Global Trade Analysis Project
https://www.gtap.agecon.purdue.edu/

This paper is from the
GTAP Annual Conference on Global Economic Analysis
https://www.gtap.agecon.purdue.edu/events/conferences/default.asp

30 April, 2004

Preliminary draft
Not for quotation

Policy reform in agriculture and the environment
Linkages in the crops sector *

by

Marinos E. Tsigas **

* Paper prepared for presentation at 7th Annual Conference on Global Economic Analysis: Trade, Poverty, and the Environment, June 17 - 19, 2004, Washington, D.C., United States.

** Marinos Tsigas is an economist at the USITC, Office of Economics. The opinions expressed in this paper are solely the opinions of the author and in no way reflect the opinions of the USITC or any of the agency's Commissioners. Address correspondence to marinos.tsigas@usitc.gov.

Policy reform in agriculture and the environment
Linkages in the crops sector

Summary

1. This study analyzes some of the environmental impacts of further multilateral trade liberalization and reduction in support on arable crops using a multi-country, global trade model and indicators of environmental quality. The model is based on standard economic theory and it allows consideration of the general equilibrium impact of food and agriculture policies by accounting for inter-sectoral linkages and inter-sectoral competition for land and other resources.

2. The GTAP framework is applied to simulate impacts for crop sectors in 24 aggregate regions. Changes in the scale and intensity of input use are analyzed to discuss environmental implications. OECD and UN environmental information data supplement model simulations to assess impacts on pesticide use, nitrogen uptake and off load, and emissions of greenhouse gases (GHGs) from crop production. This analysis provides "worst case" impacts of multilateral trade policy liberalization because the alleviating influence of existing environmental policies and regulations is not considered.

3. Two hypothetical multilateral agricultural trade liberalization scenarios are considered. The first scenario assumes an extension of the Uruguay Round Agreement on Agriculture. The second scenario involves the elimination of all food and agriculture policy measures in all trading countries. In each scenario, liberalization is limited to food and agriculture sectors.

4. The simulated crop impacts of trade liberalization suggest a complex set of environmental implications. For several regions, there would be little change in cropland and chemical use, aggregate output, and the rate of chemical application. Thus, the environmental implications for those regions would be minimal.

5. For Australia, New Zealand and Canada the simulated impacts of liberalization suggest that crop output and chemical use would expand, even though cropland would not expand. Thus, environmental issues that are associated with the degree of intensity of production might become more problematic.

6. In the United States, the simulated impacts of liberalization suggest that crop output and chemical use would expand, but cropland would decline. At the aggregate level, these impacts are small, which suggests that environmental issues would not become more problematic. At the sector level, however, grain production would become more intensive (i.e., the rate of input use per acre would increase), which suggests that environmental issues associated with grain production might become more problematic in some parts of the United States.

7. In the European Union, the simulations suggest that crop production and the intensity of input use would decline in almost all regions. The aggregate region of Denmark, Finland, and Sweden is an exception since the intensity of crop production would increase. In almost all EU regions, however, some crop sectors would become more intensive. Thus, aggregate environmental issues are not likely to become more problematic, but at the sector and/or region level there might be negative implications.

8. Further work may supplement this quantitative analysis with country-specific disaggregated analysis to assess the environmental impacts of trade liberalization at the sub-national level. The approach applied by Cooper, et al. (2003) is promising.

Policy reform in agriculture and the environment
Linkages in the crops sector

Introduction

4. In many OECD countries, there is a wide range of agricultural and trade policies that affect the arable crops sector – domestic support, import tariffs and export subsidies. Thus, further trade liberalization and reduction in support to agriculture could have a significant impact on arable crops production. Those impacts may include changes in production location and trade flows as well as changes in the scale (i.e., an expansion or contraction of the whole crops sector), composition of crops production (e.g., more wheat but less rice), and changes in farming practices (e.g., more extensive and less intensive production systems). The state of natural and environmental resources that are associated with crop production may be affected through changes in the scale and composition of inputs used in crop production (e.g., land, water, fertilizers, pesticides, etc). Moreover, as has been often pointed out at the JWP meetings, many of the environmental effects are location specific.

Methodology and data

5. This study models and analyses some of the environmental impacts of further multilateral trade liberalization and reduction in support on arable crops using various indicators of environmental quality. In particular a multi-country, global trade model is used to simulate the impacts of policy changes. The model is based on standard economic theory and it allows consideration of the general equilibrium impact of policies by explicitly accounting for upstream and downstream production linkages, inter-sectoral competition for resources, and income changes.

6. It has now become standard practice to analyze the impacts of multilateral trade policy liberalization within global trade models that rely on applied general equilibrium (AGE) methodologies; some of the analyses that relied on AGE frameworks are Francois, *et al*., 1996; Hertel, *et al*., 1996; Harrison, *et al*., 1996; Anderson, *et al*., 1999; Elbehri, *et al*., 1999; Anderson, *et al.,* 2001; Tsigas, 2001; Beghin, *et al.*, 2002; Bouet *et al.*, 2003; and Rae and Strutt 2003. Several of these studies are based on the GTAP (Global Trade Analysis Project) framework (Hertel, 1997).

7. In the trade and environment area, Vasavada and Nimon reviewed the empirical literature regarding environmental impacts of trade liberalization and they found that the overall impact may depend on several and possibly offsetting effects and that co-ordination of trade and environmental policies may promote a more sustainable pattern of natural resource use. In a recent paper, Diakosavvas (2003) econometrically analyzed agro-environmental policies that are classified as *green box* policies under the WTO and he found that those policies have a statistically significant effect on production and trade. Tsigas, *et al.* (2002) extended the GTAP framework to account for linkages between trade and environment. Using pollution and abatement data from the United States, three sources of pollution were considered for agriculture: soil erosion, pesticide toxic releases, and livestock waste; in terms of agro-environmental policies, a soil conservation programme and regulations regarding pesticide use and livestock waste were considered. The authors found that trade liberalization may lead to changes in production patterns and to more pollution in some regions. The authors concluded that if environmental resources are priced correctly and environmental regulations are enforced, trade liberalization will more likely lead to less pollution.

8. In a recent paper, Cooper, *et al* (2003) analyzed the U.S. regional environmental impacts of multilateral agricultural trade liberalization. In particular, the authors examined impacts on soil erosion, fertilizers (i.e., nitrogen and phosphorus) and pesticides lost to water, and pollution from manure. Two partial equilibrium food and agriculture models and an environmental model were used: the ERS/PSU

World Trade Model determined changes in global trade and U.S. production; the USMP spatial equilibrium model determined output and input changes at the U.S. regional level; and a spatial environmental model determined changes in physical environmental measures. The authors concluded that for the United States, as a whole, environmental impacts stemming from multilateral agricultural trade liberalization would most likely be small (i.e., less than 1.4 percent). Changes in the relevant environmental indicators, however, are not uniform across the United States and they could be larger than U.S. impacts. For example, soil erosion due to wind may increase by 1.36 percent for the U.S. as a whole, but it may increase by 9.39 percent in the Northern Plains region; phosphorus fertilizer loading to water may increase by 0.37 percent for the U.S. as a whole, but it may decline by 0.64 percent in the Southern Plains region.

9. This study focuses on the environmental impacts of multilateral trade liberalization and reduction in support in agriculture. The GTAP framework is used to quantify impacts on trade, production and input use for crop sectors in every economy in the model. Changes in the scale and intensity of input use for crop production are analyzed to discuss environmental implications. Information from the OECD *Agri-environmental Indicators* database (OECD, 2001b; OECD, 2002; OECD, 2003b; and OECD, 2003c) supplements changes in GTAP model variables to assess impacts on pesticide use, and nitrogen uptake and off load. Impacts on emissions of greenhouse gases (GHGs) from crop production are based on data for 1997 from the United Nations Framework Convention on Climate Change. This analysis provides "worst case" impacts of trade policy liberalization because the analysis does not consider the alleviating influence of existing environmental policies and regulations.

The simulations of multilateral agricultural trade liberalization

10. The environmental impacts are assessed against two hypothetical multilateral agricultural trade liberalization scenarios. The first scenario assumes extension of the Uruguay Round Agreement on Agriculture (URAA). This incorporates changes within each of the major negotiation pillars – market access, export competition and domestic support. In particular, it is simulated that all food and agriculture tariffs (including direct price impacts of TRQs) are reduced by 36% in developed countries and by 24% in developing countries; domestic support is reduced by 20% in developed countries and by 14% in developing counties; and export subsidies is reduced by 36% in developed countries and by 24% in developing countries.

11. The second hypothetical scenario involves the elimination of all food and agriculture policy measures (i.e., import tariffs and TRQs, domestic support, and export subsidies) in all trading countries. In each scenario, the simulated liberalization is limited to the food and agriculture sector; for example, regarding import tariffs, all food and agriculture (*i.e.*, not just crops) tariffs are reduced or removed, but those on industrial products remain unchanged.

The applied general equilibrium trade framework

12. The GTAP framework consists of a global database and a global trade model. The database includes information on trade; domestic production and use of each commodity; and land, labor, and capital employment, by sector. The database also contains information on trade and support policies. The model is based on assumptions that are common in the literature: perfect competition, constant returns to scale, and full employment of resources.

13. In the GTAP model, each regional economy consists of several economic agents: on the final demand side of the model, a utility-maximizing household purchases commodities and saves part of its income, which consists of returns to primary factors (land, labor, and capital) and net tax collections. On the production side of the model, cost-minimizing producers employ primary factor services and

intermediate inputs to supply commodities. In the model, intermediate (and final demand) users of commodities are assumed to differentiate a commodity by its region of origin (i.e., the *Armington* specification is applied). Labor and capital are perfectly mobile across sectors in the same region; land is employed in agriculture and it is imperfectly mobile across agricultural sectors. In each region, aggregate investment in new capital goods is represented by the output of a capital goods sector. Globally, the sum of household savings is equal to the sum of investment expenditures.

14. Integrated into this treatment of production, demand, and trade, is a set of domestic support and trade policies, which are modeled as *ad valorem* equivalents. These policies affect the market equilibrium computed by the model and when they change they induce changes by producers and consumers in all regions. The base year of the GTAP data is 1997 (Dimaranan and McDougall, 2002). The GTAP model is solved using the GEMPACK suite of software (Harrison and Pearson, 1994).

Sectoral and regional specification

15. Table 1 specifies the sectoral and regional scope of this study. There are twenty-four economies (or aggregate regions) in the model, several of which represent OECD economies. Since the GTAP data makes available data for each one of the fifteen European Union economies, the European Union is represented by six aggregate regions to help identify regional differentiation in impacts. Twelve regions have been classified as developing economies (table 1) to specify the simulation of the partial reduction in tariffs and support.

16. In terms of sectoral coverage, all the food and agriculture sectors that are available in the GTAP database have been identified in this paper: there are twelve aggregate farm sectors, eight of which represent crop production);and eight aggregate processed foods sectors. The rest of the economy is represented with ten aggregate sectors. The GTAP sector *chemical, rubber, and plastic products* includes fertilizers, pesticides, and other agricultural chemicals and it has been identified as a single sector. The aggregate sectors "other manufacturing" and "other services" are heavily aggregated, each representing eleven GTAP sectors (appendix table 1 specifies the mapping between the 30 model sectors and the 67 GTAP sectors).

Agricultural production

17. The standard GTAP model allows for substitution in production among primary factors (i.e., land, labor, and capital). Intermediate inputs, however, are used in fixed proportions in producing the various outputs, i.e., the Leontief assumption is applied for intermediate inputs. In this paper, this assumption is relaxed for crop and livestock production to allow for a better modeling of the impacts of domestic support reduction (see Dimaranan *et al*., 2003 and OECD, 2003a) and to incorporate elasticity information available in the literature.

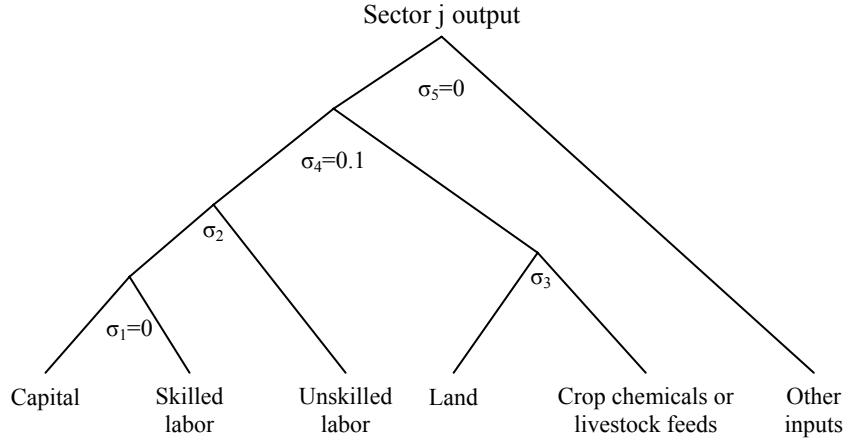
18. In particular, the production function is specified as a nested constant-elasticity-of-substitution (CES) function, a generalization of the two-level CES function, which was originally developed by Kazuo Sato (1967) and it was applied in agricultural economics by Yoav Kislev and Willis Peterson (1982). Specifically, it is assumed that in one sub-process, capital is a factor mainly to substitute for labor; in the other sub-process, agri-chemicals (i.e., fertilizer and pesticides) mainly substitute for land (Hayami and Ruttan, 1970; Kislev and Peterson, 1982).

19. Figure 1 specifies the nested CES production functions for crops and livestock in this paper. On the left side of figure 1, it is assumed that there is no substitution between capital and skilled labor and the direct elasticity of substitution σ_1 is zero; but it is assumed that there are substitution possibilities between the capital-skilled labor composite and unskilled labor (i.e., the direct elasticity of substitution σ_2 is larger

than zero). This reflects the idea that each tractor (i.e., capital) requires a single operator (i.e., skilled labor); if the relative wage for unskilled labor declines, though, farmers may decide to use more unskilled labor for some tasks that were previously mechanized.

Figure 1. Specification of crop and livestock production functions

A. Nested CES function



B. Specification of σ_2

	Australia, NZ	Japan	Korea	Canada	USA	Brazil	European Union, S&RoEFTA, 10EUacc	China, RoAs, Mexico, Argentina, RoAm, RoE, TMMENA, RoAf, RoW
Paddy rice	0.1	0.192	0.3	0.1	0.166	3.275	0.4	0.5
Wheat	0.1	0.192	0.3	0.1	0.166	0.74	0.4	0.5
Other grains	0.1	0.192	0.3	0.1	0.166	1.44	0.4	0.5
Frts, veg., nuts	0.1	0.192	0.3	0.1	0.166	1.45	0.4	0.5
Oil seeds	0.1	0.192	0.3	0.1	0.166	2.75	0.4	0.5
Sugar crops	0.1	0.192	0.3	0.1	0.166	0.71	0.4	0.5
Plant fibers	0.1	0.192	0.3	0.1	0.166	1.09	0.4	0.5
Other crops	0.1	0.192	0.3	0.1	0.166	1.45	0.4	0.5
Cattle	0.1	0.192	0.3	0.1	0.166	2.78	0.4	0.5
Other livestock	0.1	0.192	0.3	0.1	0.166	0.22	0.4	0.5
Dairy farms	0.1	0.192	0.3	0.1	0.166	0.31	0.4	0.5
Wool and silk	0.1	0.192	0.3	0.1	0.166	0.22	0.4	0.5

C. Specification of σ_3

	China, RoAs, Mexico, Argentina, RoAm, RoE, TMMENA, RoAf, RoW	Japan	Korea	Australia, NZ, Canada, 10EUacc	USA	Brazil	European Union, S&RoEFTA
Paddy rice	0.5	0.202	0.4	0.9	0.376	0.085	2.7
Wheat	0.5	0.202	0.4	0.9	0.376	0.08	2.7
Other grains	0.5	0.202	0.4	0.9	0.376	0.12	2.7
Frts, veg., nuts	0.5	0.202	0.4	0.9	0.376	0.1215	2.7
Oil seeds	0.5	0.202	0.4	0.9	0.376	0.17	2.7
Sugar crops	0.5	0.202	0.4	0.9	0.376	0.2	2.7
Plant fibers	0.5	0.202	0.4	0.9	0.376	0.11	2.7
Other crops	0.5	0.202	0.4	0.9	0.376	0.1215	2.7
Cattle	0.5	0.4	0.4	0.9	0.58	0.08	3.2
Other livestock	0.5	0.4	0.4	0.9	0.58	0.08	3.2
Dairy farms	0.5	0.4	0.4	0.9	0.58	0.08	3.2
Wool and silk	0.5	0.4	0.4	0.9	0.58	0.08	3.2

Sources: Brandão *et al*., 1992; Dimaranan *et al*., 2003; Hertel and Tsigas, 1987; Kawagoe *et al*., 1986; and Salhofer, 2000.

