well as from classical quotas to "tariff quotas", a mild decrease in average protection rights on agri-food imports, and, in the EU, a major CAP reform. The latter was predicated upon the classification of domestic support measures in the new WTO regime and thus started to reduce price support for some important commodities (mostly grains and beef) and to replace them with direct payments to farmers in order to compensate for the lost income.

The 1992 CAP reform thus engineered a 25% reduction in domestic wheat support prices, and a 15% reduction in domestic beef support prices, along with a first move in the direction of "decoupling" public financial support to farmers from quantities produced and marketed. At the Berlin European Summit, in the Spring of 1999, in a context of tight budget constraint for the EU, the CAP reform was taken one step further in the same direction, by deciding an additional cut in domestic crop support prices and introducing new, though still very limited, decoupled mechanisms in order to encourage environment protection and durable development.

In spite of significant drops in domestic production prices, these two rounds of CAP reform in Europe and the real but modest liberalization of agricultural trade in the Marrakech agreements, most existing studies[1] conclude that there has apparently not been any noticeable change in consumer prices for foodstuffs. And with regard to international trade, the consequences have not been dramatic either.

1.2 Ongoing debates in the EU and the Doha round

With the entrance of ten new members in the EU, some of whom (such as Poland and Hungary) have large agrifood sectors and agricultural production potential, the fragile balance that had been achieved at the Berlin Summit is clearly jeopardized, while the Marrakech agreements impose a further opening-up of the enlarged EU domestic food markets. In addition, the budgetary cost of current CAP, especially if and when extended to new members, is deemed excessive by many, who also consider that the reliance on price support, even on a reduced scale, carries strong incentives for farmers to intensify production: many critiques of the CAP would rather have little or no internal price support and dedicate the bulk of the public expenditures on agriculture to direct income support with environmental conditionality of some sort. Many EU governments thus advocate a new reform of CAP before the end of the six-year budget agreement of the Berlin summit, i.e. immediately following the midterm review, in 2003.

In parallel, the resumption of international trade talks in the Doha round has led to a renewed interest in agriculture trade liberalization, giving momentum to discussions on domestic reforms. The arguments in favor of a further liberalization of agricultural trade and of a complete dismantling of domestic price support are twofold: one is the traditional free-trade reasoning, which sees liberalization as benefiting consumers (and tax payers) via lower food prices; the other one, put forward by participants in the Johannesburg Durable Development Conference in the Summer

[1] See, for instance, Le Cacheux (1995), Michel (2003).

of 2002, and in particular by a number of NGOs active in the field of development, is the idea that freeing agricultural trade and phasing down domestic price support in OECD countries would benefit farmers in poorer regions of the world and therefore help economic development in these areas[2].

1.3 International trade in agrifood products in perspective

Before turning to a formal analysis of the economic consequences of trade and domestic agricultural liberalization in developed countries, a broad characterization of the current situation and major trends in world agrifood markets may be helpful to evaluate the stakes. Whereas the volume of international agrifood trade has been increasing for decades, the general trend in prices for commodities has been oriented downwards ever since the mid-1970s (FAO, 2003). At the beginning of the XXI° century, the total volume of international agrifood trade is around US $ 1,250 billions, of which EU exports to the rest of the world represent about 20%. But, although it is in excess supply of most agricultural commodities it produces and a major exporter of processed food, the EU still is a net importer of agrifood products, as it imports a lot of tropical produce and animal feed.

According to the FAO projections (2003), world agricultural goods supply has been growing faster than total demand, and the same evolutions should characterize the next couple of decades at least, so that on average agricultural commodities' prices should go on declining.

2 The structure of the CGE model

Our framework is a static general equilibrium model with a multi-region and multi-sector specification that follows the standard theoretical specifications of trade CGE models[3]. We focus our attention on several assumptions about competition. The model's equations are displayed in Appendix 2 and the exogenous key parameters are given in the third one.

[2]For articulated examples of such reasonings, see IATP, 2003, Oxfam, 2002. For a critical analysis of this position, see Bouët and Le Cacheux, 2002.

[3]Our model shares many features with the MIRAGE trade policy analysis dedicated model. See Bchir, Decreux, Guerin and Jean, 2002 for further information about this international and intertemporal model.

2.1 The supply side

The model includes five factors of production: unskilled labour, skilled labour, capital, land and natural resources. Labour is completely mobile across the sectors, but immobile internationally. Land and capital are sector-specific factors and natural resources are only used in fishing and mining activities. Perfection competition is assumed for the factor markets and leads to full-employment of factor endowments.

Production is described in figure 1. At the first level, intermediate goods and value added are assumed to be perfectly complementary, as reflected by the use a Leontieff function. The combination of production factors is represented by a nested CES structure which allows to take into account of different degrees of substitution between factors. Thus, a first CES function gives value-added by combining the aggregate of skilled labour and capital to the other factors. In a second step, skilled labour and capital are combined optimally by cost-minimizing firms. This aims at reflecting the relative complementarities between capital and skilled labour.

In the same way, composite intermediate inputs are given by a CES nested structure in order to capture the greater substitutability inside the food products class than between food products and other products. Each sector uses intermediate inputs which come from domestic and foreign sources: a standard Armington assumption is made[4]. As with primary factors, demands for intermediate products are the result of profit maximization and reflect various levels of substitution possibilities.

Several assumptions about product market competition are examined for agrifood sectors[5]:

- Perfect Competition
- Chamberlinian Monopolistic Competition i.e. the perceived elasticity of demand equals to the elasticity of substitution across varieties.
- Cournot Oligopoly i.e. the perceived elasticity of demand differs across firms and depends on their market shares.
- Cournot Oligopsony i.e. agrifood industries may use their market power in order to pull down the prices of agricultural products.

For the intermediate cases, we study two alternative assumptions: exogenous number of firms (short term) then free entry (or free exit) and zero-profits condition (long run equilibrium).

[4]The pattern of preferences between different geographical sources is the same for intermediate inputs, final consumption and capital good demand.

[5]Imperfect competition is assumed for manufactured and services sectors. Tables 4, 5, 6 and 7 display for each scenario the functioning hypothesis of the different sectors.

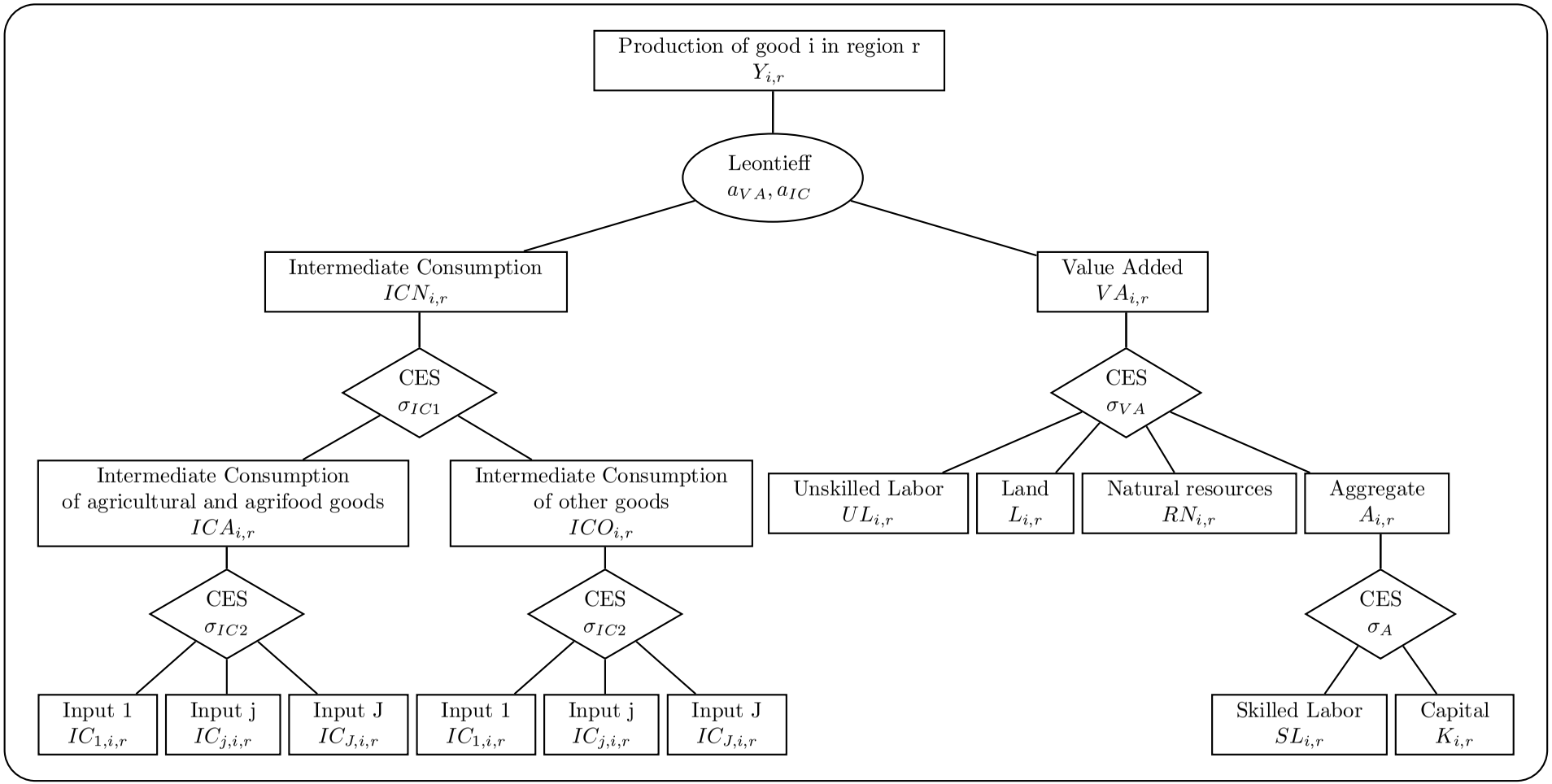

Figure 1: Production structure of sector i

When imperfect competition is considered, each firm produces its own and unique variety. Moreover, in each region, firms are assumed to be symmetrical and markets are geographically segmented. In imperfect competition sectors, increasing returns to scale come from fixed costs, expressed as a fixed quantity of output and are internal to each firm. For the oligopoly case and the Chamberlinian one, the following equation gives the Lerner formula and describes the mark-up behaviour of firms:

$$P_{i,r,s} = \frac{1}{1 + PED_{i,r,s}} Cm_{i,r}$$

with $PED_{i,r,s} = \frac{\partial P_{i,r,s}}{\partial x_{i,r,s}} \frac{x_{i,r,s}}{P_{i,r,s}} < 0$, the perceived price elasticity of demand of the firm i from region r in the market s, $Cm_{i,r}$ the marginal cost of product i in region r, $x_{i,r,s}$ the quantity supplied by the firm to the s' market and $P_{i,r,s}$ the corresponding product price

Here, the Chamberlinian hypothesis leads to the equality between the Dixit-Stiglitz elasticity of substitution and the firm's perceived elasticity of demand. In this case, the mark-up is invariant and strategic interactions vanish. Under Cournot conjecture, the perceived elasticity of demand depends on the values of the elasticitites of substitution (at the different level of the consumption structure) and on the market share of the firm. So, the mark-up will react to trade policy shock. Appendix 2 gives the analytical expressions of these perceived elasticities[6].

If many studies focus on the imperfectly competitive behaviour of sellers, the analysis of oligopsony is not very widespread, especially in a general equilibrium framework. Industry concentration implies the existence of collusive market power practices. Evidence of scale economies in the food processing sector has been offered in recent research (Ward, 1988) and they have contributed to the rapidly increasing concentration of that industry. Rogers and Sexton's study (1994) underlines the buyers' market power of agrifood firms for agricultural commodities (raw products). In this paper, we argue that a general equilibrium specification may greatly increase our understanding of the consequences of this market imperfection on the agricultural liberalization issue. In order to take into account oligopsony market structure between agricultural commodities sellers and agrifood firms, we have to adapt our model[7]. Indeed, the first-order condition for profit maximization describing intermediade consumption demand for an oligpsony sector j for an agricultural product i is defined as

[6]See Willenbockel(2002) for an overview of this topic.

[7]The choice of the nested CES structure for intermediate consumption and the values of the elasticities of substitution have direct consequences on the oligopsony power of the agrifood firms and, in our case, restrict it.

$$P\_IC_{i,j,r} = \frac{1}{1 + PES_{i,j,r}} MV_{i,j,r}$$

with $PES_{i,j,r} = \frac{\partial P\_IC_{i,j,r}}{\partial IC_{i,j,r}} \frac{IC_{i,j,r}}{P\_IC_{i,j,r}} > 0$ the perceiced supply price elasticity of good i.by firms of sector j in region r; $IC_{i,j,r}$ the intermediate consumption of good i by sector $_j$ in region r, $P\_IC_{i,j,r}$, its price. and $MV_{i,j,r}$ the marginal value of the input i for sector j in region r.

So, a price distortion occurs as the marginal value of an agricultural input in the agrifood sector exceeds its marginal cost. Here the key parameter is the perceived supply elasticity of a product i by a sector j in a region r that depends on the supply elasticity of every suppliers to this market, on theirs market shares and on the market share (as buyer) of sector j. (cf. Appendix 2).