20. On the other side of the nested CES production function in Figure 1, chemicals substitute for land in crop production (i.e., the direct elasticity of substitution σ_3 is larger than zero). In livestock production, feeds (either produced on the farm or purchased) substitute for land (i.e., grazing). Finally, it is assumed that there is limited substitutability between the augmented capital and the augmented land inputs (i.e., the direct elasticity of substitution σ_4 is 0.1). All other intermediate inputs are used in fixed proportions (i.e., the direct elasticity of substitution σ_5 is zero).

21. A review of the literature provides values for the direct elasticities σ_2 and σ_3 (Figure 1). It should be pointed out that the Allen partial elasticities of substitution in crop and livestock production (i.e., the overall, output-constant elasticities of substitution among inputs) are a function of all the direct elasticities of substitution in Figure 1 and the input cost shares (e.g., Kawagoe *et al.*, 1986).

Food and agriculture policies

22. In release 5.3 of the GTAP data, all the PSE components, excluding market price support, were classified into one of four domestic support categories: output subsidies, intermediate input subsidies, and payments to land and capital (Jensen, H.G., 2002). This was done for 14 OECD regions[1] and nine agricultural commodities for 1998.[2] The GTAP data also accounts for food and agriculture trade measures—tariffs and export subsidies. Tariff-rate quotas (TRQs) are not explicitly modeled; they are rather accounted for by price wedges which reflect the direct price impacts of TRQs. The food and agriculture tariff data is from the Agricultural Trade Policy Database, which is based largely on the Agricultural Market Access Database (AMAD) (Gibson, *et al.*, 2002). The tariff information is for 1998 or for the latest available year. Export subsidy information is based on country submissions to the WTO of export subsidy expenditures for 1998 (Elbehri, 2002).

23. The GTAP data show that producer support at the output level is small, but there are a few exceptions with relatively large output support rates (e.g., wool and silk; and oilseeds). In contrast to output support, the use of primary factors and intermediate inputs is subsidized at significant rates. Primary factor subsidies are in general larger than intermediate input subsidies. As in the case of output support, export subsidies are small, with a few exceptions (e.g., dairy and sugar). Import tariffs exhibit large variation within regions and commodity markets.

24. The GTAP agricultural policy data refer to 1998 and thus they do not reflect important agricultural policy developments since 1998: some of which are: the entry of China and Taiwan into the WTO (thus the data overstates China's oilseeds and grains tariffs); European Union policies implemented with the Berlin Accord on Agenda 2000 (which increased direct payments and reduced crop intervention prices); the 2002 U.S. farm bill (in addition, U.S. flexibility payments are mapped as subsidies to land in certain crops). These shortcomings are important but they are not expected to affect the broad conclusions of this work.

[1] Australia, New Zealand, Japan, Korea, the United States, Canada, Mexico, the European Union, Hungary, Iceland, Norway, Poland, Switzerland, and Turkey.

[2] Paddy rice, wheat, other grains, oilseeds, sugar cane and beets, cattle and sheep, other meat, raw milk, and wool.

Simulated impacts of multilateral agricultural trade liberalization

Partial multilateral agricultural trade liberalization

25. Tables 2 and 3 show selected simulated impacts of the partial liberalization scenario.[3] In particular, table 2 reports output and input impacts of the liberalization scenario; table 3 reports impacts on the rate of chemical application. An outcome of the economy-wide mechanisms of the model (i.e., relative price changes and full employment of resources) is that at the region level, some agricultural sectors expand while some other agricultural sectors contract. Thus, aggregate impacts at the whole crops or agriculture level are smaller than for most individual sector level impacts.

26. Partial liberalization of food and agricultural policies would cause aggregate crops output to expand the most in Canada – an increase of 5.2 percent; aggregate crops output would decline the most in the aggregate region of Switzerland and the rest of EFTA – a decline of 7.8 percent.[4] A large increase in wheat output (15.1 percent) is responsible for the extent of expansion in aggregate crops in Canada. In Australia and New Zealand crops would increase by 2.2 and 2.4 percent, respectively. In the United States crops output expands by 0.8 percent. In the six European Union regions, crops output would decline by 3.1 to 6.1 percent.

27. Appendix tables 2, 3, and 4 decompose the impacts into domestic support, import tariff, and export subsidy components, respectively. The decomposition results suggest that the domestic support and import tariff components of the liberalization simulation are driving the crops impacts in most regions, e.g., export subsidy liberalization leads to only a 0.5 percent expansion in Canadian crops output; but import tariff liberalization leads to a 3.8 expansion in Canadian crops output. For some European Union regions, domestic support liberalization is more influential in terms of crops output than import tariff liberalization: e.g., crops output declines by 3.1 percent in Denmark, Finland and Sweden due to domestic support liberalization; it declines by 0.8 percent due to import tariff liberalization.

28. Turning to input use impacts, the Canadian crops expansion is made possible by an intensification of crop production.[5] Land in crops increases by only 0.3 percent (table 2), but use of all other inputs increases by more than 5 percent: labor and capital increase by 5.2 to 5.3 percent, respectively and chemical use increases by 7.7 percent (table 2); all other intermediate inputs increase by about 5.2 percent. Crop production would also intensify in Australia and New Zealand: labor and capital use would increase by over 2 percent; chemical use would increase by 5.7 in Australia and by 6.4 percent in New Zealand. In fact, due to a large livestock expansion, land used in crop production would decline by 3.1 percent in New Zealand.

29. Even though crop output would decline in all European Union regions, some regions would experience an intensification of crop production while others would experience an extensification of crop production. An example of intensification is Denmark, Finland, and Sweden where land use declines by 17.5 percent, but crop output declines by 6.1 percent and chemical use declines by 11.4 percent (table 2);

[3] In the partial liberalization scenario, all food and agriculture tariffs (including direct price impacts of TRQs) are reduced by 36% in developed countries and by 24% in developing countries; domestic support is reduced by 20% in developed countries and by 14% in developing counties; and export subsidies is reduced by 36% in developed countries and by 24% in developing countries.

[4] Aggregate output and land use impacts are calculated as value share-weighted sums of sector level percentage changes.

[5] The term "intensification" implies that the rate of input use per acre (e.g., pounds of chemicals per acre) increases; the term "extensification" implies that the rate of input use per acre declines.

an example of extensification is France where land use declines by 6.4 percent, and crop output declines by 5.6 percent and chemical use declines by 15.4 percent.

30. Table 3 reports impacts on the rate of use of chemicals which is a specific indicator of intensification of crop production. Overall crop production would intensify the most in New Zealand and Canada, 9.8 and 7.4 percent, respectively. In New Zealand, wheat and other grain production would intensify by 15 percent; fruits, vegetables, and nuts production would intensify by 9 percent. In Canada, wheat production would intensify by 18 percent and other grains production would intensify by 7 percent. Individual crop impacts are determined by two factors. First, total agricultural output and input use would contract in the regions where agricultural support and protection is reduced. Second, in several regions in the model, a significant portion of support is in the form of land and capital subsidies. Liberalization would make land and capital more expensive to farmers, and thus cause an increase in demand for labor (a capital substitute) and chemicals (a land substitute). Thus, the ratio of chemicals to land may increase because land use may decline by more than chemical use. The relative size of the scale and substitution effects depend on the degree of liberalization (i.e., how the relative prices of land and capital are changing), the size of the relevant elasticities (which are specified in figure 1), and the relevant input cost shares. Regional variation in input cost shares contributes to the variation in impacts among European Union regions.

Complete multilateral agricultural trade liberalization

31. Tables 4 and 5 show selected simulated impacts of the second liberalization scenario.[6] In particular, table 4 reports output and input impacts of the liberalization scenario; table 5 reports impacts on the rate of chemical application. Appendix tables 5, 6, and 7 decompose the impacts into domestic support, import tariff, and export subsidy components, respectively.

32. Aggregate crop output would expand the most in Canada – an increase of 29.8 percent, and it would decline the most in France – a decline of 18.0 percent. In Australia and New Zealand crops would increase by 11.5 and 8.8 percent, respectively. In the United States crops output expands by 3 percent. In the six European Union regions, crops output would decline by 10.7 to 18 percent. The simulation results in appendix table 5 to 7 suggest that the domestic subsidy and import tariff components of the liberalization are driving the crops impacts in most regions.

33. Turning to input use impacts, the Canadian crops expansion is made possible by intensifying crop production. Land in crops increases by only 1.9 percent (table 4), but all other inputs increase by more than 29 percent: labor and capital increase by 29.6 to 29.7 percent, and chemical use increases by 48.1 percent (table 4); all other inputs increase by 29.8 percent. Table 5 reports impacts on the rate of use of chemicals. Overall crop production would intensify the most in New Zealand and Canada, 47.2 and 45.4 percent, respectively. In Canada, wheat production would intensify the most (64.9 percent).

Environmental implications of trade liberalization

34. The simulated crop impacts of trade liberalization suggest a complex set of environmental implications. For several regions in the model (i.e., Asia, Mexico, South America, 10 EU accession economies, rest of Europe, Middle East, Africa and the Rest of world), the simulated liberalization impacts do not suggest any significant environmental implications: the percent changes in land and chemical use,

[6] The complete multilateral agricultural trade liberalization scenario involves the elimination of all food and agriculture policy measures (i.e., import tariffs and TRQs, domestic support, and export subsidies) in all trading countries.

Figure 2. Selected impacts of partial liberalization on crops sector, percent change

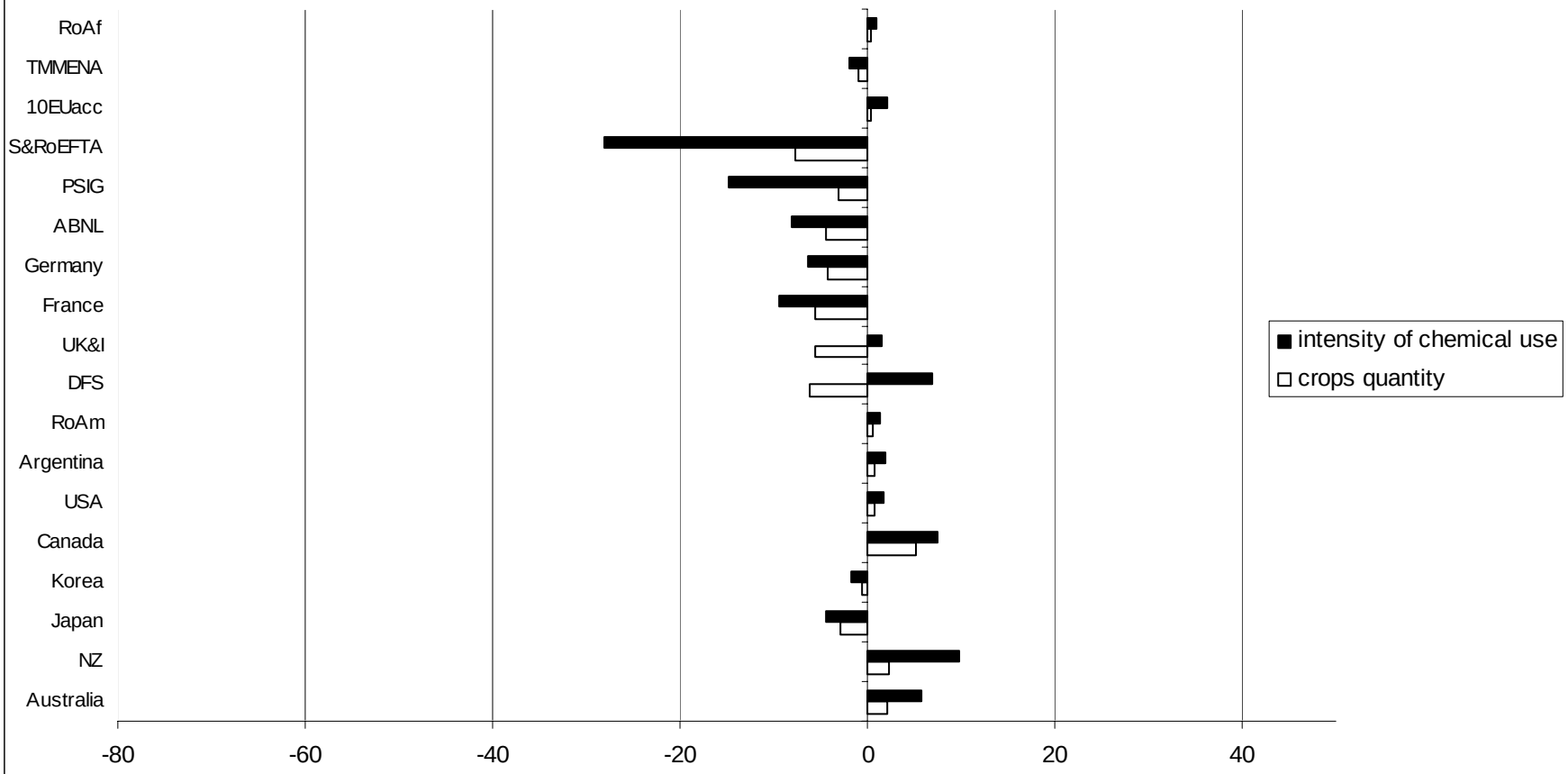
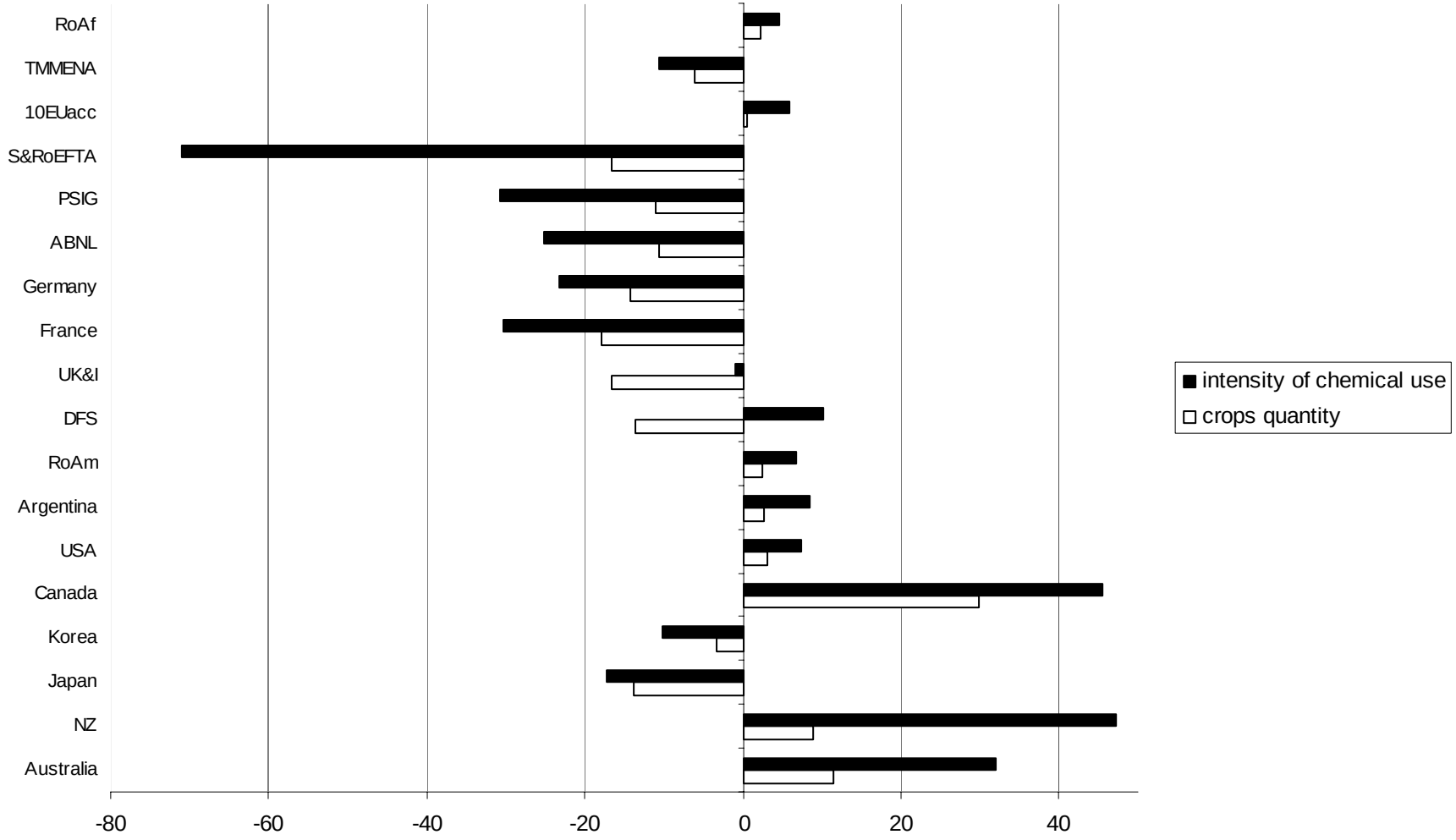


Figure 3. Selected impacts of total liberalization on crops sector, percent change



aggregate output, and the rate of chemical application are all small. This conclusion applies to both the partial and complete removal of food and agriculture support and tariffs.