Players in an oligopsony raw product market are the firms of the different agrifood sectors and from the different regions. We assume Cournot strategy for each player.

Let us note that we do not simultaneously assume an oligopoly and oligopsony structure for agrifood sectors in the different scenarios that will be examined.

Finally, the transport sector that covers both regular and international trade linked transport activities has to be handled specifically. This allows us to take into account differences between FOB and CIF values of traded goods. Following Bchir, Decreux, Guerin and Jean (2002), it is employed in fixed proportions with the volume of each good shipped along each route.

2.2 The demand side

There is a single private household in each country that saves a constant proportion of disposable income and buys consumption goods. The household in each country owns the firms but also works there, receiving wages, others factors incomes and all taxes and tariffs[8].

In each country, the preferences of the representative household follow a LES-CES (Linear Expenditure System – Constant Elasticity of Substitution) function. Consumer behaviour is modelled in four stages. The first level describes the distribution of demand between the composite agricultural good and all final industrial commodities and service sectors. The second step describes the sectoral repartition in each family of products (cf figure 2).

[8]There is no explicit public sector.

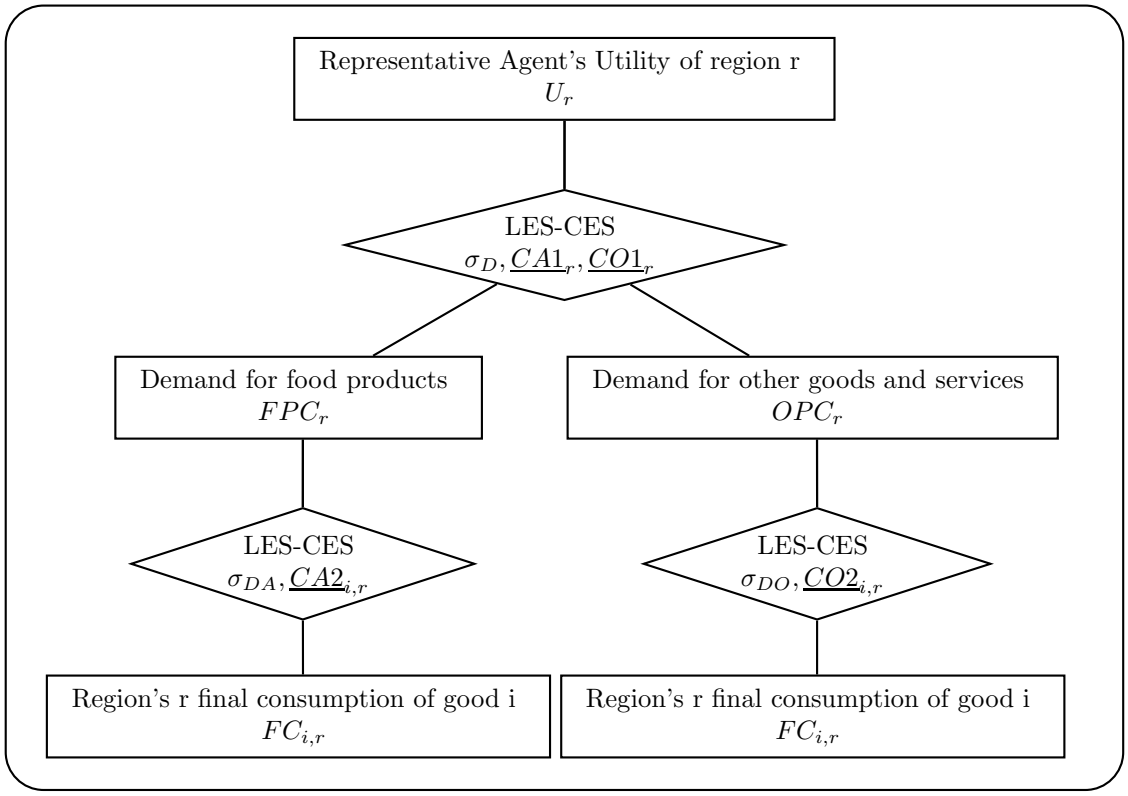

Figure 2: Final consumption structure - Top level commodity groups

Referring to Armington (1969), domestic and foreign goods are distinguished by their origin. The third and fourth levels highlight the choice between products from different geographical origins through CES functions. For imperfect competition sectors, a Dixit-Stiglitz formulation is used at the last level. Following Krugman's (1979) love for variety, the consumer chooses between horizontally-differentiated varieties of each good with a constant elasticity of substitution (cf figure 3).

Total demand is the sum of final consumption, intermediate consumption and capital goods. Let us note that changes in the number of firms influences firm's size, market power but also the number of available varieties. This leads to an increase in welfare based on the taste for varieties from consumers and its corollary on the supply side.

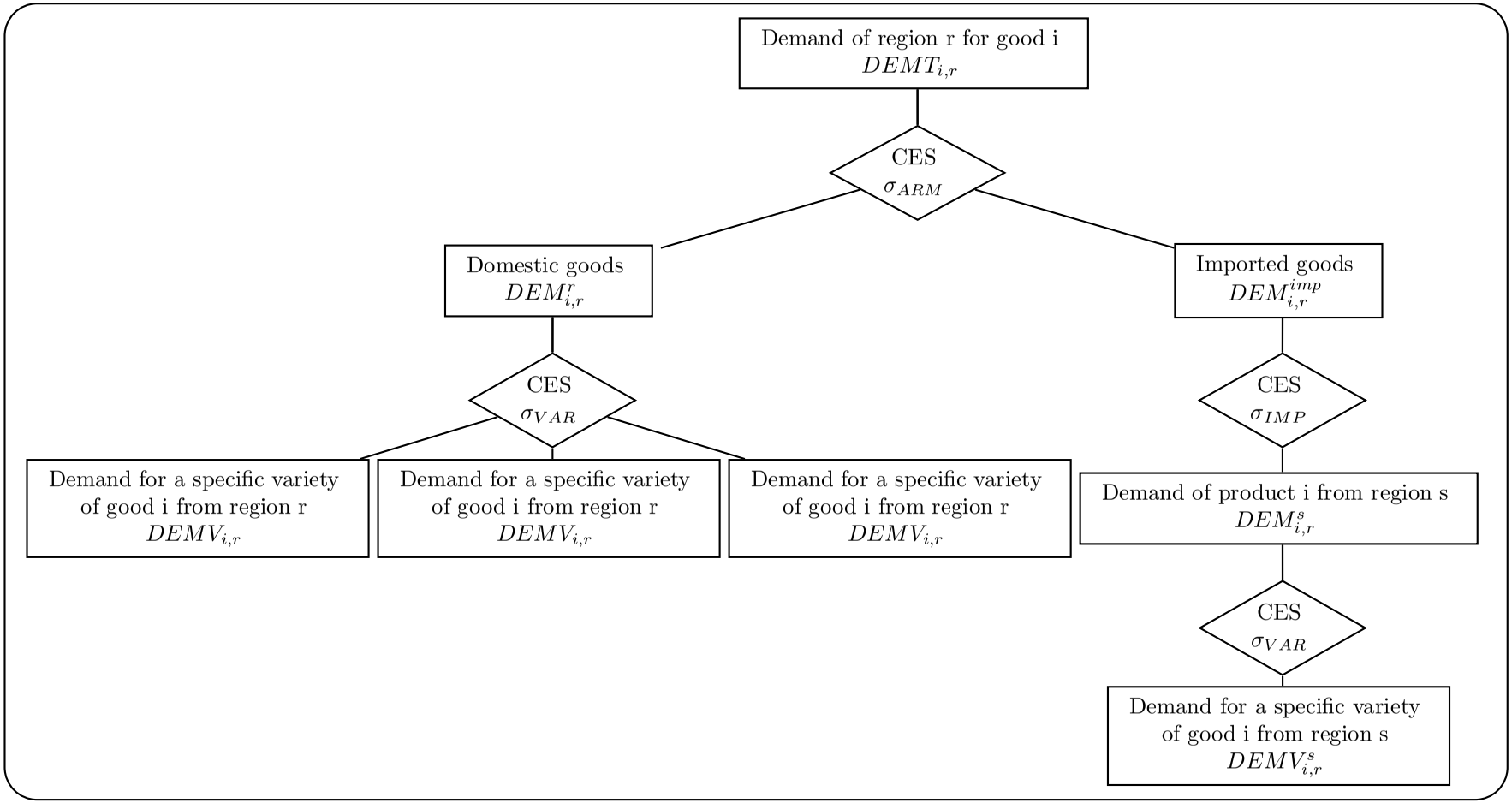

Figure 3: Demand nesting for good i : Distribution across origins and varieties

2.3 Equilibrium of the model and closure.

Once the model has been specified, we solve it for an equilibrium solution. It is given by a set of goods and factor prices for which all markets clear. Hence, the general equilibrium is reached if the following conditions are satisfied:

- Equilibrium in the domestic good's market in every country.
- Equilibrium in factor markets in every country.
- Levels of net capital inflows or outflows are fixed for each region.
- Alternatively, exogeneous number of firms and zero-profit conditions are assumed.

In order to check the Walras' Law, we take the European composite consumption good as the numeraire.

3 Data and calibration.

3.1 Benchmark Data set

The base year is 1997 and most of the data come from the database of the Global Trade Analysis Project (GTAP), version 5.3. Several comparative static analyses are carried out from this benchmark. Our model includes 34 products and 8 regions (cf. Tables 1 and 2). All regions are fully endogenized and linked through trade. The disaggregation for the agricultural and agrifood goods includes 20 products. The sector "trade" that covers retailing activities will be treated as an agrifood sector in most part of this study.Trade restrictions are measured as ad valorem tariff equivalents. Appendix 1 displays European initial levels of tariffs and export and production substidies.

Other exogeneous parameters are displayed in the third appendix and are:

- The elasticities of substitution of the production structure, taken from the literature (Cahuc and Zylberberg 1996, Cortes and Jean,1996).
- The elasticity of substitution between domestic output and import composite and the elasticity of substitution between imports of different geographic origins come from GTAP[9]et us note that the Armington elasticities here may be underestimated for agricultural and agrifood products. This issue will lead to smaller impacts of liberalization.

[9] L

Sectors		
Agricultural sectors	Paddy rice Wheat Cereal grains nec Vegetables and fruits Oil seeds Sugar cane and sugar beet	Plant-based fibers Crops nec Cattle Animal products nec Raw milk Wool
Other Primary sectors	Fishing Forestry	Mineral Raw products
Agrifood sectors	Meat (cattle) Meat products nec Vegetable oils and fats Dairy products	Processed rice Sugar Food products nec Beverages and tobacco products
Industrial and Services sectors	Textile and clothing Wood products Paper products and publishing Chemicals Metal products Transport equipments	Other manufactured products Trade Energy Services Transport

Table 1: Sectoral aggregation

Regions
European Union
Candidate countries
Subsaharian africa
Mediterranean countries
Cairnes Group
NAFTA
Asia
Rest of the world

Table 2: Geographical aggregation

- The elasticity of substitution between varieties.
- The minimum level of final consumption for each good set as a share of the initial consumption.
- The exogenous number of firms (taken from Haaland and Normann 92, Davies and Lyons 96, Rogers and Sexton 94).

For oligopoly and monopolistic competition sectors, we take the number of firms and the perceived elasticity of demand as set extraneously and we calibrate the mark-up ratio residually. Fixed costs ensure zero-profit conditions at the benchmark equilibrium. Let us note that the number of symmetric firms is computed on the basis of the sector's inverse Herfindhal concentration indices and yet the relevant level of competitive fields is at a subsector one. Following Bchir and *alii*, we assume that the initial number of firms is roughly equal to 20% of the inverse Herfindhal index given by the literature.

The presence of oligopsony demands a specific calibration strategy:

- For each agricultural sector, perceived elasticity of supply is computed from the supply side block of our model by making an infinitesimal variation of the product's price.
- Oligopsonist profits are computed from the base SAM and the previously computed value of supply elasticity.
- Fixed costs ensure zero-profits equilibrium.

The study of oligopsony power makes the issue of the determination of firms' number more prominent. We have to keep in mind that the choice of regional and sectorial disaggregation level drastically affects the relevant value for these parameters. Most studies under-estimated the true level of concentration by neglecting transportation costs that limit movement of raw products (especially live cattle, dairy products, and fesh produce) and create geographically dependant sellers. Moreover, concentration index computed on a four-digit industry categories are too broad. As shown by Rogers and Sexton for US Food markets, the average four-digit four-firm concentration is 37.8 but it jumps to 61.3 at the five-digit level. For some products, the relevant input markets are often so narrow that the seven-digit level of detail is necessary to attain the proper market definition. As a first approximation, we will assume a perfectly collusive buying behaviour between firms of the same region in an agrifood sectors, but further investigations on this topic must be conducted. This assumption do not lead to a monopsonist situation since others buyers (firms from other areas, other sectors, final consumers) exist.