35. The following discussion is based on selected simulation impacts which are summarized in figures 2 and 3 and table 6. Figure 3 identifies 18 model regions (out of the 24 regions) which may experience "significant" impacts in crop production and/or intensity due to complete liberalization. [7] For comparison purposes, the same 18 regions are also included in figure 3 (which shows impacts of partial liberalization) even though several impacts are not "significant". Table 6 identifies specific sector/regions combinations which might cause environmental "problems" due to liberalization.[8] For Australia, New Zealand and Canada the simulated impacts of partial liberalization suggest that crop output and use of chemicals would expand, even though land in crops would not expand. Thus some environmental issues, which are associated with the degree of intensity of crop production, might become more problematic. Under the complete removal of support and tariffs, crop output and the use of chemicals are likely to expand even more.

36. In the United States, the simulated impacts of partial and total liberalization suggest that crop output and use of chemicals would expand, but the area of land used in crops would decline. At the aggregate level, these impacts are small, which suggests that environmental issues are not likely to become more problematic. At the sector level, however, grain production would become more intensive, which suggest some environmental issues associated with grain production might become more problematic.

37. In the European Union, the simulated impacts of partial and total liberalization suggest that aggregate crop output, the use of land and chemicals, and the intensity of production would decline in almost all EU regions. The aggregate region of Denmark, Finland, and Sweden is an exception since the intensity of crop production would increase. In almost all EU regions, however, some crop sectors become more intensive: in the aggregate region of Denmark, Finland, and Sweden, and the UK and Ireland, grain production becomes very intensive; in Germany the production of oilseeds becomes extremely intensive. These impacts suggest that in the European Union aggregate environmental implications of trade policy liberalization would not be problematic, but at the sector, or region, level there might be significant negative implications.

38. Tables 7, 8, and 9 summarize environmental data outside the GTAP framework for several economies in the model. Table 7 reports nitrogen uptake coefficients (i.e., the nitrogen which is removed with harvested crops) by sector and for crops as a whole. The impacts of partial and total liberalization on nitrogen uptake, fertilizer use, and the balance of nitrogen are also presented in table 7. Under partial liberalization, nitrogen uptake increases by 3.0 percent in Australia, but fertilizer use increases by 5.7 percent, which implies there might be a larger nitrogen surplus in the soil and pollution might become more problematic. Total liberalization would cause the nitrogen surplus to increase by 16.9 percent in Australia. Other regions where nitrogen surplus might increase due to policy liberalization are New Zealand and Canada, and to a smaller extent in the United States and the EU-10 accession economies.

39. Using information on the total use of pesticides (table 8) and simulation results, we find that the use of pesticides in OECD economies, as a whole, would decline by 7 percent under partial liberalization and by 13 percent under total liberalization.

40. Table 9 summarizes data on greenhouse gas (GHG) emissions from agriculture. The GHG emissions that are directly related to crops are methane (CH_4) emissions from rice cultivation and nitrous oxide (N_2O) emissions from agricultural soils. The simulation results suggest that partial liberalization

[7] An impact is characterized as "significant" in figures 3 and 3 if it exceeds positive or negative 5 percent.

[8] An impact is characterized as "problematic" in table 6 if it exceeds positive or negative 10 percent.

would cause global paddy rice production to decline by 0.5 percent; total liberalization would cause global paddy rice production to decline by 2.6 percent. The regional pattern of paddy rice impacts, however, is somewhat different between the two liberalization simulations. Thus, the impact of the two liberalizations on global methane emissions would not be proportional to changes in global rice production. The data in table 9 and the simulation results in tables 2 and 4 suggest that partial liberalization would cause methane emissions (from the regions in table 9 as a whole) to decline by 1.59 percent; total liberalization would cause methane emissions to decline by 1.75 percent.

Conclusions and future work

41. This study has analyzed some of the environmental impacts of further multilateral trade liberalization and reduction in support on arable crops using a multi-country, global trade model and environmental indicators. The model is based on standard economic theory and it allows consideration of the general equilibrium impact of food and agricultural policies by explicitly accounting for upstream and downstream linkages and inter-sectoral competition for land and other resources.

42. The simulated crop impacts of trade liberalization suggest a complex set of environmental implications. For several regions, the simulated impacts suggests that there would be little change in land and chemical use, aggregate output, and the rate of chemical application. Thus the environmental implications for those regions would be minimal. For Australia, New Zealand and Canada the simulated impacts of liberalization suggest that crop output and chemical use would expand, even though cropland would not expand. Thus, environmental issues that are associated with the degree of intensity of production might become more problematic in those regions.

43. In the United States, the simulated impacts of liberalization suggest that crop output and chemical use would expand, but cropland would decline. At the aggregate level, these impacts are small, which suggests that environmental issues would not become more problematic. At the sector level, however, grain production would become more intensive, which suggests that environmental issues associated with grain production would become more problematic.

44. In the European Union, the simulated impacts of partial and total liberalization suggest that crop production and the intensity of input use would decline in almost all EU regions. The aggregate region of Denmark, Finland, and Sweden is an exception since the intensity of crop production would increase there. In almost all EU regions, however, some crop sectors become more intensive. These impacts suggest that aggregate environmental issues would not become more problematic, but at the sector (and region) level there might be significant negative implications.

REFERENCES

Anderson, K., B. Dimaranan, J. Francois, T. Hertel, B. Hoekman, and W. Martin (2001), "The Cost of Rich (and Poor) Country Protection to Developing Countries," *Journal of African Economies*, 10 (3): 227–257.

Anderson, K., E. and M. D. Ingco (1999) "Integrating Agriculture into the WTO: The Next Phase," paper presented at the World Bank's Conference on *Developing Countries and the Millennium Round*, Geneva, 19-20 September.

Beghin, J.C., D. Roland-Holst, and D. van der Mensbrugghe (2002), "Global Agricultural Trade and the Doha Round: What are the Implications for North South?" Working Paper 02-WP 308, Center for Agricultural and Rural Development, Iowa State University, June.

Bouet, A., J.C. Bureau, Y. Decreaux, and S. Jean (2003), "Is Northern agricultural liberalization beneficial to developing countries?" preliminary draft, May 28.

Brandão, A.S.P., T. Hertel and A. Campos (1992), "The Implications of International Trade Liberalization for the Brazilian Agriculture: A General Equilibrium Analysis," manuscript, The World Bank, February.

Cooper, J, R. Johansson, and M. Peters (2003), "Some Domestic Environmental Effects of U.S. Agricultural Adjustments under Liberalized Trade: A Preliminary Analysis," paper presented at conference on *Agricultural policy reform and the WTO: Where are we heading?* International Agricultural Trade Research Consortium, Capri, Italy, 23-26 June.

Diakosavvas, D. (2003), "Production and Trade Effects of the WTO Green Box Agri-Environmental Policies in OECD Countries: An Empirical Investigation," paper presented at conference on *Agricultural policy reform and the WTO: Where are we heading?* International Agricultural Trade Research Consortium, Capri, Italy, 23-26 June.

Dimaranan, B. V., and R. McDougall (eds.) (2002), *Global Trade, Assistance, and Production: The GTAP 5 Data Base*, Center for Global Trade Analysis, Purdue University, West Lafayette, Indiana, USA.

Dimaranan, B., T. Hertel and R. Keeney (2003), "OECD Domestic Support and the Developing Countries," paper presented at the *Sixth Annual Conference on Global Economic Analysis*, Scheveningen, The Hague, The Netherlands, 12-14 June.

Elbehri, A., M. D. Ingco, T. Hertel, and K. Pearson (1999), "Agriculture and WTO2000: Quantitative Assessment of Multilateral Liberalization of Agricultural Policies," paper presented at the Conference on *Agriculture and the New Trade Agenda in the WTO 2000 Negotiations*, 1-2 October, Geneva, Switzerland.

Elbehri, A. (2002), "Agricultural Export Subsidies," chapter 16.D in Dimaranan, B. V., and R. McDougall (eds.), *Global Trade, Assistance, and Production: The GTAP 5 Data Base*, Center for Global Trade Analysis, Purdue University, West Lafayette, Indiana, USA.

Francois, J., B. McDonald, and H. Nordstrom (1996), "The Uruguay Round: A Numerically-based Qualitative Assessment', in W. Martin, and L. A. Winters, *The Uruguay Round and the Developing Countries*, Chapter 9. New York: Cambridge University Press.

Gibson, P., J. Wainio, and D. Whitley (2002), "Agricultural Tariff Data," chapter 16.C in Dimaranan, B. V., and R. McDougall (eds.), *Global Trade, Assistance, and Production: The GTAP 5 Data Base*, Center for Global Trade Analysis, Purdue University, West Lafayette, Indiana, USA.

Harrison, W.J. and Pearson, K.R. (1994), "An Introduction to GEMPACK, Release 5.1," GEMPACK Document No. GPD-1, Second Edition, Monash University, April, 1994.

Harrison, G. W., T. F. Rutherford, and D. G. Tarr (1996), "Quantifying the Uruguay Round', in W. Martin, and L. A. Winters, *The Uruguay Round and the Developing Countries*, Chapter 8. New York: Cambridge University Press.

Hayami, Y. and V.W. Ruttan (1970), "Factor Prices and Technical Change in Agricultural Development: The United States and Japan, 1880-1960," *The Journal of Political Economy*, 78(5):1115-1141, Sept.-Oct.

Hertel, T. and M. Tsigas (1987), "General Equilibrium Analysis of Supply Control in U.S. Agriculture," staff paper #87-25, Department of Agricultural Economics, Purdue University, Indiana.

Hertel, T.W. (ed.) (1997), *Global Trade Analysis: Modeling and Applications*, Cambridge Univ. Press, January.

Hertel, T., W. Martin, B. Dimaranan, and K. Yanagishima (1996), "Manufactures Trade in a Changing World Economy," in W. Martin, and L. A. Winters, *The Uruguay Round and the Developing Countries*, Chapter 7. New York: Cambridge University Press.

Horner, G.L., J. Corman, R.E. Howitt, C.A. Carter and R.J. MacGregor (1992), "The Canadian Regional Agricultural Model: Structure, Operation and Development", Policy Branch Technical Report 1/92, Agriculture Canada, Ottawa, October.

Hummels, D., (1999), *Towards a Geography of Trade Costs*, GTAP Working Paper No. 17, Center for Global Trade Analysis, Purdue University, West Lafayette, Indiana.

Jensen, H.G. (2002), "Agricultural Domestic Support," chapter 16.E in Dimaranan, B. V., and R. McDougall (eds.), *Global Trade, Assistance, and Production: The GTAP 5 Data Base*, Center for Global Trade Analysis, Purdue University, West Lafayette, Indiana, USA.

Kawagoe, T., K. Otsuka and Y. Hayami (1986), "Induced Bias of Technical Change in Agriculture: The United States and Japan, 1880-1980," *Journal of Political Economy*, 94(3):523-544.

Kislev, Y. and W. Peterson (1982), "Prices, Technology, and Farm Size," *The Journal of Political Economy*, 90(3):578-595, June.

OECD (2001a), *Market Effects of Crop Support Measures*, OECD, Paris.

OECD (2001b), *OECD National Soil Surface Nitrogen Balances: Explanatory Notes,* OECD, Paris, March.

OECD (2002), *Gross Nitrogen Balances, Handbook*, OECD and Eurostat, November.

OECD (2003a), *Agriculture, Trade and the Environment: Linkages in the Dairy Sector—The Nitrogen Pollution Effects of Further Trade Liberalization*, COM/AGR/CA/ENV/EPOC(2003)20, OECD, Paris.

OECD (2003b), OECD Pesticide Use data, OECD, Paris, August.

OECD (2003c), OECD Nitrogen Balance Database, OECD, Paris, August.

Rae, Allan N. and Anna Strutt (2003), "Doha Proposals for Domestic Support: Assessing the Priorities," paper presented at conference on *Agricultural policy reform and the WTO: Where are we heading?* International Agricultural Trade Research Consortium, Capri, Italy, 23-26 June.

Salhofer, K. (2000), "Elasticities of Substitution and Factor Supply Elasticities in European Agriculture: A Review of Past Studies," diskussionspapier Nr. 83-W-2000, Institut für Wirtschaft, Politik und Recht, Universität für Bodenkultur Wien, September.

Sato, K. (1967), "A Two-Level Constant-Elasticity-of-Substitution Production Function," *The Review of Economic Studies*, 34(2):201-218, April.

Tsigas, M. (2001), **"**How Would Food Markets be Affected by Liberalizing Trade in Processed Foods?" U.S. ITC Economics Working Paper No. 2001-08-A, August.

Tsigas, M., D. Gray, and T. W. Hertel (2002), "How to Assess the Environmental Impacts of Trade Liberalization," selected paper, *Fifth Annual Conference on Global Economic Analysis*, National Tsing Hua University, Taipei, 5-7 June.

Vasavada, U. and W. Nimon, "Environmental Effects of Further Trade Liberalization in Agriculture," Economic Research Service, U.S. Department of Agriculture, found at http://www.ers.usda.gov/briefing/wto/PDF/environmentandtradeliberalization.pdf, retrieved 30 June, 2003.

United Nations Framework Convention on Climate Change (2002), *Greenhouse Gas Inventory Database*, 29 October, found at http://ghg.unfccc.int, retrieved 1 September, 2003.

Table 1. Regional and sectoral specification in model

Rregional specification				Sectoral specification[1]		
	Acronym	**Region**	***Classification***		**Sector**	***Classification***
1		Australia	*Developed*	1	Paddy rice	*Crop*
2	*NZ*	New Zealand	*Developed*	2	Wheat	*Crop*
3		China	*Developing*	3	Other grains	*Crop*
4		Japan	*Developed*	4	Fruits, vegetables, and nuts	*Crop*
5		Korea	*Developing*	5	Oil seeds	*Crop*
6	*RoAs*	Rest of Asia	*Developing*	6	Sugar crops	*Crop*
7		Canada	*Developed*	7	Plant fibers	*Crop*
8		United States	*Developed*	8	Other crops	*Crop*
9		Mexico	*Developing*	9	Cattle	*Livestock*
10		Brazil	*Developing*	10	Other livestock	*Livestock*
11		Argentina	*Developing*	11	Dairy farms	*Livestock*
12	*RoAm*	Rest of Americas	*Developing*	12	Wool and silk	*Livestock*
13	*DFS*	Denmark, Finland, and Sweden	*Developed*	13	Forestry	
14	*UK&I*	UK and Ireland	*Developed*	14	Fishing	
15		France	*Developed*	15	Minerals	
16		Germany	*Developed*	16	Red meats	*Processed foods*
17	*ABNL*	Austria, Belgium, Netherlands, and Luxembourg	*Developed*	17	Other meats	*Processed foods*
18	*PSIG*	Portugal, Spain, Italy, and Greece	*Developed*	18	Vegetable oils and fats	*Processed foods*
19	*S&RoEFTA*	Switzerland, rest of EFTA (Iceland, Norway, Liechtenstein)	*Developed*	19	Dairy products	*Processed foods*
				20	Rice	*Processed foods*
		Ten EU accession countries (Czech Republic, Hungary, Poland,		21	Sugar	*Processed foods*
20	*10EUacc*	Slovakia, Slovenia, Estonia, Latvia, Lithuania, Malta, and	*Developing*	22	Other processed foods	*Processed foods*
		Cyprus)		23	Beverages and tobacco	*Processed foods*
				24	Textiles, clothing, and footwear	
		Rest of Europe (Albania, Bulgaria, Herzegovina, Romania,		25	Petroleum, and coal products	
21	*RoE*	Russia, and rest of former Soviet Republics)	*Developing*	26	Chemical, rubber, and plastic products	
				27	Other manufacturing	
22	*TMMENA*	Turkey, Morocco, and rest of Middle East and North Africa	*Developing*	28	Trade	
23	*RoAf*	Rest of Africa	*Developing*	29	Transportation services	
24	*RoW*	Rest of world	*Developing*	30	Other services	

[1] The mapping between the 30 model sectors and the sectors in the GTAP data is shown in Appendix Table 1.

Source: Dimaranan, B.V., McDougall, R.A. (2002) Global Trade, Assistance and Production: The GTAP 5 Database. Centre for Global Trade Analysis, Purdue University.

Table 2. Output and input use impacts of trade liberalization and reduction in support in food and agriculture: *partial removal* of tariffs and subsidies, percent change

	Australia	NZ	China	Japan	Korea	RoAs	Canada	USA	Mexico	Brazil	Argentina	RoAm
Aggregate output												
Crops and livestock	2.7	5.8	0.1	-3.1	-0.2	0.1	2.5	0.7	-0.1	0.4	0.9	0.6
Crops	2.2	2.4	-0.1	-2.9	-0.5	0.1	5.2	0.8	0.1	0.3	0.7	0.6
Livestock	3.3	7.0	0.3	-3.6	1.1	0.1	-0.9	0.6	-0.5	0.6	1.2	0.6
Commodity output												
Paddy rice	12.0	0.0	0.1	-3.8	0.3	0.3	4.4	2.6	-1.3	0.1	0.5	0.7
Wheat	5.8	7.0	-1.6	-33.7	5.5	0.4	15.1	-1.1	0.6	0.5	2.6	1.9
Other grains	3.0	7.0	0.5	-6.3	-14.7	0.7	2.7	0.0	-1.4	0.3	3.2	1.2
Fruits, vegetables, nuts	0.9	0.7	0.3	-1.8	-0.1	-0.1	0.0	2.1	0.7	-0.1	-0.1	0.6
Oil seeds	1.2	6.1	-3.1	-21.9	-8.2	0.0	1.7	2.2	1.1	1.8	0.4	-0.2
Sugar crops	2.5	4.0	0.7	-3.9	0.5	0.2	7.8	-5.1	1.1	1.3	0.3	2.2
Plant fibers	-2.3	6.7	-0.1	4.4	0.9	-0.3	4.0	1.4	-0.2	-0.3	-1.1	-1.2
Other crops	2.1	-7.3	0.0	-2.3	-2.2	-0.5	0.9	0.1	3.4	-0.7	-1.3	0.1
Cattle	5.4	5.4	0.5	-6.1	0.7	0.2	2.3	1.0	0.0	0.9	2.9	0.9
Other livestock	0.2	-8.6	0.3	-1.9	1.6	0.1	-2.4	0.7	-0.9	1.0	-0.2	0.5
Dairy farms	6.4	12.5	0.2	-4.3	0.0	0.1	-2.2	-0.3	-0.1	-0.2	1.2	0.6
Wool and silk	-0.3	4.6	0.2	-3.7	1.5	-0.2	6.8	1.1	0.2	7.4	-0.5	0.1
Red meats	6.6	16.9	0.2	-3.2	0.7	0.3	1.5	0.7	-0.8	0.9	3.0	1.6
Other meats	0.5	8.7	0.7	-3.2	2.0	0.5	-2.6	0.8	-0.9	1.6	0.3	0.3
Vegetable oils and fats	-1.1	0.6	-2.2	5.1	6.2	0.8	-0.1	1.0	-1.2	1.8	0.9	-0.4
Dairy products	6.4	15.1	1.3	-4.9	-0.1	1.4	-3.1	-0.4	-0.2	-0.2	0.4	0.4
Rice	8.9	0.9	0.1	-3.0	0.4	0.6	9.1	4.5	-0.2	-0.2	0.3	-0.1
Sugar	2.6	1.2	1.4	-3.9	2.9	0.6	11.1	-5.2	1.2	2.3	0.3	4.0
Other processed foods	0.6	-0.1	1.4	-1.4	4.1	2.7	0.8	0.1	0.2	0.2	0.3	1.9
Beverages and tobacco	0.6	-0.5	-1.1	0.0	-1.0	-1.5	-6.4	1.0	0.1	-0.5	0.0	-0.4
Aggregate input use by crops												
Land	0.0	-3.1	0.0	-0.3	0.0	0.0	0.3	-0.6	-0.3	-0.1	0.0	0.0
Unskilled labor	2.4	2.2	-0.1	-3.2	-0.6	0.1	5.3	0.7	0.3	0.4	0.9	0.6
Skilled labor	2.4	2.2	-0.1	-3.3	-1.0	0.1	5.2	0.7	0.1	0.3	0.9	0.7
Capital	2.4	2.2	-0.1	-3.3	-1.1	0.1	5.3	0.7	0.1	0.3	0.9	0.7
Chemicals	5.7	6.4	0.1	-4.6	-1.8	0.4	7.7	1.0	-0.1	0.3	1.8	1.4

continued

Table 2. Output and input use impacts of trade liberalization and reduction in support in food and agriculture: *partial removal* of tariffs and subsidies, percent change (Continued)

	DFS	UK&I	France	Germany	ABNL	PSIG	S&RoEFTA	10EUacc	RoE	TMMENA	RoAf	RoW
Aggregate output												
Crops and livestock	-2.3	-5.0	-4.0	-2.9	-3.7	-2.5	-6.8	1.1	0.1	-0.8	0.5	0.2
Crops	-6.1	-5.7	-5.6	-4.2	-4.4	-3.1	-7.8	0.4	0.0	-1.0	0.5	0.2
Livestock	-0.7	-4.6	-2.5	-1.8	-3.2	-1.5	-6.3	1.9	0.2	-0.6	0.8	0.2
Commodity output												
Paddy rice	-10.8	-22.6	-23.7	-18.1	-36.8	-11.3	-23.2	1.0	-0.5	-0.2	0.1	0.1
Wheat	-9.8	-9.8	-13.9	-13.1	-15.4	-12.9	-8.2	1.1	0.3	-1.9	2.3	0.5
Other grains	-18.6	-14.8	-16.8	-15.9	-22.1	-18.4	-16.8	2.1	0.3	-0.6	0.8	0.3
Fruits, vegetables, nuts	-0.9	-1.5	-2.1	-1.6	-5.1	-0.6	-8.7	-1.0	-0.3	-0.8	0.9	0.2
Oil seeds	-6.9	-6.5	-15.2	-7.7	-17.0	-7.1	-14.2	1.4	1.3	-2.3	0.4	0.5
Sugar crops	-3.8	-10.4	-6.6	-4.3	-9.5	-4.1	-1.0	1.6	0.5	0.1	3.5	0.8
Plant fibers	-2.3	3.7	2.0	0.9	2.7	1.5	5.3	-1.1	-0.1	0.3	-0.4	-0.1
Other crops	0.5	0.6	0.6	1.9	0.2	0.2	-3.7	-0.1	-0.1	-1.4	-0.2	-0.1
Cattle	-4.9	-10.5	-6.3	-4.6	-8.3	-4.0	-4.3	6.2	1.0	-0.8	1.0	0.4
Other livestock	0.4	-2.5	-0.6	-1.0	-0.9	-0.7	-2.5	0.2	-0.3	-0.8	0.5	0.0
Dairy farms	-0.6	-1.7	-1.4	-1.4	-3.1	-0.6	-8.3	2.0	0.3	-0.8	0.5	0.2
Wool and silk	4.9	6.0	3.9	8.8	4.5	5.4	-81.8	1.1	0.6	0.4	0.7	0.2
Red meats	-4.9	-8.1	-4.9	-5.5	-9.4	-2.4	-0.7	2.3	1.8	-2.6	2.4	0.4
Other meats	-0.2	-1.4	-0.4	-1.1	-1.5	-0.4	-4.0	2.4	-1.3	-7.6	-0.5	-0.1
Vegetable oils and fats	-1.6	-2.3	-2.0	-0.4	-1.2	-4.5	16.4	-0.9	-1.8	-1.3	-1.6	0.5
Dairy products	-0.5	-1.8	-1.0	-1.5	-3.2	-0.3	-12.2	6.4	2.4	-2.5	1.4	0.8
Rice	-22.8	-12.5	-7.5	-24.5	-25.7	-8.6	3.6	3.1	-0.5	-0.4	0.0	0.1
Sugar	-3.7	-13.5	-9.9	-4.1	-9.8	-9.1	0.2	2.3	0.9	0.8	7.1	1.5
Other processed foods	-3.4	-2.0	-2.1	-2.7	-3.2	-1.6	9.7	0.6	0.0	-0.6	1.9	0.7
Beverages and tobacco	-1.0	3.9	3.4	0.4	0.9	0.9	-6.6	-0.8	-1.8	-8.8	-2.6	-0.5
Aggregate input use by crops												
Land	-17.5	-11.4	-6.4	-9.8	-5.3	-4.6	-1.3	-0.2	0.0	-0.1	0.0	0.0
Unskilled labor	-4.5	-4.8	-4.7	-3.0	-3.4	-2.7	-8.3	0.5	0.1	-1.0	0.5	0.3
Skilled labor	-6.4	-8.0	-6.8	-5.3	-4.0	-4.0	-8.3	-0.3	-0.1	-1.1	0.5	0.3
Capital	-10.9	-11.5	-10.7	-11.2	-6.3	-6.4	-8.4	-0.2	-0.1	-1.1	0.6	0.3
Chemicals	-11.8	-10.0	-15.3	-15.5	-12.9	-18.7	-29.1	1.9	0.1	-2.0	1.0	1.0

Table 3. Impacts of trade liberalization and reduction in support in food and agriculture on rate of use of chemicals in crops: *partial removal* of tariffs and subsidies

	Australia	NZ	China	Japan	Korea	RoAs	Canada	USA	Mexico	Brazil	Argentina	RoAm
	--- percent change in rate (i.e., quantity of chemicals per acre) ---											
Crops, as a whole	5.7	9.8	0.1	-4.4	-1.8	0.4	7.4	1.7	0.2	0.4	1.8	1.4
Paddy rice	17	9	0	-4	-1	0	4	1	-1	0	3	1
Wheat	10	15	-1	-14	2	1	18	8	1	0	5	2
Other grains	7	15	0	-4	-11	1	7	4	2	0	5	2
Fruits, vegetables, and nuts	4	9	0	-4	-1	0	0	-3	-1	0	2	1
Oil seeds	5	14	-2	-5	-7	0	5	-2	0	1	3	1
Sugar crops	7	14	0	-5	-1	0	6	-7	-1	1	2	3
Plant fibers	1	15	0	-2	-1	0	2	-3	-2	0	1	0
Other crops	4	1	0	-4	-3	0	1	-4	1	0	2	1

	DFS	UK&I	France	Germany	ABNL	PSIG	S&RoEFTA	10EUacc	RoE	TMMENA	RoAf	RoW
	--- percent change in rate (i.e., quantity of chemicals per acre) ---											
Crops, as a whole	6.8	1.6	-9.5	-6.3	-8.1	-14.7	-28.1	2.1	0.1	-1.8	1.0	0.9
Paddy rice	-38	-49	-34	-38	-41	-35	-61	2	0	-1	1	1
Wheat	9	11	3	7	32	31	-25	2	0	-3	2	1
Other grains	24	19	-4	11	35	-10	-28	3	0	-3	1	1
Fruits, vegetables, and nuts	-37	-28	-31	-35	-17	-40	-37	0	0	-2	1	1
Oil seeds	76	28	20	94	-14	35	-19	2	1	-3	1	1
Sugar crops	-26	-31	-28	-27	-15	-31	-5	3	0	-1	3	1
Plant fibers	-27	-28	-26	-29	-12	-42	-8	0	0	-1	0	1
Other crops	-34	-26	-36	-42	-22	-39	-37	1	0	-2	0	1

Table 4. Output and input use impacts of trade liberalization and reduction in support in food and agriculture: *total removal* of tariffs and subsidies, percent change

	Australia	NZ	China	Japan	Korea	RoAs	Canada	USA	Mexico	Brazil	Argentina	RoAm
Aggregate output												
Crops and livestock	13.3	24.9	0.2	-13.2	-1.2	0.6	14.5	2.8	-1.2	1.5	3.9	2.9
Crops	11.5	8.8	-0.6	-13.8	-3.3	0.6	29.8	3.0	0.1	1.0	2.6	2.6
Livestock	15.5	30.2	1.7	-11.4	6.2	0.5	-4.6	2.5	-3.3	2.9	5.8	3.5
Commodity output												
Paddy rice	122.4	0.4	1.3	-25.5	2.2	2.5	23.5	17.2	-6.9	-0.2	2.5	3.2
Wheat	22.7	31.9	-12.1	-84.5	33.7	1.3	85.0	-3.4	1.1	1.8	11.3	6.9
Other grains	18.9	31.6	2.9	-19.0	-78.3	2.6	15.1	-0.5	-7.7	1.3	12.7	5.4
Fruits, vegetables, nuts	4.0	-0.1	1.1	-5.9	-2.5	-0.3	1.3	8.7	3.4	-0.6	-1.1	2.4
Oil seeds	6.9	26.6	-14.5	-56.2	-45.3	0.0	9.3	7.3	5.1	9.0	0.7	1.2
Sugar crops	8.6	20.7	2.2	-12.3	4.4	0.6	38.9	-17.0	4.8	3.4	0.5	8.9
Plant fibers	-9.8	30.0	0.0	19.8	6.0	-1.5	23.5	3.6	0.0	-1.2	-4.3	-4.5
Other crops	11.7	-30.4	0.0	-8.1	-10.6	-2.7	3.2	1.5	15.6	-2.5	-4.6	0.7
Cattle	22.5	23.8	3.3	-16.9	4.4	1.0	11.1	3.8	-0.1	5.7	14.4	5.0
Other livestock	-0.8	-37.4	1.7	-4.7	9.5	0.5	-9.2	2.3	-5.5	4.2	-1.3	3.0
Dairy farms	38.6	53.0	0.8	-17.1	-0.9	0.2	-12.7	-0.6	-1.4	-1.3	5.9	2.9
Wool and silk	-4.0	20.1	1.5	-11.4	8.2	-0.7	27.4	5.1	0.5	28.4	-2.1	0.4
Red meats	28.9	75.9	1.5	-8.2	4.4	2.1	8.9	2.8	-3.6	6.2	15.1	11.1
Other meats	2.0	22.4	3.4	-9.6	9.8	1.9	-9.5	3.9	-6.1	7.4	0.3	2.6
Vegetable oils and fats	-4.1	2.4	-11.2	17.9	47.9	2.9	0.5	2.8	-6.4	6.2	2.2	-1.1
Dairy products	38.9	64.2	7.3	-19.7	-1.5	6.6	-17.9	-0.7	-2.5	-1.2	1.8	1.1
Rice	116.2	3.5	0.2	-22.2	2.4	5.3	45.4	60.4	0.2	-0.9	1.5	-1.6
Sugar	8.7	4.6	4.5	-12.4	17.9	1.9	52.1	-17.3	5.6	5.8	0.6	15.4
Other processed foods	1.6	-7.3	5.5	-4.2	32.4	8.8	2.4	0.4	-1.7	0.2	0.6	5.7
Beverages and tobacco	1.1	-2.6	-8.0	0.6	-6.1	-8.2	-23.6	4.5	-0.3	-2.6	-0.2	-2.2
Aggregate input use by crops												
Land	0.5	-13.1	-0.2	-1.6	-0.1	0.1	1.9	-2.1	-1.4	-0.5	-0.5	-0.2
Unskilled labor	12.3	7.5	-0.6	-14.6	-3.8	0.7	29.9	3.2	1.1	1.5	3.4	2.7
Skilled labor	12.3	7.7	-0.6	-15.0	-6.4	0.7	29.6	3.0	0.0	1.3	3.4	3.0
Capital	12.3	7.7	-0.6	-15.4	-6.8	0.7	29.7	3.0	-0.2	1.3	3.4	2.9
Chemicals	32.8	27.9	0.0	-18.7	-10.3	2.3	48.1	5.2	-0.8	1.1	7.9	6.6

continued

Table 4. Output and input use impacts of trade liberalization and reduction in support in food and agriculture: *total removal* of tariffs and subsidies, percent change (Continued)