4 Scenarios and Results

We use the previously described CGE model to evaluate the price and welfare consequences of three unilateral reform scenarios under the various assumptions made about the competitive structure of the food industry and retail trade: the first reform is a mere reduction of protection and domestic support for agricultural commodities, cutting tariffs, export subsidies, and domestic price support in the EU by 50%; the second reform scenario extends the trade liberalization process to processed food products; and the third scenario adds to the reduction of external protection and domestic price support a 50% cut in factor subsidies in agriculture. These scenarios are summarized in Table 3. Tables 4, 5, 6 and 7 display the different assumptions about market structure underlying them.

	Tariffs and export and production subsidies on agricultural raw products	Tariffs and export subsidies on agrifood processed products	Factors subvention
Scenario 1	50% reduction	-	-
Scenario 2	50% reduction	50% reduction	-
Scenario 3	50% reduction	50% reduction	50% reduction

Table 3: Scenario Schematic

H1. Perfect Competition Framework (PC)	
Perfectly competitive markets	Paddy rice, Wheat, Cereal grains nec, Vegetables and fruits, Oil seeds, Sugar cane and sugar beet, Plant-based fibers, Crops nec, Cattle, Animal products nec, Raw milk, Wool Meat (cattle), Meat products nec, Vegetable oils and fats, Dairy products, Processed rice, Sugar Food products nec, Beverages and tobacco products. Textile and clothing, Energy, Transport, Services.
Chamberlinian markets	Trade Wood products, Paper products and publishing, Chemicals, Metal products, Transport equipments, Other manufactured products

Table 4: Market structure assumptions I

H2. Monopolistic Competition Framework (MC)	
Perfectly competitive markets	Paddy rice, Wheat, Cereal grains nec, Vegetables and fruits, Oil seeds, Sugar cane and sugar beet, Plant-based fibers, Crops nec, Cattle, Animal products nec, Raw milk, Wool Textile and clothing, Energy, Transport, Services.
Chamberlinian markets	Trade Wood products, Paper products and publishing, Chemicals, Metal products, Transport equipments, Other manufactured products Meat (cattle), Meat products nec, Vegetable oils and fats, Dairy products, Processed rice, Sugar Food products nec, Beverages and tobacco products.

Table 5: Market structure assumptions II

H3. Cournot oligopoly Framework (CO)	
Perfectly competitive markets	ditto H2.
Chamberlinian markets	Wood products, Paper products and publishing, Chemicals, Metal products, Transport equipments, Other manufactured products
Cournot Oligopoly markets	Trade Meat (cattle), Meat products nec, Vegetable oils and fats, Dairy products, Processed rice, Sugar Food products nec, Beverages and tobacco products.

Table 6: Market structure assumptions III

H4. Cournot oligopsony Framework (OLI)	
Perfectly competitive markets	ditto H2.
Chamberlinian markets	Trade Wood products, Paper products and publishing, Chemicals, Metal products, Transport equipments, Other manufactured products
Cournot Oligopsony markets	Meat (cattle), Meat products nec, Vegetable oils and fats, Dairy products, Processed rice, Sugar Food products nec, Beverages and tobacco products.

Table 7: Market structure assumptions IV

4.1 Welfare effects of the various reforms scenarios

Because food is only on small fraction of private expenditures in most regions of the world, because agricultural products are only inputs in the agrifood and retail trade sectors serving consumers, and also because of the characteristics of general-equilibrium models in general, welfare effects of the various reform scenarios are relatively small in all cases (Table 18 in Annex 4). The effects are, in particular, hardly noticeable in the first reform scenario, which has liberalization limited to agriculture, and in which nothing is done to open up trade in processed food: in such a scenario, there are very small welfare gains for the EU and the Rest of the world, small losses for Asia and for the Candidate countries, and the Mediterranean countries are the only ones to bear a more significant, yet small, welfare loss. The competitive structures of the agrifood sectors make very little difference to these aggregate outcomes

The welfare consequences of the second and third reform scenarios are still small, but more important for all regions. Because the third scenario only differs from the second one by abolishing factor subsidies in agriculture, its welfare effects ar strictly identical: this is due to the fact that in our model, there is a representative consumer in each region who owns all production factors, so that removing a lump-sum subsidy financed by a lump-sum tax, two instruments that had no effects on relative prices, hence on incentives and behavior, is perfectly neutral for consumer welfare; it may be verified (Tables 19 and 20 in Annex 4) that the impacts on agricultural commodities prices and agrifood product prices are identical. In both reform scenarios, the welfare gains accrue only to European consumers, whereas all other regions, except the Cairnes Group, stand to lose. Once again, the big losers are the Mediterranean countries, under all assumptions regarding the competitive structures; Asia also loses in all cases, though much less, and NAFTA bears very small welfare losses too. Interestingly, the welfare effects of these scenarios on other regions differ across competitive assumptions. The distinction between fixed number of firms (short-term) and free entry (long term) makes some, but not much difference in the aggregate: the case with Cournot oligopolistic competition in the agrifood sector is the one where, unsurprisingly, the free entry assumption has marked consequences on welfare, because it somewhat dampens price effects. However, the distribution of welfare gains and losses across regions is sensitive to the assumptions made about the competitive structures of the agrifood sector: hence, for instance, candidate countries lose in the cases of a perfectly competitive or oligopsonistic agrifood sector, but gain in both other cases, while the losses of Subsaharian Africa, Mediterranean countries, Asia and the Rest of the world, and the gains of Cairnes countries also differ across

competitive structures.

4.2 Impacts on prices

The impacts of reform scenarios on prices in the agricultural and agrifood sectors are also as expected, but relatively varied across assumptions. Both agricultural commodities production prices and agrifood products price index are lowered in the EU and increased everywhere else by all three reforms, the second and third scenarios having identical effects for reasons discussed above. Here again though, the first liberalization scenario, which is strictly confined to agriculture, has a modest impact on agricultural commodities prices, and even more so on agrifood product prices. It may however be noticed that in the case of an oligopsonistic agrifood sector, the effects on agrifood product prices, especially in the EU, are significantly larger: this is so because the unilateral agricultural trade liberalization then weakens the market power of the European agrifood industry, so that production price deceases are better passed through to consumers.

The different impacts with an oligopsonistic agrifood sector are even more apparent in the case of the second (and third) reform scenario. In this case, the effects on agricultural commodities prices are all more significant, though still limited, than in the first scenario. But this time the effect on agrifood products prices are larger everywhere, except in the Cairnes countries.

4.3 Changes of specific factor returns

Real return to capital (Appendix 4) is not much affected by the various reform scenarios, which is not really surprising, given the share of the sectors concerned in the total world economy. In the first reform scenario, the gains and losses are essentially concentrated on the EU, where real return on capital is slightly increased in all cases, and Candidate countries and Subsaharian Africa, where capital return suffers a very small reduction. In the second scenario, changes in the real return of capital are more important, and positive for all competitive assumptions in all regions, except Mediterranean countries, incurring a mild loss in all but one assumptions regarding the competitive structure of the agrifood sector. The third scenario, this time, is different from the second one, but only for real returns in the EU: instead of a gain, there is a loss, due to the cut of factor subsidies in agriculture.

Real returns on land are all more affected by all reform scenarios than those of capital. In the first scenario, the drop in the real return to land in the EU is close to 1% in all cases; everywhere else there are modest gains, except in Asia and the

Rest of the world, where the change in land's real returns are almost insignificant. The second reform scenario has even more marked effects on land returns in the EU and in some other regions. And, of course, the third reform scenario induces a large reduction in land return in the EU.

5 Concluding remarks

The main findings of our analysis differ somewhat from conventional wisdom on the aggregate and distributional consequences of unilateral liberalization of agriculture in the EU. When account is taken of the presence of large sectors standing between farmers and consumers (food processing industry, transports and trade), the magnitudes of aggregate welfare and price effects of even large reforms are quite small. Looking at various assumptions with regard to the competitive structures of the agrifood sector does make a difference in some cases, especially when the agrifood sector is assumed to be oligopsonistic, but the differences are not as large as might have been expected. The model also delivers results by product, which have not been commented in this paper.

Of course, many extensions of the analysis could be imagined and should be carried ou in the next steps of our research. First, it appears that results are sensitive to numerical values of some key parameters, in particular the Armington elasticities; a sensitivity analysis would shed light on the robustness of our results and may enlighten issues such as the consequences of labels and appellations d'origine contrôlée on the effects of liberalization. Another interesting extension would entail looking at more elaborate reform scenarios, in particular multilateral trade agreements involving countries other than the EU, or complex scenarios with regional free trade agreements, for instance between the EU and Candidate countries, or between the EU and Mediterranean countries, etc. In short, this kind of model is very versatile and should be used to investigate more thoroughly the consequences of all envisaged reform scenarios.

References

[1] Bchir M.H, Decreux Y., Guérin J-L. and Jean S., 2002. "MIRAGE, un modèle d'équilibre général calculable pour l'analyse des politiques commerciales." *Economie Internationale* 89-90,109-154.

[2] Berthelot, Jacques, 2001. *L'Agriculture – Talon d'Achille de la mondialisation – Clefs pour un accord agricole solidaire à l'OMC*, L'Harmattan.

[3] Bouët, Antoine, 2002. "Commentaire" of Patrick Messerlin's article "Niveau et coût du protectionnisme européen", *Economie internationale*, n°89-90.

[4] Bouët, Antoine, and Jean-Christophe Bureau, 2001. "Agriculture et commerce international", *Economie Internationale*, n°87.

[5] Bouët, Antoine, and Jacques Le Cacheux, 2002. "Desirable and Undesirable Effects of Agricultural Liberalization in the North", paper presented at the Seminar Réformer la PAC ?,CEPII-CER, OCDE, Paris, November.

[6] Burfisher, M., et alii, 2001. "The Road Ahead – Agricultural Policy Reform in WTO", US Department of Agriculture, Economic Research Service, Agriculture Economic Report, n°797.

[7] Cahuc P. and Zylberberg A., 1996. *Economie du travail : la formation des salaires et les déterminants du chômage*. De Boeck, Paris, Bruxelles.

[8] Cortes O. and Jean S., 1998. "Does Competition from Emerging Countries Threaten Unskilled Labour in Europe ? An Applied General Equilibrium Approch." Global Trade and European Workers In : Brenton, Pelkmans J., (eds.) Macmillan, Londres, 96-122.

[9] Commission européenne, 2002. *European Agriculture Entering the 21st Century, Direction générale de l'agriculture*, octobre, www.europa.org.

[10] Davies S. and Lyons B., 1996. *Industrial Organization in the European Union.* Oxford University Press.

[11] FAO-UN, 2003. *World Agriculture: Towards 2015/2030*, Jelle Bruinsma, ed., Earthscan-FAO.

[12] Goodwin B.K., 1994. "Oligopsony Power : A Forgotten Dimension of Food Marketing ?" Discussion. *American Journal of Agricultural Economics* 76, 1163-65.

[13] Haaland J.I. and Norman V.D., 1992. "Global Production Effects of European Integration." In Winters L.A. (ed.) : *Trade Flows and Trade Policy after 1992*. Cambridge : CUP, 67-91.

[14] IATP-Institute for agriculture and trade policy, 2003. "United States Dumping on World Agricultural Markets", *Cancun Series Paper n°1*, www.iatp.org et www.tradeobservatory.org .

[15] Le Cacheux, Jacques, 1995. *La valeur ajoutée dans l'agriculture française — Evolutions, déterminants, partage* "Etudes économiques", Agra-Presse, May.

[16] Le Cacheux, Jacques, 2002. "Sécurité alimentaire : la dimension internationale", in François Constantin, *Les Biens publics mondiaux*,

[17] Le Cacheux, Jacques, and Henri MENDRAS, 1992. "Eléments pour une nouvelle politique agricole", *Revue de l'OFCE*, n°42, October.

[18] Krugman P.R., 1979. "Increasing returns, monopolistic competition and international trade." *Journal of International Economics* 9, 469-79.

[19] Michel, Frank, 2003. "L'agroindustrie et la distribution sont les grandes gagnantes des réformes de politique agricole", *Note de travail*, Chambre d'agriculture des Deux-Sèvres, February.

[20] OCDE, 2002. *L'Agriculture et la libéralisation des échanges – Elargir la portée des accords d'Uruguay*, OCDE.

[21] OXFAM, 2002.

[22] Rogers, Richard T. and Richard J.S, 1994. "Assessing the Importance of Oligopsony Power in Agricultural Markets." *American Journal of Agricultural Economics* 76, 1143-50.

[23] Ward C.E., 1988. "Meatpacking Competition and Pricing." *Blacksburg VA : Research Institute on Livestock Pricing.*

[24] Willenbockel D., 2001. "Specification Choice and Robustness in CGE Trade Policy Analysis with Imperfect Competition." *Mimeo.* Ecomod 2001.