	DFS	UK&I	France	Germany	ABNL	PSIG	S&RoEFTA	10EUacc	RoE	TMMENA	RoAf	RoW
Aggregate output												
Crops and livestock	-2.7	-16.9	-13.8	-10.1	-10.6	-9.5	-24.1	4.5	0.3	-4.9	2.6	0.6
Crops	-13.7	-16.6	-18.0	-14.3	-10.7	-11.1	-16.7	0.5	0.0	-6.1	2.3	0.7
Livestock	2.2	-17.0	-9.5	-7.0	-10.4	-7.1	-27.6	8.6	0.7	-3.1	4.0	0.5
Commodity output												
Paddy rice	-6.5	-53.3	-59.9	-44.2	-74.9	-29.4	-32.3	16.6	-3.1	0.9	0.9	0.6
Wheat	-13.8	-29.3	-45.8	-42.8	-46.1	-43.2	-46.8	1.4	0.7	-11.1	6.0	1.2
Other grains	-48.7	-38.9	-50.8	-44.9	-55.7	-55.0	-52.2	6.6	0.8	-4.8	3.0	0.2
Fruits, vegetables, nuts	-3.7	-4.3	-5.9	-5.5	-11.8	-3.1	0.5	-4.8	-1.3	-6.1	2.9	1.0
Oil seeds	-21.8	-20.0	-45.2	-22.6	-51.7	-23.5	-30.6	4.8	7.5	-10.1	2.9	2.0
Sugar crops	-13.3	-30.7	-18.1	-12.4	-27.1	-14.3	11.5	5.0	3.1	-2.2	14.8	2.2
Plant fibers	-0.3	12.4	5.2	1.1	12.1	3.2	18.3	-3.6	1.0	4.0	-0.5	-0.2
Other crops	6.1	2.5	2.4	3.9	2.9	0.3	-7.8	-0.4	-0.2	-0.2	0.3	-0.6
Cattle	-11.4	-34.9	-24.6	-19.1	-31.8	-18.9	-26.3	28.9	4.7	-5.1	5.4	1.9
Other livestock	4.5	-9.0	-1.3	-2.5	-0.7	-2.3	-12.8	-1.8	-2.1	-3.5	2.5	-0.4
Dairy farms	4.2	-6.7	-5.1	-5.6	-9.7	-2.1	-33.3	11.9	1.7	-6.1	2.3	0.8
Wool and silk	7.4	21.9	15.1	30.7	18.5	22.5	-99.9	5.1	3.0	3.3	3.4	1.3
Red meats	-19.3	-29.1	-20.4	-22.9	-35.1	-11.5	-0.8	10.9	5.9	-19.4	14.7	1.7
Other meats	1.8	-5.0	-0.7	-3.5	-4.2	-1.4	-22.7	7.8	-6.6	-33.4	-3.1	-0.5
Vegetable oils and fats	-4.5	-6.6	-5.2	0.7	-0.1	-15.1	114.2	-4.3	-8.8	-2.9	-8.3	0.9
Dairy products	4.5	-7.4	-3.3	-6.0	-9.9	-0.7	-48.2	40.4	13.8	-17.8	7.2	3.8
Rice	-60.5	-38.6	-29.4	-63.8	-70.1	-22.8	58.5	29.9	-3.3	1.5	0.3	1.0
Sugar	-11.4	-39.1	-27.8	-11.5	-26.7	-29.6	16.9	7.3	5.0	-1.5	30.7	4.3
Other processed foods	-7.4	-5.9	-6.5	-8.0	-8.9	-4.5	55.7	0.5	-1.7	-3.9	5.5	1.1
Beverages and tobacco	-6.3	22.1	18.1	2.2	9.0	5.0	53.7	-6.3	-15.4	-59.0	-16.8	-3.7
Aggregate input use by crops												
Land	-29.9	-22.6	-13.2	-17.8	-6.6	-8.6	1.0	-1.0	-0.1	-0.9	0.0	0.0
Unskilled labor	-8.4	-13.0	-14.4	-9.7	-7.6	-8.9	-16.5	1.2	0.1	-6.6	2.2	1.0
Skilled labor	-14.3	-21.8	-19.1	-14.6	-9.0	-12.4	-16.7	-3.3	-0.9	-6.6	2.5	1.0
Capital	-25.1	-31.2	-30.5	-29.1	-15.1	-19.5	-17.0	-3.5	-0.9	-6.7	2.6	1.0
Chemicals	-22.9	-23.4	-39.4	-36.9	-30.1	-36.7	-70.8	4.8	-0.5	-11.5	4.6	2.9

Table 5. Impacts of trade liberalization and reduction in support in food and agriculture on rate of use of chemicals in crops: *total removal* of tariffs and subsidies

	Australia	NZ	China	Japan	Korea	RoAs	Canada	USA	Mexico	Brazil	Argentina	RoAm
	--- percent change in rate (i.e., quantity of chemicals per acre) ---											
Crops, as a whole	32.1	47.2	0.1	-17.3	-10.3	2.2	45.4	7.4	0.7	1.7	8.4	6.8
Paddy rice	174	48	1	-20	-7	3	28	14	-5	1	13	7
Wheat	46	80	-9	-48	12	2	107	27	8	2	21	10
Other grains	43	80	2	-14	-62	4	39	16	12	2	24	9
Fruits, vegetables, and nuts	22	38	0	-16	-8	1	2	-6	-6	2	10	7
Oil seeds	27	73	-11	-21	-39	2	27	-1	0	5	13	6
Sugar crops	30	78	1	-17	-4	2	30	-18	-7	4	11	11
Plant fibers	3	78	0	-9	-3	0	16	-8	-7	1	5	1
Other crops	24	0	0	-16	-14	-1	5	-10	2	1	8	5

	DFS	UK&I	France	Germany	ABNL	PSIG	S&RoEFTA	10EUacc	RoE	TMMENA	RoAf	RoW
	--- percent change in rate (i.e., quantity of chemicals per acre) ---											
Crops, as a whole	10.1	-1.1	-30.2	-23.3	-25.2	-30.8	-71.1	5.9	-0.4	-10.7	4.6	2.9
Paddy rice	-15	-76	-60	-55	-77	-47	-89	22	-1	-5	3	3
Wheat	66	32	-5	7	40	29	-87	5	-2	-18	6	3
Other grains	30	31	-23	12	33	-39	-83	10	-2	-19	5	2
Fruits, vegetables, and nuts	-50	-43	-47	-52	-31	-57	-60	-2	0	-11	5	4
Oil seeds	151	71	14	180	-52	55	-39	7	6	-16	5	4
Sugar crops	-31	-50	-39	-37	-26	-41	9	9	1	-10	11	4
Plant fibers	-34	-37	-38	-42	-11	-57	-34	-1	1	-4	2	2
Other crops	-41	-38	-52	-56	-31	-53	-80	3	1	-7	3	2

Table 6. Selected simulation impacts of liberalization, potentially problematic sector/region combinations

A. Partial liberalization

	Australia	NZ	Japan	Korea	Canada	USA	Mexico	Argentina	DFS	UK&I	France	Germany	ABNL	PSIG	S&RoEFTA	10EUacc	RoAf
Paddy Rice	q, i																
Wheat	i	i			q, i					i			i	i			
Others Grains		i							i	i		i	i	i			
Frts, Vegs, Nuts																	
Oilseeds		i							i	i	i	i		i			
Sugar Crops		i															
Plant Fibers		i															
Other Crops																	

B. Total liberalization

	Australia	NZ	Japan	Korea	Canada	USA	Mexico	Argentina	DFS	UK&I	France	Germany	ABNL	PSIG	S&RoEFTA	10EUacc	RoAf
Paddy Rice	q, i	i			q, i	q, i		i								q, i	
Wheat	q, i	q, i		q, i	q, i	i		q, i	i	i			i	i			
Others Grains	q, i	q, i			q, i	i	i	q, i	i	i		i	i			i	
Frts, Vegs, Nuts	i	i						i									
Oilseeds	i	q, i			i			i	i	i	i	i		i			
Sugar Crops	i	q, i			q, i			i							q		q
Plant Fibers		q, i	q		q, i					q			q		q		
Other Crops	q, i						q										

Note: A "q" entry identifies a sector which would increase by 10 percent or more in scale; an "i" entry identifies a sector that would intensify its use of chemicals (i.e., quantity chemicals per acre of land) by 10 percent or more.

Table 7. Gross Nitrogen Balances and liberalization impacts

	Uptake coefficients									Simulations impacts					
										Partial liberalization			Total liberalization		
	Paddy rice	Wheat	Other grains	Fruits, vegetables, nuts	Oil seeds	Sugar crops	Plant fibers	Other crops	Crops Average	Uptake	Chemical use	Balance	Uptake	Chemical use	Balance
	---- Kg/tones ----									---- percent change ----					
Australia	22.0	20.0	18.8	7.3	39.2	1.5	5.0	29.3	15.9	3.0	5.7	2.7	15.9	32.8	16.9
NZ		21.0	18.0	11.0	35.0			40.0	15.4	2.4	6.4	4.0	9.4	27.9	18.5
Japan	20.7	25.2	19.1	17.2	68.3	1.9		16.8	18.2	-3.1	-4.6	-1.5	-14.8	-18.7	-3.9
Korea	18.0	21.9	20.0	18.0	50.1		5.0	48.7	21.2	-0.9	-1.8	-0.9	-5.6	-10.3	-4.7
Canada		30.7	27.6	11.0	41.7	2.0	5.0	32.5	27.2	5.9	7.7	1.8	33.1	48.1	15.0
USA	9.6	20.0	17.5	2.8	37.7	1.8	5.0	26.1	17.2	0.7	1.0	0.3	2.6	5.2	2.5
Mexico	13.5	24.3	18.6	9.0	40.4	5.4	5.0	25.8	13.2	0.0	-0.1	-0.1	-0.6	-0.8	-0.1
DFS		19.0	17.1	10.7	34.6	2.0	5.0	11.9	13.7	-7.5	-11.8	-4.3	-16.2	-22.9	-6.6
UK&I		18.6	17.4	10.7	30.8	1.9		21.6	15.5	-5.7	-10.0	-4.3	-16.0	-23.4	-7.4
France	25.0	26.5	20.3	9.2	38.5	2.0	5.0	15.8	16.7	-7.5	-15.3	-7.8	-23.3	-39.4	-16.1
Germany		24.7	21.3	12.9	49.5	1.8	7.5	17.5	17.3	-5.4	-15.5	-10.2	-17.0	-36.9	-20.0
ABNL		21.1	17.4	9.2	35.4	1.8	19.0	21.4	15.2	-3.6	-12.9	-9.3	-8.4	-30.1	-21.7
PSIG	22.2	24.6	21.6	8.5	39.2	2.1	5.0	15.7	14.8	-5.1	-18.7	-13.6	-16.5	-36.7	-20.2
S&RoEFTA		20.7	16.2	6.9	40.8	1.5	30.0	23.6	16.1	-7.3	-29.1	-21.7	-20.1	-70.8	-50.7
10EUacc	26.4	24.2	21.8	11.3	40.8	3.3	8.5	18.8	18.1	0.6	1.9	1.3	1.4	4.8	3.5

Source: OECD (2002), *Gross Nitrogen Balances, Handbook*, OECD and Eurostat, and authors' calculations.

Table 8. Consumption of pesticides (tonnes of active ingredients)

Australia	34,200
NZ	3,368
Japan	64,500
Korea	26,264
Canada	44,293
USA	320,236
Mexico	36,000
DFS	5,730
UK&I	37,842
France	120,502
Germany	35,403
ABNL	24,071
PSIG	226,268
S&RoEFTA	2,328
Total	981,006

Source: OECD (2003b), and authors' calculations.

Table 9. Agricultural green-house gas emissions (in Gg of CO_2 equivalent)

	Enteric Fermentation	Manure Management	Rice Cultivation	Agric. Soils	Prescribed Burning of Savannas	Field Burning of Agricultural Residues	Other Agric.	TOTAL Agr.	NATIONAL TOTAL
Australia	60,408	2,196	722	15,649	26,586	861	0	106,422	492,506
NZ	29,354	485	0	11,592	0	43	0	41,473	77,148
Japan	6,958	12,209	6,542	8,225	0	425	0	34,359	1,397,002
Canada	18,372	9,302	0	33,359	0	0	0	61,031	682,099
USA	126,771	52,927	7,481	297,489	0	2,001	0	486,669	6,900,619
DFS	7,714	3,010	0	17,629	0	0	0	28,352	235,899
UK&I	28,998	6,018	0	36,843	0	0	0	71,858	756,921
France	29,334	6,506	191	51,205	0	0	0	87,235	574,245
Germany	22,170	19,085	0	25,594	0	0	0	66,849	1,058,820
ABNL	14,612	7,049	0	14,636	0	77	0	36,314	461,469
PSIG	31,975	21,285	2,353	48,503	0	709	0	104,813	1,063,367
S&RoEFTA	4,602	1,172	0	4,980	0	17	0	10,772	110,178
10EUacc	17,744	4,007	19	19,338	0	50	0	42,997	775,880
RoE	1,595	1,008	32	11,043	0	33	0	13,711	89,812
Total	400,607	146,259	17,340	596,085	26,586	4,216	0	1,192,855	14,675,965

Source: United Nations Framework Convention on Climate Change (2002) and authors' calculations.

Appendix Tables

Appendix Table 1. Mapping between the 30 model sectors and the 67 sectors in the GTAP database

Aggregate model sector		Sector in GTAP database	
1	Paddy rice	*pdr*	*Paddy rice*
2	Wheat	*wht*	*Wheat*
3	Other grains	*gro*	*Cereal grains nec*
4	Fruits, vegetables, nuts	*v_f*	*Vegetables, fruit, nuts*
5	Oil seeds	*osd*	*Oil seeds*
6	Sugar crops	*c_b*	*Sugar cane, sugar beet*
7	Plant fiberss	*pfb*	*Plant-based fibers*
8	Other crops	*ocr*	*Crops nec*
9	Cattle	*ctl*	*Cattle, sheep, goats, horses*
10	Other livestock	*oap*	*Animal products nec*
11	Dairy farms	*rmk*	*Raw milk*
12	Wool and silk	*wol*	*Wool, silk-worm cocoons*
13	Forestry	*for*	*Forestry*
14	Fishing	*fsh*	*Fishing*
15	Minerals	*col*	*Coal*
		oil	*Oil*
		gas	*Gas*
		omn	*Minerals nec*
16	Red meats	*cmt*	*Meat: cattle, sheep, goats, horse*
17	Other meats	*omt*	*Meat products nec*
18	Vegetable oils and fats	*vol*	*Vegetable oils and fats*
19	Dairy products	*mil*	*Dairy products*
20	Rice	*pcr*	*Processed rice*
21	Sugar	*sgr*	*Sugar*
22	Other processed foods	*ofd*	*Food products nec*
23	Beverages and tobacco	*b_t*	*Beverages and tobacco products*
24	Textiles, clothing, and footwear	*tex*	*Textiles*
		wap	*Wearing apparel*
		lea	*Leather products*
25	Petroleum, coal prods	*p_c*	*Petroleum, coal products*
26	Chem., rubbers, plastics	*crp*	*Chemical, rubber, plastic prods*
27	Other manufacturing	*lum*	*Wood products*
		ppp	*Paper products, publishing*
		nmm	*Mineral products nec*
		i_s	*Ferrous metals*
		nfm	*Metals nec*
		fmp	*Metal products*
		mvh	*Motor vehicles and parts*
		otn	*Transport equipment nec*
		ele	*Electronic equipment*
		ome	*Machinery and equipment nec*
		omf	*Manufactures nec*
28	Trade	*trd*	*Trade*
29	Transportation services	*otp*	*Transport nec*
		wtp	*Sea transport*
		atp	*Air transport*
30	Other services	*ely*	*Electricity*
		gdt	*Gas manufacture, distribution*
		wtr	*Water*
		cns	*Construction*
		cmn	*Communication*
		ofi	*Financial services nec*
		isr	*Insurance*
		obs	*Business services nec*
		ros	*Recreation and other services*
		osg	*PubAdmin/Defence/Health/Educat*
		dwe	*Dwellings*

Appendix Table 2. Output and input use impacts of *partial removal* of domestic support in food and agriculture, percent change