Appendix 1

Table 8: Geographical mapping

Regions	**GTAP regions**
European Union	Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom
Candidate countries	Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Slovenia
Subsaharian africa	Botswana, Malawi, Mozambique, Other Southern Africa, Rest of South Afr C Union, Rest of Sub-Saharan Africa, Tanzania, Uganda, Zambia, Zimbabwe
Mediterranean countries	Cyprus, Morocco, Turkey, Rest of Middle East, Rest of North Africa
Cairnes Group + South america	Argentina, Australia, Brazil, Central America, Caribbean, Chile, Colombia, New Zealand, Peru, Rest of Andean Pact, Rest of South America, Uruguay, Venezuela
NAFTA	Canada, Mexico, United States
Asia	Bangladesh, China, Hong Kong, India, Indonesia, Japan, Korea, Malaysia, Philippines, Rest of South AsiaSingapore, Sri Lanka, Taiwan, Thailand, Vietnam
Rest of the world	Albania, Croatia, Rest of Eur Free Trade Area, Rest of Former Soviet Union, Rest of World, Russian Federation, Switzerland

Table 9: Sectoral mapping

Sectors	**GTAP sectors**
Paddy rice	Paddy rice
Wheat	Wheat
Cereal grains nec	Cereal grains nec
Vegetables and fruits	Vegetables and fruits
Oil seeds	Oil seeds
Sugar cane and sugar beet	Sugar cane and sugar beet
Plant-based fibers	Plant-based fibers
Crops nec	Crops nec
Cattle	Cattle, sheeps, goats, horses
Animal products nec	Animal products nec
Raw milk	Raw milk
Wool	Wool
Forestry	Forestry
Fishing	Fishing
Mineral Raw products	Coal, Oil, Gas,Minerals nec
Meat (cattle)	Meat : cattle, sheeps, goats, horses
Meat products nec	Meat products nec
Vegetable oils and fats	Vegetable oils and fats
Dairy products	Dairy products
Processed rice	Processed rice
Sugar	Sugar
Food products nec	Food products nec
Beverages and tobacco products	Beverages and tobacco products
Textile and clothing	Textile, Wearing apparel, Leather products
Wood products	Wood products
Paper products and publishing	Paper products and publishing
Chemicals	Petroleum, coal products, Chemical,rubber,plastic prods
Metal products	Mineral products nec, Ferrous metals, Metals nec, Metal products
Transport equipments	Motor vehicles and parts, Transport equipment nec
Other manufactured products	Electronic equipment, Machinery and equipment nec, Manufactures nec
Trade	Trade
Energy	Electricity, Gas manufacture and distribution, Water
Services	Construction, Communication, Financial services nec, Insurance, Business services nec,Recreation and other services, PubAdmin/Defence/Health/Educat, Dwellings
Transport	Transport nec, Sea transport, Air transport

Table 10: European Production subsidy rate

Sectors	**Production subsidy rate**
Paddy rice	0.24
Wheat	0.47
Cereal grains nec	0.25
Vegetables and fruits	0.00
Oil seeds	0.25
Sugar cane and sugar beet	0.39
Plant-based fibers	0.00
Crops nec	0.00
Cattle	0.28
Animal products nec	0.36
Raw milk	0.34

Source : GTAP database.

Table 11: European Export subsidy rate

	Candidate countries	Rest of the world	Subsaharian africa	Cairnes Group	NAFTA	Asia	Mediterranean countries
Paddy rice	12.13	12.13	12.13	12.13	12.13	12.13	12.13
Wheat	8.35	8.35	8.35	8.35	8.35	8.35	8.35
Cereal grains nec	25.49	25.49	25.49	25.49	25.49	25.49	25.49
Vegetables and fruits	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Oil seeds	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sugar cane and sugar beet	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Crops nec	0.37	0.37	0.37	0.37	0.37	0.37	0.37
Cattle	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Animal products nec	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Raw milk	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wool	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fishing	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Meat (cattle)	21.34	21.34	21.34	21.34	21.34	21.34	21.34
Meat products nec	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Vegetable oils and fats	0.14	0.14	0.14	0.14	0.14	0.14	0.14
Dairy products	19.51	19.51	19.51	19.51	19.51	19.51	19.51
Processed rice	12.13	12.13	12.13	12.13	12.13	12.13	12.13
Sugar	35.24	35.24	35.24	35.24	35.24	35.24	35.24
Food products nec	4.29	4.29	4.29	4.29	4.29	4.29	4.29
Beverages and tobacco products	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Source : GTAP database.

Table 12: European Tariffs rate

	Candidate countries	Rest of the world	Subsaharian africa	Cairnes Group	NAFTA	Asia	Mediterranean countries
Paddy rice	64.93	64.93	64.93	64.93	64.93	64.93	64.93
Wheat	61.40	61.40	61.40	61.40	61.40	61.40	61.40
Cereal grains nec	38.58	38.58	38.58	38.58	38.58	38.58	38.58
Vegetables and fruits	14.51	14.51	14.51	14.51	14.51	14.51	14.51
Oil seeds	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sugar cane and sugar beet	251.40	251.40	251.40	251.40	251.40	251.40	251.40
Crops nec	3.09	3.09	3.09	3.09	3.09	3.09	3.09
Cattle	36.62	36.62	36.62	36.62	36.62	36.62	36.62
Animal products nec	6.72	6.72	6.72	6.72	6.72	6.72	6.72
Raw milk	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wool	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fishing	8.80	1.62	12.28	9.74	8.87	3.78	11.10
Meat (cattle)	88.94	88.94	88.94	88.94	88.94	88.94	88.94
Meat products nec	30.94	30.94	30.94	30.94	30.94	30.94	30.94
Vegetable oils and fats	11.41	11.41	11.41	11.41	11.41	11.41	11.41
Dairy products	87.68	87.68	87.68	87.68	87.68	87.68	87.68
Processed rice	87.38	87.38	87.38	87.38	87.38	87.38	87.38
Sugar	76.41	76.41	76.41	76.41	76.41	76.41	76.41
Food products nec	28.83	28.83	28.83	28.83	28.83	28.83	28.83
Beverages and tobacco products	8.34	8.34	8.34	8.34	8.34	8.34	8.34

Source : GTAP database.

Appendix 2

A. Notations

The i and j indices refer to sectors, r and s refer to regions.

The generic notation "P_Var" indicate the price associated to the variable "Var".

The AI set is made up of the eight agrifood sectors.

The $AGRI$ set is made up of the twelve agricultural sectors.

B. Parameters definition

$\sigma_{VA,j}, \sigma_{A,j}, \sigma_D, \sigma_{DA}, \sigma_{DO},$ $\sigma_{IC,j}, \sigma_{IC1,j}, \sigma_{IC2,j},$ $\sigma_{ARM,i}, \sigma_{IMP,i}, \sigma_{VAR,i}$	Elasticities of substitution in production functions, utility functions , intermediate consumption and capital good demand functions.
$\underline{CA1}_r$	Minimal consumption of agricultural and agrifood goods in the utility function of region r
$\underline{CO1}_r$	Minimal consumption of no-food related goods in the utility function of region r
$\underline{CA2}_{i,r}$	Minimal consumption of good i in the agricultural and agrifood final consumption bundle of region r
$\underline{CO2}_{i,r}$	Minimal consumption of good i in the no-food related final consumption bundle of region r
$ES_{i,r}$	Supply elasticity of agricultural sector i from region r
sav_r	Saving rate in region r
$\mu_{i,r,s}$	Transport demand per volume
θ_r	Value share of region r transport sector in the world production of transport
a_T	Cobb-Douglas scale coefficient of the transport of commodities sector
$taxp_{i,r}, taxex_{i,r,s}, taxfc_{i,s},$ $taxicc_{i,s}, taxkgc_{i,s}$	Tax rate applied on production, export, final consumption intermediate consumption and capital good
$DD_{i,r,s}$	Ad-valorem tariff rate applied by region s on its imports from region r of good i
$taxamf_{i,r,s}$	MFA export tax equivalent (negative)
$subvT_{j,r}$	specific subvention by unit of land in sector j of region r
$subvK_{j,r}$	specific subvention by unit of capital in sector j of region r

$fct_{j,r}$	Fixed cost per unit of output in an imperfectly competitive sector j of region r
$KAbar_{j,r}$, $RNbar_{j,r}$, $TEbar_{j,r}$	Initial endowments of specific factors (capital, natural ressources, land) of sector j in region r
a_{XX}	share parameter of the XX variable in the relevant CES function

C. Variables definition

Production

$Y_{j,r}$	Output of sector j firms
$VA_{j,r}$	Value added
$ICN_{j,r}$	Aggregate intermediate consumption by sector j
$ICA_{j,r}$	Aggregate consumption of agricultural and agri-food inputs by sector j
$ICO_{j,r}$	Aggregate consumption of other inputs by sector j
$A_{j,r}$	Aggregate capital and skilled labor used in sector j
$UL_{j,r}$	Unskilled labour used in sector j
$TE_{j,r}$	Land used in sector j
$RN_{j,r}$	Natural ressources used in sector j
$KA_{j,r}$	Capital stock used in sector j
$SL_{j,r}$	Skilled labour in sector j

Factors

$ULbar_r, SLbar_r$	Total supply of unskilled labour and skilled labour.
INV_r	Total Investment in region r
$WKA_{i,r}$	Capital return in sector i of region r
$WTE_{i,r}$	Land return in sector i of region r

Demand

$BUDC_r$	Budget allocated to consumption
$PROFIT_{j,r}$	Profit of sector j
$SOLD_r$	Current account balance
UT_r	Utility
P_r	Price of utility
FPC_r	Agricultural and agrifood products aggregate bundle in final consumption of region r

OPC_r	No-food related products aggregate bundle in final consumption of region r
$FC_{i,r}$	Final consumption of good i in region r
$DEMT_{i,r}$	Total demand of good i in region r
$DEML_{i,r}$	Total demand in region r of good i originating from region r
$DEMIMP_{i,r}$	Demand in region s of good i originating from region r
$DEM_{i,r,s}$	Demand in region s of good i produced in region r
$DEMVAR_{i,r,s}$	Demand for one variety of product i produced in r from region r
$IC_{i,j,r}$	Intermediate consumption of good i used in the production of sector j in region r
$KG_{i,r}$	Capital good demand of good i in region r

Transport

$TRADE_{i,r,s}$	Exports to region s, of industry i in region r
$TR_{i,r,s}$	Transport demand
$WoTR$	Transport aggregate
PT	Transport of commodities price
TRM_r	Supply of international transportation by region r

Imperfect competition

$PED_{i,r,s}$	Perceived price-elasticity of total demand for the product i from region r in region s
$PES_{i,j,r}$	Perceived price-elasticity of supply for agricultural product i by sector j in region r
$NB_{i,r}$	Number of varieties (=1 for perfectly competitive sectors or oligopsony sectors)
$shSE_{i,r,s}, shST_{i,r,s}$	Auxiliary variables corresponding to market share in the Cournot oligopoly framework
$shO_{i,r,s}, shP_{i,j,r}$	Auxiliary variables corresponding to market share in the Cournot oligopsony framework

Tax revenue

$RECPROD_{i,r}, RECDD_{i,r}$, $RECCONS_{i,r}, RECEXP_{i,r}$	Revenue of production tax, tariff, consumption tax, exports tax

REV_r	Regional revenue

Price

$PCIF_{i,r,s}$	CIF price

D. Equations of the model

Supply

Leontieff relation between value added and intermediate consumption gives :

$$\begin{aligned} NB_{i,r}(Y_{i,r} + fct_{i,r}) &= a_{VA,i,r} VA_{i,r} = a_{ICN,i,r} ICN_{i,r} \\ P\_Y_{i,r} \times NB_{i,r}(Y_{i,r} + fct_{i,r}) &= P\_VA_{i,r} \times VA_{i,r} + P\_ICN_{i,r} \times ICN_{i,r} \end{aligned} \tag{1}$$

Factors demand result by the two following cost minimizing programs :

$$\left\{ \begin{array}{l} Min\ P\_VA_{i,r} \times VA_{i,r} = \left(\begin{array}{c} P\_UL_{i,r} \times UL_{i,r} + P\_RN_{i,r} \times RN_{i,r} \\ +P\_TE_{i,r} \times TE_{i,r} + P\_A_{i,r} \times A_{i,r} \end{array} \right) \\ s.t.\ VA_{i,r}^{1-\frac{1}{\sigma_{VA,i}}} = \left(\begin{array}{c} a_{UL,i,r} \times UL_{i,r}^{1-\frac{1}{\sigma_{VA,i}}} + a_{RN,i,r} \times RN_{i,r}^{1-\frac{1}{\sigma_{VA,i}}} \\ +a_{TE,i,r} \times TE_{i,r}^{1-\frac{1}{\sigma_{VA,i}}} + a_{A,i,r} \times A_{i,r}^{1-\frac{1}{\sigma_{VA,i}}} \end{array} \right) \end{array} \right. \tag{2}$$

and

$$\left\{ \begin{array}{c} Min\ P\_A_{i,r} \times A_{i,r} = P\_SL_{i,r} \times SL_{i,r} + P\_KA_{i,r} \times KA_{i,r} \\ s.t.\ A_{i,r}^{1-\frac{1}{\sigma_{A,i}}} = a_{SL,i,r} \times SL_{i,r}^{1-\frac{1}{\sigma_{A,i}}} + a_{KA,i,r} \times KA_{i,r}^{1-\frac{1}{\sigma_{A,i}}} \end{array} \right. \tag{3}$$

Demand

Final consumption

Representative consumer's maximisation of her LES CES nested utility function leads to the following relations :

LES-CES (first-step)

$$\left\{ \begin{array}{c} FPC_r - CA1_r = a_{FPC,r} \times UT_r \left(\frac{P_r}{P\_FPC_r} \right)^{\sigma_D} \\ OPC_r - CO1_r = a_{OPC,r} \times UT_r \left(\frac{P_r}{P\_OPC_r} \right)^{\sigma_D} \\ P_r \times UT_r = P\_FPC_r \times (FPC_r - CA1_r) + P\_OPC_r \times (OPC_r - CO1_r) \end{array} \right. \tag{4}$$

LES-CES (second step)

$$\begin{cases} FC_{i,r} - CA2_{i,r} = a_{C,i,r} \times (FPC_r - CA1_r) \left(\frac{P\_FPC_r}{P\_FC_r}\right)^{\sigma_{DA}} \\ P\_FPC_r \times (FPC_r - CA1_r) = \sum_i P\_FC_{i,r} \times (FC_{i,r} - CA2_{i,r}) \end{cases} \quad \forall i \in AGRI \text{ or } \forall i \in AI \tag{5}$$

$$\begin{cases} FC_{i,r} - CO2_{i,r} = a_{FC,i,r} \times (OPC_r - CO1_r) \left(\frac{P\_OPC_r}{P\_FC_r}\right)^{\sigma_{DO}} \\ P\_OPC_r \times (OPC_r - CO1_r) = \sum_i P\_FC_{i,r} \times (FC_{i,r} - CO2_{i,r}) \end{cases} \quad \forall i \notin AGRI \text{ and } \forall i \notin AI \tag{6}$$

The budget constraint is given by

$$BUDG_r = \sum_i P\_FC_{i,r} \times FC_{i,r} \tag{7}$$

Finally, Consumption price is

$$P\_FC_{i,r} = P\_DEMT_{i,r} \times (1 + taxcc_{i,r}) \tag{8}$$

Intermediate consumption

The cost minimizing behaviour of firms gives

$$\begin{cases} ICA_{j,r} = a_{ICA,j,r} \times ICN_{j,r} \left(\frac{P\_ICN_{j,r}}{P\_ICA_{j,r}}\right)^{\sigma_{IC1,j}} \\ ICO_{j,r} = a_{ICOj,r} \times ICN_{j,r} \left(\frac{P\_ICN_{j,r}}{P\_ICO_{j,r}}\right)^{\sigma_{IC1,j}} \\ P\_ICN_{j,r} \times ICN_{j,r} = P\_ICA_{j,r} \times ICA_{j,r} + P\_ICO_{j,r} \times ICO_{j,r} \end{cases} \tag{9}$$

$$\begin{cases} IC_{i,j,r} = a_{IC,i,j,r} \times ICA_{j,r} \left(\frac{P\_ICA_{j,r}}{P\_IC_{i,j,r}}\right)^{\sigma_{IC2,j}} \\ P\_ICA_{j,r} \times ICA_{j,r} = \sum_i P\_IC_{i,j,r} \times IC_{i,j,r} \end{cases} \quad \forall i \in AGRI \text{ and } j \text{ not oligopsony} \tag{10}$$

$$\begin{cases} IC_{i,j,r} = a_{IC,i,j,r} \times \frac{ICA_{j,r}}{1+PES_{i,j,r}} \left(\frac{P\_ICA_{j,r}}{P\_IC_{i,j,r}}\right)^{\sigma_{IC2,j}} \\ P\_ICA_{j,r} \times ICA_{j,r} = \sum_i P\_IC_{i,j,r} \times IC_{i,j,r} \end{cases} \quad \forall i \in AGRI \text{ and } j \text{ oligopsony} \tag{11}$$

$$\begin{cases} IC_{i,j,r} = a_{IC,i,j,r} \times ICO_{j,r} \left(\frac{P\_ICO_{j,r}}{P\_IC_{i,j,r}}\right)^{\sigma_{IC2,j}} \\ P\_ICO_{j,r} \times ICO_{j,r} = \sum_i P\_IC_{i,j,r} \times IC_{i,j,r} \end{cases} \quad \forall i \notin AGRI \tag{12}$$

with

$$P\_IC_{i,j,r} = P\_DEMT_{i,r} \times (1 + taxicc_{i,j,r}) \tag{13}$$

Capital good

$$\begin{cases} KG_{i,r} = a_{KG,i,r} \times INV_r \left(\frac{P\_INV_{i,r}}{P\_KG_{i,r}}\right)^{\sigma_{KG}} \\ P\_INV_r \times INV_r = \sum_i P\_KG_{i,r} \times KG_{i,r} \end{cases} \tag{14}$$

with

$$P\_KG_{i,r} = P\_DEMT_{i,r} \times (1 + taxikg_{i,r}) \tag{15}$$

Total Demand

Total demand of the good i in region r is

$$DEMT_{i,r} = FC_{i,r} + KG_{i,r} + \sum_j IC_{i,j,r} \tag{16}$$

Geographical distribution of Demand

Armington assumption gives the distribution between domestic and imported varieties:

$$\begin{cases} DEML_{i,r} = DEM_{i,r,r} = a_{DEM,i,r,r} \times DEMT_{i,r} \left(\frac{P\_DEMT_{i,r}}{P\_DEM_{i,r,r}}\right)^{\sigma_{ARM,i}} \\ DEMIMP_{i,r} = a_{DEMIMPi,r} \times DEMT_{i,r} \left(\frac{P\_DEMT_{i,r}}{P\_DEMIMP_{i,r}}\right)^{\sigma_{ARM,i}} \\ P\_DEMT_{i,r} \times DEMT_{i,r} = P\_DEM_{i,r,r} \times DEM_{i,r,r} + P\_DEMIMP_{i,r} \times DEMIMP_{i,r} \end{cases} \tag{17}$$

At the next level, the imported aggregate is allocated to the different trade partners :

$$\begin{cases} DEM_{i,s,r} = a_{DEM,i,s,r} \times DEMIMP_{i,r} \left(\frac{P\_DEMIMP_{i,r}}{P\_DEM_{i,s,r}}\right)^{\sigma_{IMP,i}} \\ P\_DEMIMP_{i,r} \times DEMIMP_{i,r} = \sum_s^{r \neq s} P\_DEM_{i,s,r} \times DEM_{i,s,r} \end{cases} \quad \forall r \neq s \tag{18}$$

Varieties

$$\begin{cases} DEM_{i,s,r} = DEMV_{i,s,r} \times NB_{i,s}^{\frac{\sigma_{VAR,i}-1}{\sigma_{VAR,i}}} \\ P\_DEM_{i,s,r} = P\_DEMV_{i,s,r}^{\frac{1}{1-\sigma_{VAR,i}}} \end{cases} \tag{19}$$

Commodity market equilibrium

$$Y_{i,r} = \sum_s DEMV_{i,r,s} \tag{20}$$

Transport sector

$$TRADE_{i,r,s} = NB_{i,r} \times DEMV_{i,r,s} \tag{21}$$

Transport demand

$$TR_{i,r,s} = \mu_{i,r,s} \times TRADE_{i,r,s} \tag{22}$$

$$WoTR = \sum_{i,r,s} TR_{i,r,s} \tag{23}$$

Transport supply

$$Y_{"Transport",r} = \sum_{s} TRADE_{"Transport",r,s} + TRW_r \tag{24}$$

$$P\_Y_{"Transport",r} \times \left(1 + taxp_{"Transport",r}\right) \times TRW_r = \theta \times PT \times WoTR \tag{25}$$

$$TRW_r = a_T \prod_{r} TRW_r^{\theta} \tag{26}$$

Factor market clearing conditions:

$$\begin{aligned} SLbar_r &= \sum_j SL_{j,r} \\ ULbar_r &= \sum_j UL_{j,r} \\ KAbar_{i,r} &= KA_{i,r} \\ RNbar_{i,r} &= RN_{i,r} \\ TEbar_{i,r} &= TE_{i,r} \end{aligned} \tag{27}$$

Revenues

Profit

For an oligopoly or monopolistic competitition sector:

$$PROFIT_{i,r} = P\_Y_{i,r} \times NB_{i,r} \times \sum_{s} \frac{DEMV_{i,r,s}}{1 + PED_{i,r,s}} - (P\_VA_{i,r} \times VA_{i,r} + P\_ICN_{i,r} \times ICN_{i,r}) \tag{28}$$

For an oligopsony sector:

$$PROFIT_{i,r} = P\_Y_{i,r} \times Y_{i,r} + \sum_{j \in AGRI} - (P\_VA_{i,r} \times VA_{i,r} + P\_ICN_{i,r} \times ICN_{i,r}) \tag{29}$$

Tax revenue

$$RECPROD_{i,r} = taxp_{i,r} \times P\_Y_{i,r} \times NB_{i,r} \times \sum_s \frac{DEMV_{i,r,s}}{1 + PED_{i,r,s}} \tag{30}$$

$$RECEXP_{i,r} = (1 + taxp_{i,r}) \times P\_Y_{i,r} \times NB_{i,r} \times \sum_s (taxex_{i,r,s} + taxamf_{i,r,s}) \frac{DEMV_{i,r,s}}{1 + PED_{i,r,s}}$$

$$RECDD_{i,s} = \sum_r NB_{i,r} \times PCIF_{i,r,s} \times \frac{DEMV_{i,r,s}}{1 + PED_{i,r,s}} \tag{31}$$

$$RECCONS_{i,r} = P\_DEMT_{i,r} \times \begin{pmatrix} taxcc_{i,j,r} \times \times FC_{i,r} + taxkg_{i,j,r} \times KG_{i,r} \\ + \sum_j taxicc_{i,j,r} \times IC_{i,j,r} \end{pmatrix} \tag{32}$$

Factor mobility

$$\begin{aligned} P\_SLbar_r &= P\_SL_{j,r} \\ P\_ULbar_r &= P\_UL_{j,r} \end{aligned} \tag{33}$$

Subsidized factors

$$\begin{aligned} WTE_{i,r} &= P\_TE_{j,r} + subvT_{i,r} \\ WKA_{i,r} &= P\_KA_{j,r} + subvK_{i,r} + \frac{PROFIT_{i,r}}{KA_{i,r}} \end{aligned} \tag{34}$$

Price definition

$$P\_DEM_{i,r,s} = PCIF_{i,r,s} \times (1 + DD_{i,r,s}) \tag{35}$$

$$PCIF_{i,r,s} = (1 + taxp_{i,r})(1 + taxex_{i,r,s} + taxamf_{i,r,s}) \frac{P\_Y_{i,r}}{1 + PED_{i,r,s}} + \mu_{i,r} PT \tag{36}$$

Regional equilibrium

$$REV_r + SOLD_r = \sum_i (RECPROD_{i,r} + RECEXP_{i,r} + RECDD_{i,r} + RECCONS_{i,r}) + \sum_i (P\_RN_{i,r} \times RN_{i,r} + WTE_{i,r} \times TE_{i,r} + WK_{i,r} \times KA_{i,r}) + SLbar_r \times P\_SLbar_r + ULbar_r \times P\_ULbar_r$$

$$sav_r \times REV_r = INV_r \tag{37}$$

Monpolitistic competition specification

Perceived price-elasticity of demand by a firm of sector i from region r in market s

$$PED_{i,r,s} = \frac{\partial P\_DEMV_{i,r,s}}{\partial DEMV_{i,r,s}} \times \frac{DEMV_{i,r,s}}{P\_DEMV_{i,r,s}} = -\frac{1}{\sigma_{VAR,i}} \tag{38}$$

Cournot oligopoly specification

Market share of region r's sector i on market s:

$$shST_{i,r,s} = \frac{P\_DEM_{i,r,s} \times DEM_{i,r,s}}{\sum_r P\_DEM_{i,r,s} \times DEM_{i,r,s}} \tag{39}$$

Market share of region r's sector i in the imported market of s:

$$shSE_{i,r,s} = \frac{P\_DEM_{i,r,s} \times DEM_{i,r,s}}{\sum_r^{r \neq s} P\_DEM_{i,r,s} \times DEM_{i,r,s}}, \forall r \neq s \tag{40}$$

Perceived price-elasticity of demand by a firm of sector i from region r in market s:

$$\begin{aligned} PED_{i,r,s} &= \frac{\partial P\_DEMV_{i,r,s}}{\partial DEMV_{i,r,s}} \times \frac{DEMV_{i,r,s}}{P\_DEMV_{i,r,s}} \\ &= \frac{1}{NB_{i,r}} \left(\begin{array}{c} \frac{1}{\sigma_{VAR,i}} - \frac{1}{\sigma_{IMP,i}} \\ + \left(\frac{1}{\sigma_{IMP,i}} - \frac{1}{\sigma_{ARM,i}}\right) \times shSE_{i,r,s} \\ + \left(\frac{1}{\sigma_{ARM,i}} - 1\right) \times shST_{i,r,s} \end{array} \right) - \frac{1}{\sigma_{VAR,i}} \ \forall r \neq s \end{aligned} \tag{41}$$

Perceived price-elasticity of demand by a firm of sector i from region r in market r:

$$PED_{i,r,r} = \frac{1}{NB_{i,r}} \left(\left(\frac{1}{\sigma_{VAR,i}} - \frac{1}{\sigma_{ARM,i}} \right) + \left(\frac{1}{\sigma_{ARM,i}} - 1 \right) \times shST_{i,r,s} \right) - \frac{1}{\sigma_{VAR,i}} \tag{42}$$