	Australia	NZ	China	Japan	Korea	RoAs	Canada	USA	Mexico	Brazil	Argentina	RoAm
Aggregate output												
Crops and livestock	0.3	0.3	0.0	-0.1	-0.1	0.0	0.4	0.1	0.0	0.0	0.2	-0.1
Crops	0.5	-0.6	0.0	-0.1	0.0	0.0	0.8	0.3	0.0	0.0	0.3	-0.2
Livestock	0.0	0.5	0.1	-0.1	-0.2	0.1	-0.1	-0.1	0.1	0.0	0.1	0.1
Commodity output												
Paddy rice	-0.2	0.1	0.0	-0.1	0.0	0.0	0.7	-0.2	-0.8	0.0	-0.1	0.1
Wheat	3.6	0.9	0.4	1.0	2.4	0.3	3.5	-4.2	1.9	0.3	1.2	1.7
Other grains	0.3	0.8	0.4	-0.6	0.6	0.3	0.5	-1.1	-0.3	0.1	1.6	1.3
Fruits, vegetables, nuts	-0.4	-1.2	0.0	-0.1	0.0	-0.1	-0.9	1.2	0.0	0.0	-0.3	-0.5
Oil seeds	0.2	1.1	0.2	-11.0	-0.2	0.1	0.0	1.2	0.5	1.0	0.2	1.0
Sugar crops	-0.4	0.0	0.0	-0.1	0.0	0.0	0.2	0.4	-0.1	0.0	-0.1	0.0
Plant fibers	-1.0	0.7	-0.2	-0.6	-0.3	-0.2	0.4	1.3	-0.3	-0.1	-0.5	-0.5
Other crops	0.1	-2.6	-0.6	-0.1	-0.2	-0.6	-0.9	2.4	0.1	-1.1	-1.0	-0.9
Cattle	0.7	0.8	0.1	0.0	-0.1	0.1	0.6	-0.1	0.6	0.1	0.2	0.2
Other livestock	-0.3	-0.1	0.0	-0.2	-0.2	0.1	-0.9	0.0	0.0	0.1	0.0	0.2
Dairy farms	-0.1	0.2	0.0	-0.3	-0.1	0.0	-0.1	-0.2	-0.1	0.0	0.1	0.1
Wool and silk	-0.8	1.0	0.1	0.2	0.3	0.7	3.6	-0.1	0.3	0.6	0.0	0.2
Red meats	0.5	2.1	0.1	-0.2	-0.1	0.2	0.0	-0.3	0.1	0.1	0.2	0.2
Other meats	-0.1	0.8	0.1	-0.1	-0.1	0.1	-0.4	-0.1	0.0	0.1	0.0	0.1
Vegetable oils and fats	0.2	0.1	0.1	0.0	-0.2	0.4	0.2	0.3	-0.2	0.3	0.1	0.2
Dairy products	-0.1	0.1	0.1	-0.3	-0.1	0.2	-0.1	-0.2	-0.1	0.0	0.0	0.1
Rice	-0.1	0.1	0.0	-0.1	0.0	0.0	0.0	-1.5	0.2	0.0	-0.1	0.2
Sugar	-0.4	0.1	0.0	-0.1	-0.1	0.0	-0.3	0.4	-0.1	-0.1	-0.1	0.0
Other processed foods	0.0	0.1	0.1	-0.1	-0.2	0.0	0.0	0.0	-0.6	0.0	0.0	0.1
Beverages and tobacco	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.1	0.0	0.0	0.0
Aggregate input use by crops												
Land	0.3	-0.5	0.0	-0.1	0.0	0.0	-0.5	-0.7	-0.4	0.0	0.1	-0.1
Unskilled labor	0.5	-0.7	0.0	-0.1	0.0	-0.1	0.8	0.3	0.0	0.0	0.3	-0.3
Skilled labor	0.5	-0.7	0.0	-0.2	-0.4	-0.1	0.8	0.2	-0.1	0.0	0.3	-0.3
Capital	0.5	-0.7	0.0	-0.2	-0.5	0.0	0.8	0.2	-0.1	0.0	0.3	-0.3
Chemicals	1.0	-0.9	0.1	-0.1	-0.2	-0.1	1.3	-0.6	0.2	0.0	0.3	-0.4

continued

Appendix Table 2. Output and input use impacts of *partial removal* of domestic support in food and agriculture, percent change (Continued)

	DFS	UK&I	France	Germany	ABNL	PSIG	S&RoEFTA	10EUacc	RoE	TMMENA	RoAf	RoW
Aggregate output												
Crops and livestock	-0.6	-2.1	-1.7	-0.6	-0.6	-0.8	-2.5	0.1	0.0	0.1	-0.1	0.0
Crops	-3.1	-2.4	-2.5	-1.6	-1.7	-0.9	-1.5	0.1	0.0	0.1	-0.2	-0.1
Livestock	0.4	-2.0	-0.8	0.1	0.3	-0.5	-3.1	0.2	0.0	0.2	0.2	0.0
Commodity output												
Paddy rice	0.3	1.0	0.1	0.2	0.0	0.7	-16.7	0.2	0.0	0.1	0.0	0.0
Wheat	-6.0	-5.1	-6.5	-6.1	-6.8	-6.7	-2.0	0.4	0.1	1.1	2.0	0.2
Other grains	-10.2	-8.6	-9.2	-10.5	-10.9	-15.4	-9.2	0.6	0.1	0.8	0.4	0.0
Fruits, vegetables, nuts	0.9	0.2	0.1	0.7	-1.7	1.7	-0.2	-0.4	-0.1	-0.3	-0.3	-0.1
Oil seeds	-6.6	-7.2	-15.4	-8.0	-18.5	-6.4	-1.1	1.6	1.7	0.0	0.8	0.2
Sugar crops	-0.1	0.0	0.2	0.1	0.0	0.2	-1.7	-0.1	0.0	-0.1	0.0	0.0
Plant fibers	-0.7	1.1	0.9	0.6	0.3	1.1	-0.5	-0.6	-0.8	-0.4	-0.4	-0.1
Other crops	0.2	0.4	0.8	2.0	0.1	1.1	0.3	-0.1	-0.1	-1.5	-0.8	-0.4
Cattle	-0.5	-5.6	-2.5	0.5	0.3	-1.4	-1.9	1.6	0.2	0.7	0.2	0.2
Other livestock	0.7	-0.8	-0.2	-0.3	0.5	-0.3	-2.7	-0.2	0.0	0.1	0.2	0.0
Dairy farms	0.4	-0.1	-0.2	0.2	-0.1	-0.1	-3.4	0.0	-0.1	0.0	0.0	0.0
Wool and silk	4.5	2.5	1.8	4.5	1.2	2.0	-82.7	0.4	0.2	0.0	0.4	0.2
Red meats	-0.3	-1.8	-1.5	0.1	-0.3	-0.8	-1.0	0.3	0.4	0.2	0.5	0.1
Other meats	0.4	-0.7	-0.1	-0.2	0.4	-0.2	-0.7	-0.2	0.0	0.0	0.1	0.0
Vegetable oils and fats	-0.3	-0.6	-0.1	0.0	0.0	-2.8	-1.3	0.0	0.3	0.3	0.3	0.1
Dairy products	0.4	0.1	0.3	0.2	-0.1	0.0	-4.8	-0.1	-0.2	-0.1	0.1	-0.1
Rice	0.3	0.7	0.1	0.5	0.4	0.4	0.1	0.2	0.0	0.1	0.0	0.0
Sugar	-0.1	0.1	0.2	0.1	0.0	0.1	-1.4	-0.1	0.0	-0.2	0.0	0.0
Other processed foods	-0.3	-0.3	0.2	-0.1	-0.3	0.1	-1.5	0.0	0.0	-0.1	0.0	0.0
Beverages and tobacco	-1.5	0.1	0.2	0.0	0.2	-0.1	0.4	-0.1	0.0	-0.1	0.0	0.0
Aggregate input use by crops												
Land	-17.4	-11.4	-6.3	-9.7	-5.5	-4.6	-0.7	0.0	0.0	0.0	-0.1	0.0
Unskilled labor	-1.6	-1.5	-1.8	-0.4	-1.4	-0.5	-1.5	0.2	0.1	0.1	-0.2	-0.1
Skilled labor	-3.6	-5.0	-4.0	-2.9	-2.0	-1.9	-1.6	-0.5	-0.1	0.1	-0.2	-0.1
Capital	-6.9	-8.0	-7.0	-8.0	-3.9	-4.2	-1.6	-0.5	-0.1	0.1	-0.2	-0.1
Chemicals	-6.3	-4.8	-9.2	-9.2	-6.1	-14.3	-8.7	0.5	-0.1	0.0	-0.2	0.0

Appendix Table 3. Output and input use impacts of *partial removal* of import tariffs in food and agriculture, percent change

	Australia	NZ	China	Japan	Korea	RoAs	Canada	USA	Mexico	Brazil	Argentina	RoAm
Aggregate output												
Crops and livestock	2.0	4.5	0.0	-3.1	-0.1	0.1	1.5	0.5	-0.2	0.3	0.7	0.7
Crops	1.4	3.3	-0.2	-2.9	-0.5	0.1	3.8	0.3	0.1	0.2	0.4	0.9
Livestock	2.6	4.9	0.3	-3.7	1.1	0.0	-1.4	0.6	-0.7	0.4	1.1	0.3
Commodity output												
Paddy rice	12.2	-0.2	0.1	-3.8	0.4	0.3	3.6	2.8	-0.5	0.0	0.5	0.6
Wheat	1.6	5.7	-2.1	-34.9	2.7	0.1	10.2	3.0	-1.7	0.0	1.1	0.1
Other grains	2.4	5.7	-0.1	-6.1	-15.4	0.3	1.2	0.8	-1.2	0.1	1.1	-0.2
Fruits, vegetables, nuts	1.3	2.5	0.3	-1.7	-0.1	0.0	0.7	0.7	0.7	0.0	0.2	1.2
Oil seeds	1.0	4.6	-3.4	-12.8	-8.0	-0.1	1.6	0.8	0.6	0.9	0.2	0.2
Sugar crops	2.3	2.6	-0.1	-3.9	0.4	0.1	7.1	-5.6	0.8	0.5	0.3	1.8
Plant fibers	-1.1	5.5	0.1	5.1	1.2	-0.1	3.0	0.0	0.1	-0.2	-0.5	-0.7
Other crops	1.7	-3.3	0.6	-2.3	-2.0	0.1	1.9	-2.3	3.3	0.6	-0.1	1.0
Cattle	4.2	4.4	0.2	-6.3	0.8	0.0	1.5	1.0	-0.6	0.7	2.6	0.6
Other livestock	0.6	-6.7	0.3	-1.8	1.8	0.0	-1.7	0.6	-0.8	0.8	-0.1	0.2
Dairy farms	4.1	8.1	0.0	-4.5	-0.5	0.0	-3.4	-0.3	-0.6	-0.3	1.1	0.1
Wool and silk	0.5	3.7	0.2	-4.0	1.2	-1.0	2.9	1.1	-0.2	6.8	-0.5	-0.1
Red meats	5.4	14.6	-0.2	-3.1	0.8	-0.1	1.2	0.9	-0.9	0.8	2.8	1.2
Other meats	0.6	8.5	0.4	-3.2	1.8	0.3	-2.4	0.8	-0.9	1.4	0.3	0.1
Vegetable oils and fats	-1.3	0.3	-2.4	5.1	6.3	0.3	-0.3	0.6	-0.9	1.6	0.9	-0.6
Dairy products	4.1	9.5	-0.6	-5.1	-0.7	-0.9	-4.7	-0.3	-1.9	-0.4	0.2	-0.5
Rice	8.9	0.5	0.0	-3.0	0.4	0.5	8.4	5.9	-0.6	-0.3	0.1	0.3
Sugar	2.4	0.8	-0.2	-3.9	2.1	0.4	10.9	-5.7	1.0	0.7	0.3	3.2
Other processed foods	0.4	0.0	1.1	-1.4	4.2	2.5	0.5	0.0	0.7	0.1	0.3	1.6
Beverages and tobacco	0.7	-0.4	-1.1	0.0	-1.0	-1.5	-6.3	1.0	0.2	-0.5	0.0	-0.4
Aggregate input use by crops												
Land	-0.2	-1.5	0.0	-0.2	0.0	0.0	0.7	0.1	0.1	-0.1	-0.1	0.1
Unskilled labor	1.6	3.2	-0.2	-3.2	-0.6	0.1	3.8	0.3	0.2	0.3	0.5	1.0
Skilled labor	1.6	3.2	-0.2	-3.2	-0.6	0.1	3.8	0.3	0.2	0.3	0.5	1.0
Capital	1.6	3.2	-0.2	-3.2	-0.6	0.1	3.8	0.3	0.1	0.3	0.5	1.0
Chemicals	4.0	7.0	-0.1	-4.5	-1.6	0.4	5.4	1.4	-0.5	0.2	1.3	1.9

continued

Appendix Table 3. Output and input use impacts of *partial removal* of import tariffs in food and agriculture, percent change (Continued)

	DFS	UK&I	France	Germany	ABNL	PSIG	S&RoEFTA	10EUacc	RoE	TMMENA	RoAf	RoW
Aggregate output												
Crops and livestock	-0.4	-2.2	-1.8	-1.8	-2.3	-1.6	-0.4	0.7	-0.1	-1.1	0.5	0.2
Crops	-0.8	-2.4	-2.2	-2.0	-1.9	-2.1	-5.6	-0.1	-0.1	-1.2	0.6	0.2
Livestock	-0.2	-2.1	-1.4	-1.7	-2.7	-0.9	2.9	1.6	0.0	-1.0	0.4	0.0
Commodity output												
Paddy rice	-9.4	-22.5	-23.4	-17.7	-36.4	-10.9	-6.4	0.0	-0.6	-0.5	0.1	0.0
Wheat	-1.5	-3.7	-5.1	-6.1	-7.1	-5.9	-4.8	0.2	-0.1	-3.4	-0.5	0.1
Other grains	0.2	-3.1	-5.2	-2.6	-1.7	-2.9	-7.1	0.5	-0.1	-2.4	0.1	0.1
Fruits, vegetables, nuts	-1.9	-1.8	-2.3	-2.4	-3.6	-2.4	-7.1	-0.6	-0.2	-0.4	1.3	0.3
Oil seeds	-0.3	1.0	0.1	0.3	1.4	-0.8	-12.8	-0.2	-0.4	-2.3	-0.4	0.2
Sugar crops	-2.4	-7.2	-2.8	-1.9	-2.6	-2.5	0.6	0.9	0.1	-0.8	2.7	0.7
Plant fibers	-1.2	2.3	0.9	0.0	2.1	0.3	4.3	-0.4	0.8	0.8	0.0	0.0
Other crops	0.2	0.1	-0.2	-0.2	0.0	-0.8	-4.2	-0.2	-0.2	0.2	0.6	0.3
Cattle	-2.9	-4.2	-3.4	-4.3	-7.4	-2.3	-1.7	4.3	0.2	-1.8	0.6	0.1
Other livestock	0.0	-1.6	-0.4	-0.8	-1.4	-0.4	3.5	0.5	-0.3	-0.9	0.3	0.0
Dairy farms	0.6	-1.1	-0.8	-1.4	-1.6	-0.4	3.9	1.6	0.1	-1.4	-0.2	0.1
Wool and silk	0.0	2.9	1.8	3.4	2.8	2.9	4.8	0.6	0.3	0.5	0.2	0.0
Red meats	-3.0	-5.5	-2.8	-4.8	-7.7	-1.4	0.5	1.6	-0.6	-3.7	1.5	0.0
Other meats	0.0	-0.7	-0.3	-1.0	-1.8	-0.2	0.3	2.6	-1.6	-8.1	-0.8	-0.1
Vegetable oils and fats	-1.2	-1.7	-1.9	-0.4	-1.0	-1.7	19.7	-0.8	-2.2	-1.6	-1.9	0.3
Dairy products	0.7	-1.1	-0.6	-1.6	-1.5	-0.3	6.3	5.2	0.8	-4.4	-2.1	0.2
Rice	-23.0	-8.5	-7.7	-24.7	-25.6	-7.5	4.1	1.7	-0.6	-0.8	0.0	0.1
Sugar	-2.2	-9.3	-4.3	-1.7	-2.4	-5.1	1.3	1.2	0.2	-1.1	5.6	1.3
Other processed foods	-2.5	-1.5	-2.1	-2.4	-2.4	-1.4	14.6	0.1	-0.4	-0.6	1.7	0.6
Beverages and tobacco	0.5	3.7	3.1	0.3	0.7	1.0	-7.4	-0.5	-1.8	-8.6	-2.6	-0.4
Aggregate input use by crops												
Land	0.1	0.0	0.0	0.0	0.2	0.0	-1.3	-0.2	0.0	-0.1	0.1	0.1
Unskilled labor	-1.0	-2.4	-2.0	-1.9	-1.3	-2.1	-6.0	-0.1	-0.2	-1.3	0.6	0.3
Skilled labor	-1.0	-2.4	-2.1	-1.9	-1.3	-2.1	-5.9	-0.1	-0.2	-1.4	0.7	0.3
Capital	-0.8	-2.6	-2.7	-2.4	-1.4	-2.2	-5.9	0.0	-0.2	-1.4	0.7	0.3
Chemicals	-1.3	-3.8	-4.3	-4.6	-3.9	-4.5	-16.8	0.4	-0.3	-2.3	1.0	0.7

Appendix Table 4. Output and input use impacts of *partial removal* of export subsidies in food and agriculture, percent change