Cournot oligopsony specification

Market share of region r's sector i on market s:

$$shO_{i,r,s} = \frac{P\_DEM_{i,r,s} \times DEM_{i,r,s}}{P\_DEMT_{i,s} \times DEMT_{i,s}} \tag{43}$$

Market share of region r's sector j as buyer of agricultural input i on the r market s:

$$shP_{i,j,r} = \frac{IC_{i,j,r}}{DEMT_{i,r}}, \forall i \in AGRI \text{ and } \forall j \in IA \tag{44}$$

Perceived price-elasticity of supply of good i by the sector j of sector i from region r in market s:

$$PES_{i,j,r} = \frac{1}{\sum_s shO_{i,s,r} \times ES_{i,s}} shP_{i,j,r} \tag{45}$$

Moreover Equation (1) for agrifood sectors becomes :

$$P\_Y_{i,r}(Y_{i,r} + fct_{i,r}) = P\_VA_{i,r} \times VA_{i,r} + P\_ICN_{i,r} \times ICN_{i,r} + IC_{i,j,r} + \sum_{j \in AGRI} P\_IC_{j,i,r} \times IC_{j,i,r} \times PES_{j,i,r}$$

Appendix 3

Table 13: Elasticity of Substitution

Parameters	**Value**
$\sigma_{VA}(i)$	1.1
$\sigma_{VA}(i)$ if i is an agricultural sector	0.5
$\sigma_{A}(i)$	0.6
$\sigma_{A}(i)$if i is an agricultural sector	0.4
$\sigma_{IC1}(i)$	0.4
$\sigma_{IC1}(i)$ if i is an agrifood sector	0.3
$\sigma_{IC2}(i)$	0.6
$\sigma_{IC2}(i)$if i is an agrifood sector	0.5
σ_{KG}	0.6
σ_{D}	0.4
σ_{DA}	0.6
σ_{DO}	0.6

Source : author's calculations, based on the average of the values provided by the references cited in the text.

Table 14: Minimul level of consumption

Parameters	**Share of initial consumption level**
$\underline{CA2}_{i,r}$ if r is EU, NAFTA or Cairnes group.	1/3
$\underline{CA2}_{i,r}$ if r is not EU, NAFTA or Cairnes group.	2/3
$\underline{CO2}_{i,r}$ if r is EU, NAFTA or Cairnes group.	1/3
$\underline{CO2}_{i,r}$ if r is not EU, NAFTA or Cairnes group.	2/3

Table 15: Demand Elasticity of Substitution - Second Stage

Sectors	σ_{ARM}	σ_{IMP}	σ_{VAR}
Paddy rice	3.40	4.40	5.81
Wheat	3.40	4.40	5.81
Cereal grains nec	3.40	4.40	5.81
Vegetables and fruits	3.40	4.40	5.81
Oil seeds	3.40	4.40	5.81
Sugar cane and sugar beet	3.40	4.40	5.81
Plant-based fibers	3.40	4.40	5.81
Crops nec	3.40	4.40	5.81
Cattle	4.25	5.60	7.51
Animal products nec	4.25	5.60	7.51
Raw milk	3.40	4.40	5.81
Wool	3.40	4.40	5.81
Forestry	4.25	5.60	7.51
Fishing	4.25	5.60	7.51
Mineral Raw products	4.25	5.60	7.51
Meat (cattle)	3.40	4.40	5.81
Meat products nec	3.40	4.40	5.81
Vegetable oils and fats	3.40	4.40	5.81
Dairy products	3.40	4.40	5.81
Processed rice	3.40	4.40	5.81
Sugar	3.40	4.40	5.81
Food products nec	3.40	4.40	5.81
Beverages and tobacco products	4.68	6.20	8.35
Textile and clothing	5.09	6.78	9.17
Wood products	4.25	5.60	7.51
Paper products and publishing	2.84	3.60	4.68
Chemicals	2.98	3.80	4.96
Metal products	4.25	5.60	7.51
Transport equipments	7.65	10.40	14.29
Other manufactured products	4.25	5.60	7.51
Trade	2.98	3.80	4.96
Energy	4.25	5.60	7.51
Services	2.98	3.80	4.96
Transport	2.98	3.80	4.96

Source : author's calculations and GTAP V5.3. σ_{IMP} is given by GTAP database and the other substitution elasticities are linked by the following relationships : $\sigma_{IMP} - 1 = \sqrt{2}\,(\sigma_{ARM} - 1)\,; \sigma_{VAR} - 1 = \sqrt{2}\,(\sigma_{IMP} - 1)$.

Table 16: Equivalent number of firms

Sectors	European Union	Candidate countries	Rest of the world	Subsaharian africa	Cairnes Group	NAFTA	Asia	Mediterranean countries
Mineral Raw products	63.63	7.45	2.25	1.80	9.33	19.99	12.27	0.95
Meat (cattle)	332.17	118.66	138.18	149.91	139.79	328.98	349.74	97.88
Meat products nec	213.36	53.10	111.34	222.80	211.47	332.76	261.61	464.04
Vegetable oils and fats	51.10	17.21	13.94	21.96	30.52	152.79	28.77	34.54
Dairy products	50.89	23.35	26.00	93.79	43.95	99.54	98.12	34.31
Processed rice	2340.23	127.58	56.52	12.85	142.03	2654.41	24.26	88.80
Sugar	71.97	10.70	26.71	12.10	21.65	165.08	29.10	6.72
Food products nec	20.72	6.52	8.67	7.61	12.59	23.77	9.70	6.27
Beverages and tobacco products	19.55	3.89	5.38	7.50	17.06	23.01	7.94	8.86
Wood products	281.23	80.33	159.41	153.39	215.52	195.14	235.09	143.29
Paper products and publishing	39.11	23.43	29.22	31.11	43.63	37.35	26.71	29.90
Chemicals	22.48	11.25	11.51	13.82	19.97	22.97	11.53	8.68
Metal products	27.86	11.28	13.18	14.10	24.90	38.16	12.78	17.17
Transport equipments	8.95	5.36	5.16	10.52	11.61	8.53	4.78	12.14
Other manufactured products	15.84	10.48	12.20	23.69	32.12	19.11	6.19	18.02
Trade	16.49	13.42	9.98	9.92	22.47	14.68	8.15	9.69

Source : author's calculations, based on the references cited in the text.

Table 17: Computed Supply Elasitcity of agricultural sector

Sectors	European Union	Candidate countries	Rest of the world	Subsaharian africa	Cairnes Group	NAFTA	Asia	Mediterranean countries
Paddy rice	2.30	4.61	1.38	2.16	0.40	0.54	0.65	1.28
Wheat	1.81	1.25	1.28	1.83	0.58	0.56	0.85	0.99
Cereal grains nec	1.73	1.40	0.78	1.27	0.48	0.61	0.70	1.01
Vegetables and fruits	1.69	1.07	0.79	1.35	0.44	0.58	0.76	1.02
Oil seeds	1.49	1.42	0.98	1.58	0.39	0.55	0.55	1.00
Sugar cane and sugar beet	1.83	1.39	0.95	2.04	0.35	0.47	0.48	1.05
Plant-based fibers	3.71	9.12	2.60	1.99	1.35	0.73	0.69	1.39
Crops nec	1.55	1.72	0.65	1.67	0.47	0.42	0.64	1.11
Cattle	2.34	1.96	1.19	1.83	0.54	1.54	0.93	1.01
Animal products nec	3.78	2.28	1.34	1.72	0.46	1.28	1.35	1.14
Raw milk	1.88	2.18	1.09	1.63	0.57	1.53	0.61	1.10
Wool	3.16	4.80	1.85	2.11	0.86	4.44	1.01	2.02

Source : author's calculations

Strong variations across regions come from the capital and land factors specificity and regional production structure.

Appendix 4

Macroeconomic results. Given as a percentage of benchmark values.

Table 18: Welfare

Regions	Scenario 1								Scenario 2								Scenario 3							
	Exogeneous number of firms				Free entry/exit				Exogeneous number of firms				Free entry/exit				Exogeneous number of firms				Free entry/exit			
	PC	MC	CO	OLI	PC	MC	CO	OLI	PC	MC	CO	OLI	PC	MC	CO	OLI	PC	MC	CO	OLI	PC	MC	CO	OLI
Europ. Union	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.03	0.17	0.11	0.11	0.15	0.18	0.11	0.11	0.15	0.17	0.11	0.11	0.15	0.18	0.11	0.11	0.15
Med. count.	-0.06	-0.07	-0.09	-0.06	-0.06	-0.08	-0.10	-0.06	-0.37	-0.29	-0.31	-0.32	-0.38	-0.30	-0.41	-0.33	-0.37	-0.29	-0.31	-0.32	-0.38	-0.30	-0.41	-0.33
Cand. count.	-0.01	-0.02	-0.04	-0.01	-0.01	-0.03	-0.03	-0.02	-0.15	0.05	0.03	-0.11	-0.17	0.07	0.04	-0.13	-0.15	0.05	0.03	-0.11	-0.17	0.07	0.04	-0.13
Subs. Af.	0.01	0.00	-0.01	0.00	0.01	-0.01	-0.01	0.00	-0.06	0.12	0.10	0.03	-0.07	0.15	0.12	0.01	-0.06	0.12	0.10	0.03	-0.07	0.15	0.12	0.01
NAFTA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.02	-0.01	-0.01	-0.01	-0.02	-0.01	-0.01	-0.01	-0.02	-0.01	-0.01	-0.01	-0.02	-0.01	-0.01	-0.01
Cairnes Gr.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.05	0.09	0.00	0.06	0.06	0.09	0.00	0.05	0.05	0.09	0.00	0.06	0.06	0.09
Asia	-0.02	-0.02	-0.03	-0.02	-0.02	-0.03	-0.03	-0.03	-0.08	-0.06	-0.06	-0.06	-0.08	-0.05	-0.06	-0.06	-0.08	-0.06	-0.06	-0.06	-0.08	-0.05	-0.06	-0.06
RoW	0.02	0.01	0.01	0.02	0.02	0.01	0.01	0.02	-0.13	-0.03	-0.05	-0.10	-0.14	-0.03	-0.05	-0.11	-0.13	-0.03	-0.05	-0.10	-0.14	-0.03	-0.05	-0.11

Table 19: Raw agrigultural products Price Index

Regions	Scenario 1								Scenario 2								Scenario 3							
	Exogeneous number of firms				Free entry/exit				Exogeneous number of firms				Free entry/exit				Exogeneous number of firms				Free entry/exit			
	PC	MC	CO	OLI	PC	MC	CO	OLI	PC	MC	CO	OLI	PC	MC	CO	OLI	PC	MC	CO	OLI	PC	MC	CO	OLI
Europ. Union	-0.82	-0.82	-0.82	-0.83	-0.82	-0.82	-0.82	-0.83	-1.61	-1.52	-1.51	-1.57	-1.62	-1.58	-1.57	-1.57	-1.61	-1.52	-1.51	-1.57	-1.62	-1.58	-1.57	-1.57
Med. count.	0.52	0.52	0.52	0.51	0.51	0.51	0.51	0.50	1.35	1.31	1.31	1.33	1.29	1.31	1.31	1.28	1.35	1.31	1.31	1.33	1.29	1.31	1.31	1.28
Cand. count.	0.20	0.20	0.20	0.20	0.20	0.19	0.19	0.19	0.97	0.95	0.95	0.95	0.92	0.97	0.96	0.91	0.97	0.95	0.95	0.95	0.92	0.97	0.96	0.91
Subs. Af.	0.41	0.42	0.42	0.41	0.40	0.40	0.40	0.40	1.42	1.40	1.40	1.41	1.37	1.46	1.45	1.36	1.42	1.40	1.40	1.41	1.37	1.46	1.45	1.36
NAFTA	0.46	0.46	0.46	0.46	0.45	0.45	0.45	0.45	1.78	1.71	1.72	1.63	1.74	1.75	1.76	1.59	1.78	1.71	1.72	1.63	1.74	1.75	1.76	1.59
Cairnes Gr.	0.42	0.43	0.43	0.43	0.42	0.42	0.42	0.42	1.11	1.07	1.07	1.04	1.08	1.04	1.05	1.02	1.11	1.07	1.07	1.04	1.08	1.04	1.05	1.02
Asia	0.21	0.21	0.21	0.21	0.20	0.21	0.21	0.21	0.78	0.75	0.76	0.74	0.74	0.72	0.73	0.71	0.78	0.75	0.76	0.74	0.74	0.72	0.73	0.71
RoW	0.48	0.49	0.49	0.48	0.48	0.47	0.47	0.47	1.28	1.25	1.23	1.25	1.24	1.29	1.26	1.21	1.28	1.25	1.23	1.25	1.24	1.29	1.26	1.21