	Australia	NZ	China	Japan	Korea	RoAs	Canada	USA	Mexico	Brazil	Argentina	RoAm
Aggregate output												
Crops and livestock	0.4	1.1	0.0	0.1	0.0	0.0	0.5	0.1	0.1	0.1	0.1	0.0
Crops	0.2	-0.2	0.0	0.0	0.0	0.0	0.5	0.1	0.1	0.1	0.1	0.0
Livestock	0.6	1.5	0.0	0.2	0.1	0.0	0.5	0.1	0.1	0.1	0.1	0.2
Commodity output												
Paddy rice	0.0	0.1	0.0	0.0	0.0	0.0	0.2	0.0	0.1	0.1	0.2	0.0
Wheat	0.4	0.4	0.1	0.2	0.2	0.0	0.7	0.3	0.1	0.2	0.3	0.1
Other grains	0.3	0.4	0.1	0.3	0.1	0.1	0.9	0.3	0.1	0.1	0.5	0.1
Fruits, vegetables, nuts	0.0	-0.4	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0
Oil seeds	0.1	0.2	0.1	0.2	0.1	0.0	0.2	0.1	0.0	0.0	-0.1	-1.3
Sugar crops	0.6	1.2	0.8	0.1	0.1	0.1	0.4	0.1	0.3	0.8	0.0	0.4
Plant fibers	-0.2	0.4	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0
Other crops	0.3	-1.3	0.1	0.1	0.0	0.0	0.0	-0.1	0.0	-0.2	-0.1	0.0
Cattle	0.4	0.0	0.0	0.1	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.1
Other livestock	0.0	-1.7	0.0	0.0	0.1	0.0	0.2	0.1	0.0	0.1	0.0	0.1
Dairy farms	2.1	4.0	0.1	0.5	0.5	0.0	1.1	0.1	0.5	0.1	0.1	0.3
Wool and silk	0.0	-0.2	0.0	0.0	0.0	0.0	0.2	0.2	0.0	-0.1	0.0	0.0
Red meats	0.6	-0.1	0.3	0.1	0.0	0.3	0.2	0.1	0.0	0.0	0.0	0.1
Other meats	0.1	-0.4	0.2	0.1	0.3	0.1	0.3	0.1	0.0	0.1	0.0	0.1
Vegetable oils and fats	0.0	0.2	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	-0.1	-0.1
Dairy products	2.1	5.4	1.7	0.6	0.5	1.9	1.5	0.1	1.7	0.2	0.2	0.8
Rice	0.1	0.3	0.0	0.0	0.0	0.0	0.4	0.3	0.1	0.1	0.3	-0.5
Sugar	0.6	0.3	1.6	0.1	0.9	0.2	0.5	0.1	0.3	1.6	0.0	0.8
Other processed foods	0.2	-0.1	0.1	0.0	0.1	0.2	0.2	0.1	0.1	0.0	0.0	0.1
Beverages and tobacco	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aggregate input use by crops												
Land	-0.1	-1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unskilled labor	0.2	-0.2	0.0	0.0	0.0	0.0	0.5	0.1	0.1	0.1	0.1	0.0
Skilled labor	0.2	-0.2	0.0	0.0	0.0	0.0	0.5	0.1	0.1	0.1	0.1	0.0
Capital	0.2	-0.2	0.0	0.0	0.0	0.0	0.5	0.1	0.1	0.1	0.1	0.0
Chemicals	0.6	0.4	0.1	0.1	0.0	0.1	0.7	0.3	0.2	0.1	0.2	0.0

continued

Appendix Table 4. Output and input use impacts of *partial removal* of export subsidies in food and agriculture, percent change (Continued)

	DFS	UK&I	France	Germany	ABNL	PSIG	S&RoEFTA	10EUacc	RoE	TMMENA	RoAf	RoW
Aggregate output												
Crops and livestock	-1.2	-0.5	-0.5	-0.4	-0.7	-0.1	-2.0	0.2	0.2	0.2	0.1	0.1
Crops	-1.9	-0.8	-0.8	-0.7	-0.8	-0.1	-0.4	0.3	0.2	0.2	0.1	0.1
Livestock	-0.9	-0.4	-0.2	-0.2	-0.7	-0.1	-3.0	0.1	0.2	0.2	0.2	0.1
Commodity output												
Paddy rice	-1.3	-0.8	-0.4	-0.5	-0.3	-0.8	1.0	0.8	0.1	0.1	0.0	0.0
Wheat	-1.8	-0.9	-2.1	-0.9	-1.2	-0.2	-1.1	0.3	0.3	0.4	0.8	0.1
Other grains	-8.1	-3.4	-2.5	-2.9	-10.3	-0.5	-0.2	0.9	0.3	1.0	0.3	0.1
Fruits, vegetables, nuts	0.0	0.1	0.1	0.1	0.1	0.1	-0.9	0.1	0.0	0.0	-0.1	0.0
Oil seeds	0.1	0.1	0.3	0.1	0.4	0.1	-0.3	-0.1	0.0	0.0	0.1	0.1
Sugar crops	-1.3	-3.0	-3.8	-2.4	-6.5	-1.7	1.8	0.8	0.4	1.0	0.8	0.1
Plant fibers	-0.4	0.3	0.3	0.3	0.3	0.1	0.7	-0.1	0.0	0.0	0.0	0.0
Other crops	0.1	0.0	0.0	0.1	0.2	-0.1	0.1	0.1	0.2	0.0	0.0	0.0
Cattle	-1.4	-0.4	-0.3	-0.6	-0.9	-0.2	-0.5	-0.2	0.4	0.2	0.1	0.1
Other livestock	-0.4	-0.1	0.0	0.0	-0.1	0.0	-1.6	0.0	0.1	0.0	0.0	0.0
Dairy farms	-1.5	-0.6	-0.5	-0.3	-1.5	-0.1	-4.4	0.4	0.3	0.6	0.7	0.1
Wool and silk	0.3	0.4	0.3	0.6	0.4	0.3	0.7	0.1	0.0	-0.1	0.1	0.1
Red meats	-1.5	-0.8	-0.5	-0.7	-1.1	-0.2	-0.1	0.4	1.9	0.9	0.3	0.3
Other meats	-0.6	0.0	-0.1	0.0	-0.2	-0.1	-1.8	0.1	0.2	0.4	0.1	0.1
Vegetable oils and fats	-0.1	0.0	0.0	0.0	-0.1	0.0	-0.9	-0.1	0.1	-0.1	0.0	0.0
Dairy products	-1.5	-0.7	-0.7	-0.3	-1.7	-0.2	-6.7	1.4	1.7	1.7	3.3	0.7
Rice	0.1	-4.2	0.1	-0.2	-0.4	-1.3	-0.5	1.1	0.2	0.3	0.0	0.1
Sugar	-1.4	-4.0	-5.6	-2.5	-7.0	-4.0	2.0	1.2	0.6	2.0	1.6	0.2
Other processed foods	-0.5	-0.2	-0.2	-0.2	-0.6	-0.2	-2.0	0.5	0.3	0.2	0.2	0.1
Beverages and tobacco	0.1	0.1	0.1	0.0	0.1	0.0	0.2	-0.2	-0.1	-0.1	-0.1	0.0
Aggregate input use by crops												
Land	-0.2	-0.1	0.0	-0.1	-0.1	0.0	0.4	0.1	0.0	0.0	0.0	0.0
Unskilled labor	-1.7	-0.8	-0.8	-0.6	-0.6	-0.1	-0.5	0.3	0.2	0.2	0.1	0.1
Skilled labor	-1.7	-0.8	-0.8	-0.6	-0.7	-0.1	-0.5	0.3	0.2	0.2	0.1	0.1
Capital	-3.0	-1.1	-1.1	-1.0	-1.0	-0.1	-0.5	0.3	0.2	0.2	0.1	0.1
Chemicals	-3.8	-1.3	-1.8	-1.9	-3.0	-0.3	-2.7	0.9	0.5	0.4	0.2	0.3

Appendix Table 5. Output and input use impacts of *total removal* of domestic support in food and agriculture, percent change

	Australia	NZ	China	Japan	Korea	RoAs	Canada	USA	Mexico	Brazil	Argentina	RoAm
Aggregate output												
Crops and livestock	1.4	1.9	0.3	-0.4	-0.4	0.0	2.0	-0.6	-0.1	0.2	0.9	0.2
Crops	2.7	-1.0	0.4	-0.3	-0.2	-0.1	4.2	-0.3	-0.2	0.2	1.4	-0.1
Livestock	-0.1	2.8	0.3	-0.8	-1.0	0.3	-0.7	-1.1	-0.1	0.2	0.3	0.7
Commodity output												
Paddy rice	-0.4	0.7	0.1	-0.4	-0.4	-0.1	4.3	-2.0	-5.6	0.0	-0.5	0.9
Wheat	13.9	4.4	1.8	1.6	9.9	0.5	14.3	-13.9	4.6	1.4	5.3	6.8
Other grains	1.2	4.0	2.3	-2.7	1.4	1.5	2.6	-4.7	-2.4	0.5	7.2	6.0
Fruits, vegetables, nuts	-1.0	-3.3	-0.1	-0.2	-0.1	-0.3	-2.3	3.5	0.9	-0.2	-0.9	-1.4
Oil seeds	4.1	5.6	1.9	-35.6	-0.6	0.5	1.4	1.4	2.1	5.0	1.2	5.9
Sugar crops	-1.6	0.8	0.2	-0.6	0.3	-0.1	1.8	0.6	-0.7	-0.2	-0.2	0.3
Plant fibers	-2.4	3.5	-0.6	-1.8	-0.4	-0.7	2.3	3.9	-0.4	-0.3	-1.9	-1.6
Other crops	1.0	-7.3	-1.5	-0.3	-0.4	-1.7	-1.2	7.3	3.2	-3.4	-3.3	-2.4
Cattle	3.0	3.9	0.7	-0.4	-0.8	0.4	2.6	-1.4	2.0	0.3	1.0	0.7
Other livestock	-1.2	0.4	0.3	-0.7	-1.3	0.4	-3.8	-0.6	-0.6	0.3	0.0	0.9
Dairy farms	-0.2	1.4	0.1	-1.5	-0.5	0.0	-0.5	-0.9	-0.8	-0.1	0.2	0.5
Wool and silk	-4.2	5.0	0.3	1.0	1.5	3.4	13.8	-1.1	1.3	2.8	0.1	0.5
Red meats	2.9	10.3	0.7	-0.9	-0.8	0.8	0.4	-1.8	0.2	0.3	0.7	1.2
Other meats	-0.5	3.8	0.6	-0.4	-0.8	0.5	-1.9	-0.7	-0.5	0.3	-0.2	0.5
Vegetable oils and fats	1.2	0.7	0.3	-0.7	-1.5	2.0	1.3	-0.7	-1.8	1.1	0.4	1.5
Dairy products	-0.2	1.0	0.6	-1.7	-0.5	1.0	-0.7	-0.9	-0.8	0.0	-0.1	0.4
Rice	-0.3	0.4	0.1	-0.3	-0.4	-0.1	-0.4	-5.6	0.5	-0.1	-0.2	0.7
Sugar	-1.7	0.4	0.5	-0.5	-0.1	0.0	0.3	0.6	-0.8	-0.3	-0.2	0.2
Other processed foods	0.1	0.7	0.6	-0.2	-1.1	0.3	0.2	-0.2	-3.8	0.0	-0.2	0.7
Beverages and tobacco	-0.3	-0.1	0.0	-0.1	-0.2	-0.1	0.0	0.2	-0.5	-0.1	-0.1	0.0
Aggregate input use by crops												
Land	1.2	-1.7	0.0	-0.2	0.0	-0.1	-1.7	-2.6	-2.0	0.0	0.4	-0.2
Unskilled labor	2.7	-1.4	0.4	-0.1	0.2	-0.1	4.5	0.0	0.5	0.3	1.6	-0.2
Skilled labor	2.6	-1.4	0.4	-0.6	-2.5	-0.2	4.3	-0.2	-0.7	0.2	1.7	-0.1
Capital	2.6	-1.4	0.4	-0.6	-2.9	-0.1	4.3	-0.2	-0.7	0.2	1.7	-0.2
Chemicals	5.0	-1.3	0.6	-0.5	-0.9	-0.2	6.8	-2.8	1.4	0.1	2.3	0.0

continued

Appendix Table 5. Output and input use impacts of *total removal* of domestic support in food and agriculture, percent change (Continued)

	DFS	UK&I	France	Germany	ABNL	PSIG	S&RoEFTA	10EUacc	RoE	TMMENA	RoAf	RoW
Aggregate output												
Crops and livestock	-2.6	-7.5	-6.6	-2.9	-1.6	-4.1	-9.9	0.2	-0.1	0.6	0.2	-0.3
Crops	-10.6	-8.7	-9.5	-6.7	-4.6	-5.2	-5.7	0.2	0.0	0.4	-0.1	-0.4
Livestock	1.0	-7.0	-3.6	-0.1	0.9	-2.6	-12.2	0.2	-0.3	0.8	1.0	-0.1
Commodity output												
Paddy rice	1.3	3.5	1.9	1.8	2.9	1.8	-13.8	1.4	0.1	0.5	0.2	-0.1
Wheat	-20.0	-16.4	-23.3	-19.9	-21.6	-21.4	-9.3	0.3	-0.1	3.3	5.9	0.4
Other grains	-31.1	-25.7	-31.3	-31.2	-33.6	-48.2	-33.5	1.1	0.0	2.8	1.8	-0.2
Fruits, vegetables, nuts	1.2	-0.4	0.3	0.9	-2.7	2.8	-0.5	-0.9	-0.3	-0.9	-0.7	-0.2
Oil seeds	-22.6	-24.4	-46.6	-25.6	-55.4	-22.2	-3.3	4.6	8.1	-1.0	4.1	0.7
Sugar crops	-0.1	0.0	0.8	0.5	0.1	0.6	-6.1	-0.6	-0.3	-0.3	0.2	-0.3
Plant fibers	3.5	1.4	1.3	1.0	0.7	2.8	-2.7	-1.9	-1.9	-1.1	-1.1	-0.2
Other crops	0.5	0.4	1.9	2.9	0.3	2.6	1.7	0.2	-0.2	-3.4	-1.6	-1.7
Cattle	-2.9	-17.3	-10.2	0.1	-0.1	-6.1	-8.3	6.5	0.8	2.7	1.0	0.6
Other livestock	2.1	-3.4	-0.9	-1.2	2.2	-1.5	-9.9	-1.9	-0.5	0.5	1.0	-0.3
Dairy farms	1.1	-0.4	-0.7	0.6	-0.1	-0.6	-14.1	-0.4	-0.5	-0.2	0.2	-0.2
Wool and silk	8.1	3.8	5.4	11.2	3.7	5.3	-99.9	1.4	0.9	-0.1	1.8	0.8
Red meats	-2.0	-6.8	-6.5	-0.5	-2.1	-3.3	-4.5	0.9	1.5	0.9	2.1	0.4
Other meats	1.4	-2.9	-0.3	-0.6	1.9	-0.9	-3.1	-1.3	-0.2	0.1	0.6	-0.2
Vegetable oils and fats	-0.4	-2.1	0.8	0.4	0.2	-9.9	-4.6	-0.6	1.2	1.3	1.0	0.3
Dairy products	1.2	0.1	1.1	0.8	-0.2	0.1	-19.7	-0.8	-1.2	-0.2	0.6	-0.6
Rice	2.5	3.3	0.6	3.1	2.0	1.2	-1.1	1.2	0.0	0.8	0.1	0.0
Sugar	-0.1	0.2	1.1	0.5	0.1	0.6	-5.4	-0.6	-0.3	-0.7	0.2	-0.3
Other processed foods	0.4	-0.7	1.6	0.6	-0.9	0.8	-6.2	-0.2	0.0	-0.5	0.2	0.1
Beverages and tobacco	-7.1	0.0	0.4	0.0	0.6	-0.5	1.2	-0.6	0.0	-0.3	0.0	-0.1
Aggregate input use by crops												
Land	-30.6	-23.3	-13.3	-18.1	-8.0	-8.7	-1.2	-0.2	-0.1	-0.1	-0.1	-0.2
Unskilled labor	-4.9	-4.8	-6.3	-2.4	-3.4	-3.0	-5.4	1.1	0.3	0.5	-0.1	-0.4
Skilled labor	-11.4	-15.0	-12.5	-8.7	-5.0	-6.9	-5.8	-3.3	-0.8	0.5	-0.1	-0.5
Capital	-21.2	-23.6	-21.6	-21.3	-10.4	-13.9	-6.0	-3.7	-0.8	0.5	0.0	-0.5
Chemicals	-15.4	-10.3	-22.6	-18.7	-12.4	-25.0	-31.2	1.0	-0.6	-0.2	0.2	-0.5

Appendix Table 6. Output and input use impacts of *total removal* of import tariffs in food and agriculture, percent change

	Australia	NZ	China	Japan	Korea	RoAs	Canada	USA	Mexico	Brazil	Argentina	RoAm
Aggregate output												
Crops and livestock	10.1	19.7	-0.4	-12.9	-0.9	0.5	9.1	2.7	-1.3	1.1	2.8	2.7
Crops	8.1	11.2	-1.3	-13.3	-3.1	0.7	21.6	2.4	0.2	0.7	1.3	3.1
Livestock	12.3	22.5	1.3	-11.6	6.6	0.0	-6.5	3.2	-3.8	2.2	5.1	1.8
Commodity output												
Paddy rice	124.2	-0.6	1.0	-25.2	2.5	2.5	16.9	19.1	-0.6	-0.4	2.2	2.5
Wheat	7.0	25.0	-15.3	-85.6	19.8	0.4	60.5	13.5	-8.2	-0.2	5.1	0.1
Other grains	16.7	25.0	-0.7	-19.5	-78.9	0.7	8.8	3.8	-5.9	0.3	4.6	-1.5
Fruits, vegetables, nuts	5.6	6.4	1.1	-5.5	-2.3	0.0	3.1	3.1	2.9	-0.3	0.2	4.2
Oil seeds	3.9	19.7	-16.7	-30.2	-44.4	-0.6	7.5	4.7	3.7	4.5	0.3	2.0
Sugar crops	9.3	14.1	0.4	-12.2	3.6	0.4	34.1	-18.0	4.2	1.6	0.8	7.2
Plant fibers	-6.1	24.1	0.8	22.8	6.5	-0.8	18.0	-1.1	0.6	-0.8	-2.1	-2.6
Other crops	8.7	-18.7	1.8	-7.9	-10.2	-0.6	4.3	-7.0	12.7	1.8	-0.6	3.2
Cattle	17.3	19.2	1.4	-18.0	4.9	0.2	7.1	4.7	-2.4	4.5	12.7	3.1
Other livestock	0.8	-31.2	1.3	-4.5	10.8	-0.2	-5.9	2.5	-5.0	3.5	-1.0	1.2
Dairy farms	26.4	38.8	0.4	-17.5	-3.0	0.1	-17.7	0.2	-2.5	-1.6	5.1	1.0
Wool and silk	0.7	15.8	1.1	-12.8	6.2	-4.3	10.5	5.4	-0.8	25.6	-2.1	-0.4
Red meats	23.3	63.7	-0.3	-8.1	4.9	0.1	7.2	4.3	-4.0	4.9	13.5	7.6
Other meats	2.5	22.3	2.0	-9.7	9.2	0.8	-8.3	4.2	-5.6	6.3	0.5	1.1
Vegetable oils and fats	-5.0	1.2	-11.9	18.4	48.2	0.3	-0.8	2.8	-4.6	5.3	2.6	-2.2
Dairy products	26.6	46.1	-0.2	-20.3	-4.0	-2.3	-24.4	0.1	-7.8	-2.0	0.8	-1.6
Rice	114.9	2.3	0.0	-22.0	2.7	4.9	39.3	70.8	-1.3	-1.2	0.4	1.0
Sugar	9.4	3.3	0.6	-12.4	14.5	1.2	49.1	-18.3	4.9	2.3	0.8	12.5
Other processed foods	1.0	-5.6	4.4	-4.4	32.2	7.6	1.4	0.2	2.6	0.1	0.8	4.4
Beverages and tobacco	2.0	-1.9	-7.9	0.7	-6.0	-7.9	-23.2	4.4	0.3	-2.3	0.0	-2.1
Aggregate input use by crops												
Land	-0.1	-8.3	-0.2	-1.3	-0.1	0.2	3.4	0.5	0.4	-0.4	-0.8	0.4
Unskilled labor	9.0	10.7	-1.3	-14.5	-4.0	0.7	21.6	2.4	0.5	1.1	1.8	3.4
Skilled labor	9.0	10.8	-1.3	-14.5	-4.0	0.8	21.6	2.4	0.4	1.0	1.8	3.5
Capital	9.1	10.8	-1.3	-14.8	-4.0	0.7	21.6	2.5	0.2	1.0	1.8	3.6
Chemicals	24.2	28.4	-1.1	-18.3	-9.5	2.1	33.2	7.6	-2.8	0.8	5.1	7.3

continued

Appendix Table 6. Output and input use impacts of *total removal* of import tariffs in food and agriculture, percent change (Continued)

	DFS	UK&I	France	Germany	ABNL	PSIG	S&RoEFTA	10EUacc	RoE	TMMENA	RoAf	RoW
Aggregate output												
Crops and livestock	6.5	-6.4	-5.3	-6.0	-6.2	-5.1	18.5	3.5	-0.3	-6.3	2.2	0.6
Crops	10.3	-4.4	-5.8	-5.6	-3.8	-6.0	-9.6	-0.6	-0.5	-6.8	2.2	0.9
Livestock	4.8	-7.3	-4.6	-6.3	-8.2	-3.8	36.1	7.9	0.1	-5.3	2.1	0.2
Commodity output												
Paddy rice	11.1	-51.7	-59.8	-42.4	-73.9	-27.2	-19.0	10.4	-3.5	-0.2	0.6	0.5
Wheat	45.6	-5.4	-16.2	-20.7	-14.6	-21.8	-37.3	0.2	-0.2	-16.0	-3.1	0.0
Other grains	13.6	-5.4	-13.9	-6.6	-3.6	-9.7	-18.7	2.1	-0.4	-10.7	-0.2	-0.1
Fruits, vegetables, nuts	-5.1	-4.5	-6.7	-6.9	-10.0	-6.2	4.3	-3.8	-1.1	-4.6	4.3	1.3
Oil seeds	2.3	10.8	3.0	4.7	8.2	-1.7	-29.7	0.5	-0.7	-9.6	-1.5	1.0
Sugar crops	-10.1	-23.3	-9.6	-7.1	-7.9	-11.3	27.6	5.1	1.1	-4.2	12.9	2.3
Plant fibers	-1.7	9.8	3.1	-0.8	10.4	0.1	8.6	-1.4	3.3	5.5	0.7	0.1
Other crops	5.6	2.0	0.7	0.9	2.4	-1.9	-12.3	-0.7	-0.6	4.7	2.3	1.2
Cattle	-4.3	-12.9	-12.3	-15.1	-25.8	-10.4	-9.7	19.0	1.4	-11.0	3.3	0.4
Other livestock	2.5	-5.6	-0.6	-1.6	-3.5	-1.1	29.1	0.9	-1.7	-4.3	1.2	-0.2
Dairy farms	11.4	-4.5	-3.1	-6.6	-4.0	-1.9	51.8	11.9	1.3	-8.3	-0.5	0.5
Wool and silk	-2.3	14.4	7.7	14.9	11.7	14.4	16.6	3.5	1.6	3.6	0.9	0.1
Red meats	-11.9	-20.0	-12.2	-19.0	-28.2	-7.2	5.8	10.5	-1.6	-22.3	9.9	0.4
Other meats	1.5	-2.6	-0.2	-3.2	-6.5	-0.6	15.6	9.9	-7.0	-35.3	-4.1	-0.5
Vegetable oils and fats	-3.9	-4.6	-5.8	0.3	0.5	-4.9	135.5	-2.9	-10.5	-5.2	-9.0	0.5
Dairy products	11.9	-5.3	-2.6	-7.5	-3.4	-1.4	81.1	40.3	9.2	-25.5	-5.5	2.1
Rice	-60.9	-27.3	-30.0	-63.9	-69.4	-18.1	58.2	22.2	-3.9	-0.3	0.3	0.8
Sugar	-7.7	-29.2	-15.1	-6.0	-5.7	-21.3	31.9	7.1	1.5	-5.2	27.0	4.4
Other processed foods	-5.2	-4.4	-7.2	-7.9	-6.4	-4.7	83.6	-0.7	-2.6	-3.7	4.6	0.7
Beverages and tobacco	0.9	21.8	17.2	2.2	8.3	5.3	41.9	-4.6	-14.5	-58.0	-16.6	-3.4
Aggregate input use by crops												
Land	1.4	0.4	0.0	0.2	0.9	-0.1	-4.1	-1.0	-0.1	-0.5	0.2	0.3
Unskilled labor	9.1	-4.4	-5.4	-5.3	-2.0	-5.8	-9.7	-0.8	-0.8	-7.5	2.2	1.2
Skilled labor	9.1	-4.4	-5.4	-5.3	-2.0	-5.9	-9.7	-0.8	-0.8	-7.5	2.5	1.3
Capital	16.5	-4.0	-7.4	-7.0	-2.0	-6.3	-9.9	-0.6	-0.7	-7.5	2.5	1.3
Chemicals	17.9	-7.1	-12.2	-13.7	-9.0	-13.0	-31.9	0.9	-1.5	-12.1	4.0	2.6

Appendix Table 7. Output and input use impacts of *total removal* of export subsidies in food and agriculture, percent change

	Australia	NZ	China	Japan	Korea	RoAs	Canada	USA	Mexico	Brazil	Argentina	RoAm
Aggregate output												
Crops and livestock	1.1	3.0	0.1	0.2	0.1	0.1	1.4	0.3	0.2	0.2	0.2	0.0
Crops	0.5	-0.6	0.1	0.1	0.0	0.1	1.3	0.3	0.1	0.2	0.2	-0.2
Livestock	1.7	4.2	0.1	0.5	0.4	0.1	1.5	0.2	0.4	0.2	0.2	0.4
Commodity output												
Paddy rice	0.1	0.2	0.0	0.0	0.0	0.1	0.5	0.1	0.2	0.3	0.9	-0.2
Wheat	1.2	1.1	0.2	0.6	0.5	0.1	2.1	0.9	0.2	0.5	0.8	0.0
Other grains	0.8	1.2	0.3	0.7	0.3	0.2	2.3	0.7	0.2	0.3	1.4	0.3
Fruits, vegetables, nuts	0.0	-1.3	0.1	0.0	0.0	0.1	0.7	0.0	0.0	0.0	-0.1	-0.1
Oil seeds	0.3	0.6	0.2	0.6	0.2	0.1	0.7	0.3	0.1	0.1	-0.1	-5.5
Sugar crops	1.5	3.7	2.0	0.3	0.2	0.2	1.3	0.3	0.7	2.1	0.1	1.0
Plant fibers	-0.5	1.0	0.0	0.1	0.1	0.1	1.2	0.0	0.0	-0.1	-0.1	0.0
Other crops	1.0	-3.7	0.2	0.2	0.0	0.0	0.0	-0.2	-0.1	-0.4	-0.3	0.2
Cattle	1.0	0.0	0.1	0.2	0.1	0.2	0.4	0.2	0.0	0.0	0.1	0.3
Other livestock	0.0	-4.8	0.0	0.1	0.2	0.1	0.5	0.2	0.0	0.2	-0.1	0.3
Dairy farms	6.1	11.7	0.2	1.3	1.3	0.1	3.1	0.3	1.4	0.3	0.2	0.8
Wool and silk	-0.1	-0.6	0.0	0.1	0.1	0.1	0.5	0.5	0.1	-0.3	-0.1	0.1
Red meats	1.7	-0.5	0.7	0.2	0.1	0.6	0.5	0.2	0.0	0.0	0.1	0.3
Other meats	0.2	-1.4	0.4	0.3	0.8	0.2	0.7	0.3	0.0	0.2	0.0	0.2
Vegetable oils and fats	0.0	0.6	0.2	-0.1	0.0	0.2	0.1	0.1	-0.1	-0.1	-0.3	-0.3
Dairy products	6.2	15.8	4.7	1.6	1.5	5.3	4.1	0.3	4.6	0.6	0.7	1.8
Rice	0.3	0.8	0.0	0.0	0.0	0.1	1.3	1.0	0.5	0.3	1.2	-2.1
Sugar	1.5	0.9	4.3	0.3	2.2	0.6	1.5	0.3	0.8	4.1	0.1	2.1
Other processed foods	0.6	-0.3	0.3	0.1	0.3	0.7	0.7	0.2	0.1	0.1	0.1	0.4
Beverages and tobacco	-0.2	-0.3	0.0	0.0	-0.1	-0.1	-0.1	0.0	-0.1	-0.1	0.0	0.0
Aggregate input use by crops												
Land	-0.2	-3.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	-0.1
Unskilled labor	0.6	-0.7	0.1	0.1	0.0	0.1	1.3	0.3	0.2	0.3	0.3	-0.2
Skilled labor	0.6	-0.7	0.1	0.1	0.0	0.1	1.3	0.3	0.2	0.3	0.3	-0.2
Capital	0.6	-0.7	0.1	0.1	0.0	0.1	1.3	0.3	0.2	0.3	0.3	-0.2
Chemicals	1.7	1.2	0.2	0.2	0.1	0.3	2.0	0.9	0.4	0.3	0.5	-0.3

continued

Appendix Table 7. Output and input use impacts of *total removal* of export subsidies in food and agriculture, percent change (Continued)

	DFS	UK&I	France	Germany	ABNL	PSIG	S&RoEFTA	10EUacc	RoE	TMMENA	RoAf	RoW
Aggregate output												
Crops and livestock	-3.1	-1.2	-1.3	-1.0	-1.8	-0.2	-3.1	0.4	0.5	0.5	0.2	0.2
Crops	-4.7	-1.8	-1.9	-1.5	-1.6	-0.2	-0.5	0.7	0.4	0.5	0.2	0.2
Livestock	-2.4	-0.9	-0.6	-0.7	-2.0	-0.2	-4.8	0.0	0.5	0.5	0.4	0.2
Commodity output												
Paddy rice	-3.3	-1.8	-0.8	-1.1	-0.6	-1.8	2.6	2.3	0.3	0.4	0.0	0.1
Wheat	-4.6	-2.2	-5.5	-2.4	-3.3	-0.6	-2.1	0.6	0.8	0.9	2.2	0.4
Other grains	-19.4	-8.0	-5.9	-7.0	-24.3	-1.3	0.9	2.3	0.8	2.5	0.6	0.4
Fruits, vegetables, nuts	0.1	0.2	0.3	0.3	0.5	0.2	-1.5	0.2	0.1	-0.1	-0.4	0.0
Oil seeds	0.2	0.3	0.9	0.4	1.3	0.3	-0.5	-0.3	0.1	-0.1	0.2	0.3
Sugar crops	-3.3	-6.5	-8.5	-5.5	-14.4	-3.7	8.2	1.4	1.0	2.4	1.8	0.3
Plant fibers	-1.0	0.8	0.7	0.8	0.8	0.4	1.2	-0.1	0.0	-0.1	0.1	0.0
Other crops	0.3	0.1	0.0	0.2	0.4	-0.2	0.0	0.2	0.5	-0.1	0.0	0.1
Cattle	-3.3	-0.9	-0.6	-1.5	-2.0	-0.3	-1.1	-0.9	1.2	0.5	0.2	0.3
Other livestock	-1.0	-0.2	-0.1	0.1	-0.2	0.0	-3.3	-0.1	0.2	0.0	0.1	0.1
Dairy farms	-4.1	-1.5	-1.3	-0.9	-4.2	-0.5	-6.6	0.7	0.7	1.6	1.9	0.4
Wool and silk	0.8	1.2	0.8	1.6	1.0	0.9	1.2	0.2	0.1	-0.2	0.2	0.3
Red meats	-3.6	-1.9	-1.3	-1.8	-2.5	-0.5	-0.4	0.9	5.1	2.2	0.6	0.8
Other meats	-1.8	-0.1	-0.3	0.0	-0.5	-0.1	-3.5	0.0	0.6	1.3	0.2	0.2
Vegetable oils and fats	-0.1	0.0	0.1	0.0	-0.4	0.0	-1.9	-0.6	0.4	-0.3	-0.1	0.1
Dairy products	-4.2	-1.9	-2.0	-1.1	-4.9	-0.6	-9.9	2.7	4.5	4.9	9.5	1.8
Rice	1.0	-10.2	0.5	0.1	-0.1	-2.8	-1.0	3.0	0.4	0.7	-0.1	0.2
Sugar	-3.6	-8.9	-12.5	-5.6	-15.4	-8.8	8.6	2.2	1.5	4.9	3.6	0.5
Other processed foods	-1.4	-0.5	-0.5	-0.6	-1.5	-0.6	-4.8	1.4	0.9	0.5	0.5	0.3
Beverages and tobacco	0.2	0.2	0.3	0.1	0.2	0.0	0.2	-0.7	-0.1	-0.3	-0.1	-0.1
Aggregate input use by crops												
Land	-0.6	-0.2	-0.1	-0.2	-0.2	0.0	0.6	0.1	0.1	0.0	0.0	0.0
Unskilled labor	-4.1	-1.8	-1.9	-1.5	-1.4	-0.1	-0.6	0.7	0.5	0.6	0.1	0.2
Skilled labor	-4.1	-1.8	-1.9	-1.5	-1.4	-0.1	-0.6	0.7	0.5	0.5	0.1	0.2
Capital	-7.3	-2.6	-2.7	-2.4	-2.2	-0.2	-0.6	0.8	0.5	0.6	0.2	0.2
Chemicals	-9.2	-3.1	-4.4	-4.4	-6.7	-0.5	-3.1	2.1	1.3	1.1	0.4	0.7