Table 20: Agrifood products Price Index

Regions	Scenario 1								Scenario 2								Scenario 3							
	Exogeneous number of firms				Free entry/exit				Exogeneous number of firms				Free entry/exit				Exogeneous number of firms				Free entry/exit			
	PC	MC	CO	OLI	PC	MC	CO	OLI	PC	MC	CO	OLI	PC	MC	CO	OLI	PC	MC	CO	OLI	PC	MC	CO	OLI
Europ. Union	-0.03	-0.03	-0.03	-0.19	-0.03	-0.04	-0.04	-0.19	-0.56	-0.53	-0.54	-1.91	-0.56	-0.45	-0.45	-1.92	-0.56	-0.53	-0.54	-1.91	-0.56	-0.45	-0.45	-1.92
Med. count.	0.14	0.14	0.14	0.16	0.13	0.14	0.14	0.15	1.08	1.05	1.05	1.40	1.03	0.87	0.88	1.35	1.08	1.05	1.05	1.40	1.03	0.87	0.88	1.35
Cand. count.	0.09	0.09	0.09	0.09	0.08	0.09	0.09	0.08	1.07	1.04	1.04	1.43	1.03	0.93	0.94	1.39	1.07	1.04	1.04	1.43	1.03	0.93	0.94	1.39
Subs. Af.	0.16	0.16	0.16	0.16	0.15	0.16	0.16	0.16	1.28	1.27	1.27	1.54	1.24	1.13	1.15	1.49	1.28	1.27	1.27	1.54	1.24	1.13	1.15	1.49
NAFTA	0.16	0.16	0.16	0.21	0.15	0.16	0.16	0.21	1.25	1.22	1.22	1.44	1.21	1.11	1.13	1.40	1.25	1.22	1.22	1.44	1.21	1.11	1.13	1.40
Cairnes Gr.	0.10	0.10	0.10	0.17	0.10	0.10	0.10	0.17	0.55	0.54	0.55	0.79	0.52	0.49	0.49	0.76	0.55	0.54	0.55	0.79	0.52	0.49	0.49	0.76
Asia	0.10	0.10	0.10	0.14	0.09	0.10	0.10	0.13	0.58	0.57	0.57	0.72	0.55	0.50	0.51	0.69	0.58	0.57	0.57	0.72	0.55	0.50	0.51	0.69
RoW	0.15	0.16	0.16	0.19	0.15	0.17	0.16	0.19	1.13	1.12	1.13	1.49	1.10	0.99	0.98	1.46	1.13	1.12	1.13	1.49	1.10	0.99	0.98	1.46

Table 21: Real return to capital

Regions	Scenario 1								Scenario 2								Scenario 3							
	Exogeneous number of firms				Free entry/exit				Exogeneous number of firms				Free entry/exit				Exogeneous number of firms				Free entry/exit			
	PC	MC	CO	OLI	PC	MC	CO	OLI	PC	MC	CO	OLI	PC	MC	CO	OLI	PC	MC	CO	OLI	PC	MC	CO	OLI
Europ. Union	0.03	0.03	0.04	0.03	0.02	0.03	0.03	0.03	0.13	0.04	0.04	0.09	0.10	0.05	0.04	0.06	-0.12	-0.21	-0.21	-0.16	-0.15	-0.20	-0.21	-0.19
Med. count.	0.00	-0.02	-0.03	0.00	0.00	-0.01	-0.02	0.00	-0.05	0.02	0.00	-0.02	-0.04	-0.01	-0.06	-0.01	-0.05	0.02	0.00	-0.02	-0.04	-0.01	-0.06	-0.01
Cand. count.	-0.05	-0.06	-0.08	-0.05	-0.04	-0.05	-0.05	-0.04	0.01	0.19	0.16	0.04	0.05	0.15	0.14	0.08	0.01	0.19	0.16	0.04	0.05	0.15	0.14	0.08
Subs. Af.	-0.02	-0.03	-0.04	-0.02	-0.01	-0.02	-0.02	-0.01	0.01	0.17	0.14	0.07	0.05	0.13	0.12	0.11	0.01	0.17	0.14	0.07	0.05	0.13	0.12	0.11
NAFTA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.02	0.02	0.01	0.02	0.02	0.03	0.01	0.02	0.02	0.02	0.01	0.02	0.02	0.03
Cairnes Gr.	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.10	0.17	0.16	0.21	0.12	0.16	0.16	0.23	0.10	0.17	0.16	0.21	0.12	0.16	0.16	0.23
Asia	0.00	-0.01	-0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.04	0.03	0.03	0.02	0.03	0.03	0.04	0.02	0.04	0.03	0.03	0.02	0.03	0.03	0.04
RoW	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.11	0.08	0.04	0.04	0.08	0.07	0.06	0.02	0.11	0.08	0.04	0.04	0.08	0.07	0.06

Table 22: Real return to land

Regions	Scenario 1								Scenario 2								Scenario 3							
	Exogeneous number of firms				Free entry/exit				Exogeneous number of firms				Free entry/exit				Exogeneous number of firms				Free entry/exit			
	PC	MC	CO	OLI	PC	MC	CO	OLI	PC	MC	CO	OLI	PC	MC	CO	OLI	PC	MC	CO	OLI	PC	MC	CO	OLI
Europ. Union	-0.98	-0.99	-0.99	-1.00	-0.99	-0.98	-0.98	-1.00	-1.76	-1.66	-1.65	-1.70	-1.78	-1.81	-1.81	-1.72	-7.29	-7.18	-7.17	-7.22	-7.30	-7.34	-7.33	-7.24
Med. count.	0.20	0.20	0.20	0.19	0.20	0.19	0.19	0.19	0.28	0.24	0.22	0.25	0.30	0.36	0.36	0.27	0.28	0.24	0.22	0.25	0.30	0.36	0.36	0.27
Cand. count.	0.39	0.39	0.39	0.39	0.40	0.39	0.39	0.39	0.35	0.32	0.31	0.34	0.38	0.47	0.46	0.37	0.35	0.32	0.31	0.34	0.38	0.47	0.46	0.37
Subs. Af.	0.14	0.14	0.14	0.13	0.14	0.14	0.14	0.14	0.50	0.42	0.40	0.46	0.53	0.69	0.66	0.49	0.50	0.42	0.40	0.46	0.53	0.69	0.66	0.49
NAFTA	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.14	0.10	0.10	0.06	0.16	0.15	0.15	0.08	0.14	0.10	0.10	0.06	0.16	0.15	0.15	0.08
Cairnes Gr.	0.12	0.13	0.12	0.12	0.13	0.13	0.12	0.12	0.14	0.09	0.09	0.03	0.17	0.19	0.18	0.06	0.14	0.09	0.09	0.03	0.17	0.19	0.18	0.06
Asia	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.04	0.02	0.01	0.00	0.05	0.06	0.06	0.02	0.04	0.02	0.01	0.00	0.05	0.06	0.06	0.02
RoW	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.00	-0.03	-0.03	-0.02	0.02	0.07	0.06	0.00	0.00	-0.03	-0.03	-0.02	0.02	0.07	0.06	0.00

Table 23: Import (volume)

Regions	Scenario 1								Scenario 2								Scenario 3							
	Exogeneous number of firms				Free entry/exit				Exogeneous number of firms				Free entry/exit				Exogeneous number of firms				Free entry/exit			
	PC	MC	CO	OLI	PC	MC	CO	OLI	PC	MC	CO	OLI	PC	MC	CO	OLI	PC	MC	CO	OLI	PC	MC	CO	OLI
Europ. Union	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.85	0.86	0.85	0.86	0.87	0.90	0.88	0.88	0.85	0.86	0.85	0.86	0.87	0.90	0.88	0.88
Med. count.	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.14	0.14	0.13	0.14	0.13	0.12	0.11	0.14	0.14	0.14	0.13	0.14	0.13	0.12	0.11	0.14
Cand. count.	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.37	0.38	0.36	0.37	0.35	0.36	0.36	0.35	0.37	0.38	0.36	0.37	0.35	0.36	0.36	0.35
Subs. Af.	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.81	0.84	0.82	0.83	0.80	0.88	0.87	0.82	0.81	0.84	0.82	0.83	0.80	0.88	0.87	0.82
NAFTA	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
Cairnes Gr.	0.13	0.13	0.13	0.13	0.14	0.13	0.13	0.13	0.93	0.96	0.95	0.98	0.93	1.00	1.00	0.99	0.93	0.96	0.95	0.98	0.93	1.00	1.00	0.99
Asia	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.13	0.13	0.13	0.13	0.12	0.12	0.12	0.12	0.13	0.13	0.13	0.13	0.12	0.12	0.12	0.12
RoW	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.46	0.47	0.45	0.46	0.45	0.47	0.46	0.46	0.46	0.47	0.45	0.46	0.45	0.47	0.46	0.46

Table 24: Export (volume)

Regions	Scenario 1								Scenario 2								Scenario 3							
	Exogeneous number of firms				Free entry/exit				Exogeneous number of firms				Free entry/exit				Exogeneous number of firms				Free entry/exit			
	PC	MC	CO	OLI	PC	MC	CO	OLI	PC	MC	CO	OLI	PC	MC	CO	OLI	PC	MC	CO	OLI	PC	MC	CO	OLI
Europ. Union	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.76	0.77	0.76	0.77	0.77	0.80	0.78	0.78	0.76	0.77	0.76	0.77	0.77	0.80	0.78	0.78
Med. count.	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.14	0.14	0.13	0.14	0.13	0.12	0.10	0.13	0.14	0.14	0.13	0.14	0.13	0.12	0.10	0.13
Cand. count.	0.12	0.12	0.11	0.12	0.11	0.11	0.11	0.11	0.56	0.58	0.56	0.57	0.54	0.55	0.54	0.54	0.56	0.58	0.56	0.57	0.54	0.55	0.54	0.54
Subs. Af.	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.87	0.90	0.89	0.89	0.86	0.95	0.93	0.88	0.87	0.90	0.89	0.89	0.86	0.95	0.93	0.88
NAFTA	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.22	0.22	0.22	0.22	0.21	0.21	0.22	0.22	0.22	0.22	0.22	0.22	0.21	0.21	0.22	0.22
Cairnes Gr.	0.18	0.17	0.17	0.17	0.18	0.17	0.17	0.17	1.20	1.24	1.23	1.27	1.21	1.29	1.29	1.27	1.20	1.24	1.23	1.27	1.21	1.29	1.29	1.27
Asia	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.05	0.05	0.05	0.05	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.04	0.05	0.05	0.05
RoW	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.41	0.42	0.40	0.41	0.40	0.42	0.41	0.41	0.41	0.42	0.40	0.41	0.40	0.42	0.41	0.41

Table 25: Terms of Trade

Regions	Scenario 1								Scenario 2								Scenario 3							
	Exogeneous number of firms				Free entry/exit				Exogeneous number of firms				Free entry/exit				Exogeneous number of firms				Free entry/exit			
	PC	MC	CO	OLI	PC	MC	CO	OLI	PC	MC	CO	OLI	PC	MC	CO	OLI	PC	MC	CO	OLI	PC	MC	CO	OLI
Europ. Union	-0.05	-0.03	-0.03	-0.05	-0.04	-0.02	-0.02	-0.04	-0.05	-0.29	-0.27	-0.04	0.01	-0.27	-0.25	0.01	-0.05	-0.29	-0.27	-0.04	0.01	-0.27	-0.25	0.01
Med. count.	-0.04	-0.04	-0.05	-0.03	-0.04	-0.05	-0.06	-0.04	-0.19	-0.14	-0.15	-0.19	-0.22	-0.15	-0.17	-0.22	-0.19	-0.14	-0.15	-0.19	-0.22	-0.15	-0.17	-0.22
Cand. count.	0.02	0.01	0.01	0.02	0.01	0.00	0.00	0.01	0.08	0.23	0.24	0.08	0.02	0.20	0.21	0.01	0.08	0.23	0.24	0.08	0.02	0.20	0.21	0.01
Subs. Af.	0.05	0.04	0.04	0.05	0.04	0.03	0.02	0.04	0.08	0.31	0.31	0.07	0.03	0.33	0.31	0.02	0.08	0.31	0.31	0.07	0.03	0.33	0.31	0.02
NAFTA	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.03	0.08	0.08	0.03	0.02	0.07	0.08	0.02	0.03	0.08	0.08	0.03	0.02	0.07	0.08	0.02
Cairnes Gr.	0.07	0.06	0.06	0.07	0.07	0.05	0.05	0.07	0.36	0.64	0.64	0.33	0.34	0.65	0.66	0.30	0.36	0.64	0.64	0.33	0.34	0.65	0.66	0.30
Asia	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.04	0.00	0.00	-0.04	-0.05	-0.01	-0.01	-0.05	-0.04	0.00	0.00	-0.04	-0.05	-0.01	-0.01	-0.05
RoW	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.01	-0.08	0.03	0.03	-0.09	-0.13	0.02	0.02	-0.13	-0.08	0.03	0.03	-0.09	-0.13	0.02	0.02	-0.13

Appendix 5

Sectorial impacts. Given as a percentage of benchmark values.

Table 26: Production's Variations

Sectors	Scenario 1								Scenario 2							
	Exogeneous number of firms				Free entry/exit				Exogeneous number of firms				Free entry/exit			
	PC	MC	CO	OLI	PC	MC	CO	OLI	PC	MC	CO	OLI	PC	MC	CO	OLI
Paddy rice	-13.60	-13.70	-13.70	-13.70	-13.60	-13.50	-13.50	-13.80	-17.30	-17.00	-17.00	-17.10	-17.40	-17.70	-17.70	-17.20
Wheat	-4.68	-4.68	-4.68	-4.81	-4.69	-4.69	-4.69	-4.82	-5.47	-5.36	-5.32	-5.54	-5.51	-5.46	-5.45	-5.58
Cereal grains nec	-5.57	-5.58	-5.57	-5.62	-5.57	-5.58	-5.58	-5.62	-6.38	-6.27	-6.25	-6.37	-6.41	-6.36	-6.35	-6.40
Vegetables and fruits	-2.14	-2.14	-2.14	-2.14	-2.14	-2.15	-2.15	-2.15	-2.23	-2.21	-2.20	-2.22	-2.26	-2.22	-2.21	-2.25
Oil seeds	-0.06	-0.06	-0.06	-0.07	-0.07	-0.07	-0.07	-0.07	-0.25	-0.21	-0.20	-0.25	-0.29	-0.25	-0.24	-0.29
Sugar cane and sugar beet	-0.87	-0.88	-0.88	-0.90	-0.88	-0.87	-0.87	-0.91	-7.08	-6.44	-6.37	-6.72	-7.11	-7.39	-7.32	-6.74
Plant-based fibers	0.18	0.18	0.18	0.17	0.16	0.16	0.16	0.16	0.89	0.88	0.89	0.89	0.82	0.85	0.85	0.82
Crops nec	-0.48	-0.48	-0.48	-0.48	-0.48	-0.49	-0.49	-0.49	-0.79	-0.74	-0.72	-0.75	-0.82	-0.78	-0.77	-0.79
Cattle	-1.29	-1.32	-1.32	-1.33	-1.29	-1.30	-1.30	-1.33	-4.91	-4.43	-4.41	-4.60	-4.94	-4.95	-4.94	-4.62
Animal products nec	-0.24	-0.25	-0.25	-0.24	-0.24	-0.24	-0.24	-0.25	-0.46	-0.41	-0.40	-0.42	-0.49	-0.56	-0.57	-0.45
Raw milk	-0.11	-0.11	-0.11	-0.12	-0.11	-0.11	-0.11	-0.13	-2.37	-2.09	-2.06	-2.18	-2.39	-2.35	-2.34	-2.20
Wool	0.52	0.52	0.52	0.52	0.50	0.51	0.51	0.51	1.73	1.67	1.68	1.67	1.66	1.62	1.62	1.61
Meat (cattle)	0.28	0.29	0.29	0.37	0.28	0.27	0.27	0.37	-5.41	-5.63	-5.62	-5.69	-5.43	-5.48	-5.48	-5.71
Meat products nec	0.15	0.16	0.16	0.19	0.15	0.15	0.15	0.19	-0.85	-0.89	-0.89	-0.85	-0.87	-0.89	-0.89	-0.86
Vegetable oils and fats	-0.01	-0.01	-0.01	-0.00	-0.01	-0.00	-0.00	-0.01	-1.09	-1.14	-1.12	-1.20	-1.11	-1.17	-1.16	-1.22
Dairy products	0.00	0.01	0.01	0.02	0.00	0.00	0.00	0.01	-2.79	-2.93	-2.94	-2.93	-2.81	-2.81	-2.84	-2.94
Processed rice	4.36	4.59	4.58	5.96	4.35	4.70	4.69	5.96	-10.60	-11.20	-11.10	-10.50	-10.70	-12.00	-12.00	-10.50
Sugar	0.14	0.15	0.15	0.20	0.13	0.15	0.15	0.19	-8.57	-9.21	-9.20	-9.30	-8.60	-9.22	-9.21	-9.33
Food products nec	0.15	0.15	0.15	0.20	0.14	0.15	0.16	0.20	-2.13	-2.21	-2.17	-2.12	-2.15	-2.26	-2.24	-2.15
Beverages and tobacco products	0.06	0.07	0.07	0.07	0.06	0.06	0.07	0.06	-0.01	-0.03	-0.02	-0.02	-0.03	-0.03	-0.00	-0.03
Trade	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.07	0.05	0.05	0.06	0.05	0.04	0.04	0.04

Table 27: Consumer's price

Sectors	Scenario 1								Scenario 2							
	Exogeneous number of firms				Free entry/exit				Exogeneous number of firms				Free entry/exit			
	PC	MC	CO	OLI	PC	MC	CO	OLI	PC	MC	CO	OLI	PC	MC	CO	OLI
Meat (cattle)	-0.34	-0.35	-0.35	-0.45	-0.34	-0.40	-0.40	-0.45	-4.28	-4.07	-4.07	-4.15	-4.28	-3.26	-3.25	-4.15
Meat products nec	-0.22	-0.23	-0.23	-0.27	-0.22	-0.26	-0.26	-0.27	-1.15	-1.09	-1.10	-1.16	-1.15	-0.91	-0.90	-1.16
Vegetable oils and fats	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	-1.16	-1.08	-1.07	-1.08	-1.17	-0.95	-0.93	-1.09
Dairy products	-0.01	-0.01	-0.01	-0.03	-0.01	-0.01	-0.01	-0.03	-2.28	-2.09	-2.10	-2.13	-2.28	-1.67	-1.67	-2.12
Processed rice	-2.14	-2.26	-2.27	-2.95	-2.15	-2.79	-2.80	-2.95	-12.00	-11.80	-11.80	-12.10	-12.00	-10.70	-10.70	-12.10
Sugar	-0.04	-0.05	-0.05	-0.08	-0.04	-0.05	-0.06	-0.08	-8.71	-8.17	-8.15	-8.25	-8.73	-7.55	-7.49	-8.26
Food products nec	-0.20	-0.21	-0.21	-0.26	-0.20	-0.23	-0.23	-0.26	-2.11	-1.99	-2.03	-2.10	-2.11	-1.67	-1.65	-2.10
Beverages and tobacco products	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.37	-0.37	-0.37	-0.37	-0.38	-0.37	-0.36	-0.38
Trade	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.03	0.12	0.12	0.12	0.12	0.13	0.09	0.09	0.12

Table 28: Producer's Price

	Scenario 1								Scenario 2							
Sectors	Exogeneous number of firms				Free entry/exit				Exogeneous number of firms				Free entry/exit			
	PC	MC	CO	OLI	PC	MC	CO	OLI	PC	MC	CO	OLI	PC	MC	CO	OLI
Paddy rice	-6.28	-6.33	-6.34	-6.35	-6.28	-6.25	-6.25	-6.35	-7.51	-7.39	-7.38	-7.45	-7.52	-7.67	-7.66	-7.45
Wheat	-2.62	-2.62	-2.62	-2.69	-2.62	-2.62	-2.62	-2.69	-2.94	-2.88	-2.86	-2.98	-2.95	-2.96	-2.95	-2.99
Cereal grains nec	-3.23	-3.24	-3.24	-3.25	-3.23	-3.23	-3.23	-3.25	-3.56	-3.50	-3.49	-3.56	-3.57	-3.58	-3.57	-3.57
Vegetables and fruits	-1.32	-1.32	-1.32	-1.32	-1.32	-1.32	-1.32	-1.32	-1.27	-1.26	-1.25	-1.26	-1.27	-1.28	-1.28	-1.27
Oil seeds	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.05	-0.02	-0.01	-0.05	-0.06	-0.07	-0.06	-0.06
Sugar cane and sugar beet	-0.47	-0.47	-0.47	-0.48	-0.47	-0.46	-0.46	-0.48	-3.55	-3.23	-3.19	-3.37	-3.55	-3.72	-3.69	-3.37
Plant-based fibers	0.03	0.03	0.03	0.04	0.03	0.03	0.03	0.03	0.29	0.28	0.29	0.29	0.27	0.27	0.26	0.27
Crops nec	-0.31	-0.31	-0.31	-0.30	-0.31	-0.31	-0.31	-0.31	-0.40	-0.37	-0.36	-0.38	-0.41	-0.42	-0.41	-0.39
Cattle	-0.74	-0.76	-0.76	-0.77	-0.74	-0.75	-0.75	-0.77	-2.67	-2.43	-2.43	-2.53	-2.67	-2.61	-2.61	-2.52
Animal products nec	-0.57	-0.57	-0.57	-0.59	-0.57	-0.58	-0.58	-0.59	-1.39	-1.32	-1.33	-1.37	-1.40	-1.26	-1.25	-1.38
Raw milk	-0.22	-0.22	-0.22	-0.23	-0.22	-0.22	-0.22	-0.23	-1.69	-1.51	-1.50	-1.58	-1.68	-1.62	-1.61	-1.58

Table 29: Real return to specific factors

	Scenario 2								Scenario 3							
Sectors	Exogeneous number of firms				Free entry/exit				Exogeneous number of firms				Free entry/exit			
	PC	MC	CO	OLI	PC	MC	CO	OLI	PC	MC	CO	OLI	PC	MC	CO	OLI
Paddy rice	-33.10	-32.60	-32.60	-32.90	-33.20	-33.70	-33.70	-32.90	-44.30	-43.80	-43.70	-44.00	-44.30	-44.90	-44.80	-44.10
Wheat	-2.89	-2.83	-2.82	-2.92	-2.90	-2.88	-2.88	-2.94	-43.70	-43.60	-43.60	-43.70	-43.70	-43.70	-43.70	-43.70
Cereal grains nec	-3.38	-3.33	-3.32	-3.38	-3.39	-3.38	-3.37	-3.39	-44.00	-44.00	-44.00	-44.00	-44.00	-44.00	-44.00	-44.00
Vegetables and fruits	-6.54	-6.48	-6.46	-6.52	-6.60	-6.52	-6.51	-6.58	-6.54	-6.48	-6.46	-6.52	-6.60	-6.52	-6.51	-6.58
Oil seeds	-0.10	-0.08	-0.08	-0.10	-0.12	-0.10	-0.10	-0.11	-42.30	-42.30	-42.30	-42.30	-42.30	-42.30	-42.30	-42.30
Sugar cane and sugar beet	-16.80	-15.40	-15.30	-16.00	-16.90	-17.50	-17.40	-16.10	-24.40	-22.90	-22.80	-23.60	-24.40	-25.00	-24.90	-23.60
Plant-based fibers	2.84	2.80	2.81	2.84	2.66	2.71	2.70	2.65	2.84	2.80	2.81	2.84	2.66	2.71	2.70	2.65
Crops nec	-2.30	-2.15	-2.09	-2.20	-2.37	-2.28	-2.26	-2.28	-2.30	-2.15	-2.09	-2.20	-2.37	-2.28	-2.26	-2.28
Cattle	-4.23	-3.83	-3.82	-3.97	-4.24	-4.26	-4.25	-3.98	-39.20	-38.80	-38.80	-39.00	-39.20	-39.30	-39.30	-39.00
Animal products nec	-1.23	-1.07	-1.05	-1.12	-1.27	-1.52	-1.53	-1.15	-6.53	-6.37	-6.35	-6.42	-6.57	-6.82	-6.83	-6.45
Raw milk	-6.81	-6.00	-5.92	-6.27	-6.82	-6.75	-6.72	-6.28	-8.50	-7.70	-7.61	-7.96	-8.51	-8.44	-8.41	-7.97
Wool	5.49	5.30	5.33	5.31	5.31	5.12	5.11	5.13	5.49	5.30	5.33	5.31	5.31	5.12	5.11	5.13
Meat (cattle)	-10.70	-18.80	-18.90	-16.40	-10.70	-10.90	-10.80	-16.40	-10.70	-18.80	-18.90	-16.40	-10.70	-10.90	-10.80	-16.40
Meat products nec	-1.65	-3.12	-3.16	-2.53	-1.64	-1.73	-1.73	-2.53	-1.65	-3.12	-3.16	-2.53	-1.64	-1.73	-1.73	-2.53
Vegetable oils and fats	-2.73	-3.34	-3.42	-2.93	-2.75	-2.95	-2.93	-2.96	-2.73	-3.34	-3.42	-2.93	-2.75	-2.95	-2.93	-2.96
Dairy products	-6.50	-9.01	-9.26	-7.98	-6.51	-6.55	-6.52	-7.99	-6.50	-9.01	-9.26	-7.98	-6.51	-6.55	-6.52	-7.99
Processed rice	-23.70	-37.90	-37.80	-31.30	-23.70	-26.60	-26.40	-31.30	-23.70	-37.90	-37.80	-31.30	-23.70	-26.60	-26.40	-31.30
Sugar	-22.30	-26.90	-27.00	-24.30	-22.30	-23.80	-23.60	-24.30	-22.30	-26.90	-27.00	-24.30	-22.30	-23.80	-23.60	-24.30
Food products nec	-4.38	-6.30	-7.02	-4.75	-4.39	-4.67	-4.59	-4.77	-4.38	-6.30	-7.02	-4.75	-4.39	-4.67	-4.59	-4.77
Beverages and tobacco products	0.05	-0.00	-0.08	0.03	0.03	-0.01	-0.01	0.01	0.05	-0.00	-0.08	0.03	0.03	-0.01	-0.01	0.01
Trade	0.25	0.22	0.22	0.24	0.23	0.16	0.16	0.22	0.25	0.22	0.22	0.24	0.23	0.16	0.16	0.22