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Processed food trade and developing countries: protection and trade reform

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Abstract

Exports of processed foods from developing countries have expanded rapidly in recent times, contributing to those countries' development. Recent research has shown that the developing country exporter's 'openness' and agricultural resource endowment offered significant explanations of this export growth. But what if 'openness' is enhanced? What if processed and other food trade barriers are lowered? What if trade in manufactured goods is further liberalised? Would developing countries continue expanding processed food exports, or would resources be drawn into textiles and manufacturing? An applied general equilibrium model is used to shed light on these questions through trade policy simulations. Impacts of the simulated reforms on the effective rate of protection of processed foods production are also measured. Most developing regions studied had a positive effective protection rate for processed foods in the base year. This effective protection was reduced when agricultural tariffs were cut. When tariff cuts were extended to manufactured goods, effective protection of food processing in most developing regions increased somewhat, but was still less than base-period protection. Simulated reductions in agricultural and all tariffs increased processed foods exports from developing regions and increased their share of such trade globally, but less so when tariffs of all commodities were reduced.

Keywords: processed food, protection, trade reforms, exports, developing regions

Introduction

Fuelled by rapid income growth and urbanisation, lifestyle changes and improved marketing infrastructures, food consumption patterns in many developing countries are exhibiting the substitution of high-value processed foods for traditional foods. Associated with this phenomenon is a major change in the composition of international trade in food and agricultural goods. Processed food's¹ share of total global agricultural trade increased from 40% to 50% over the 1965-1985 period, but increased more rapidly to over 60% by 1995. Developing country exporters are cashing in on this accelerating growth, and over the past decade the growth of their processed food exports has exceeded that from the developed regions. By 1995 the total value of global processed food exports was 2.5 times as high as that in 1985, but for unprocessed agricultural commodities the increase over this period was only 1.5 times.

The Uruguay Round Agreement on Agriculture (URAA) put in place a set of rules that significantly improve the conditions for market access for agricultural goods. Bound tariffs have almost entirely replaced non-tariff measures, and exporters now have a much clearer view of the conditions for entry into markets. Most commentators agree, however, that the Agreement did little to liberalise trade in agricultural products and actual improvements in market access were modest (IATRC 1994; Josling 1998). The process of 'tariffication' produced a number of tariffs so high that it is difficult to see any profitable trade opportunities developing in such markets. The same can be said for the out-of-quota tariffs in many of the tariff rate quotas that cover processed foods as well as raw commodities. Thus there is much unfinished business to be addressed in a new round of multilateral talks on agriculture. Generally, the URAA did not reduce tariffs more for processed products than for basic agricultural products and the reductions are less in many cases (OECD 1997). For the OECD countries where tariffication was applied to processed products, the high base tariffs set for some basic commodities carry through to the processed products that use them as inputs, and in some cases additional protection is also included. While tariff escalation was reduced in some instances it still persists in a number of cases, especially for coffee, cocoa, oilseeds, vegetables and fruits.

An earlier study of the authors (Josling and Rae 1999) examined a number of modalities for reducing the levels of agricultural tariffs, and found that in some cases the reductions in processed food tariffs contributed a large proportion of the developing countries' welfare gains. This, coupled with the knowledge that growth in processed food exports was especially rapid in the case of developing countries, encouraged us to examine the issue more deeply. Further, it has been shown that 'openness' is an important factor in explaining the growth in processed food exports from developing countries (Athukorala and Sen 1998) which raises the question of how increases in openness, as might be negotiated in a future round of trade negotiations, might impact on the processed food sectors of developing regions.

Processed Food Exports and Developing Countries

For our data, we use the GTAP version 4 database, which is benchmarked to 1995 (McDougall *et al.* 1998). This database covering 50 commodities and 45 countries or regions was aggregated up to the level of 15 regions (Appendix Table 1) and 20 commodities. Seven of the 20 commodities are processed foods, and were chosen to represent our interest in the

impacts of trade liberalisation on those sectors. These are meats (ruminants and non-ruminants), vegetable oils and fats, dairy products, processed rice, sugar, beverages and tobacco products, and ‘other processed foods’.

Between 1975 and 1985 the value of global processed food trade increased by 5% per year, but grew at almost double that rate from 1985 to 1995 (Table 1). While the growth in processed food exports during the former decade was fuelled mainly by exports from developed countries, processed food exports from developing countries played a more important role over the latter decade. In 1985 processed foods accounted for 55% of the total agricultural exports of developed countries, but only 40% of those of developing countries. Ten years later, processed food’s contribution had grown to almost 56% of the developing world’s agricultural exports, and 66% of those of developed countries.

Annual growth in global exports for many of the processed foods listed in Table 1 exceeded 9% during 1985-95, while exports of vegetable oils and fats, and processed rice grew at a slower rate. Growth rates for all commodities over the previous decade were slower, with the exception of vegetable oils and fats. Global sugar exports actually declined 9% per year from 1975 to 1985. Similar patterns are to be seen in the export growth data for the developed countries. The situation is somewhat different for the developing regions, however. Fastest export growth rates (almost 20% per year) over 1985-95 are found for dairy products (but from a very low base) and beverages and tobacco. Developing countries’ rice exports grew by 10% per year over 1985-95, but by under 2% annually over the earlier decade. Sugar exports from developing regions also picked up over the 1985-95 decade after falling by 11% per year during 1975-85.

The ‘other processed foods’ aggregate had by far the largest share of total processed food exports of both developed and developing regions in 1995 (Table 2). This aggregate comprises processed fish, fruit and vegetable products, grain mill products (except rice), bakery products, cocoa, chocolate and confectionery, processed animal feeds and other processed foods not elsewhere specified. Given this large number of items, it is perhaps not surprising that together they comprised nearly 40% of developed countries processed food exports in 1995, and over one-half of those from developing countries. The more disaggregated data examined by Athukorala and Sen (1998) suggests that very rapid growth in processed fish exports from developing countries could have been a major factor in the recent dominance of the ‘other processed foods’ group in their total processed food exports. Because of the importance of this group of processed foods in total processed food exports from developing countries, it will be a focus of this paper.

One-half of the value of global processed food trade takes place between developed countries. The value of such exports from developed to developing countries is almost the same as the flow in the opposite direction. Processed food trade between the developing countries themselves has been increasing however – this made up 11% of global trade in 1985 but had risen to over 14% in 1995. This is perhaps not surprising given the increasing growth of processed food exports from developing countries, and the rapid demand increases that are occurring in many of those countries. In monetary terms, processed food trade between developed countries increased from US\$59 billion in 1985 to US\$149 billion in 1995, or an increase of 150%. Such trade between the developing countries increased over the same time period from US\$13 billion to US\$41 billion, or by 205%.

It has been suggested by some that manufacturing expansion contributes more to superior growth performance in developing countries than strategies that emphasise agricultural development. Athukorala and Sen (1998) challenge this view, and suggest that the labour-intensity of much food processing implies the expansion of this sector could have a strong positive effect on employment generation in the typical labour-surplus developing country. Further, other supposed benefits of manufacturing expansion such as knowledge and technology spillovers may be just as important in food processing activities. Where food processing relies more heavily on domestically-sourced inputs than does manufacturing, then expansion of the processed food sector may also produce greater 'spread' effects, through input linkages, on the domestic economy. Athukorala and Sen then proceed to test the hypothesis that inter-country differences in processed food export growth rates are influenced more by the trade policy regime than by resource endowments. Their econometric results are shown to support this position for their sample of 36 developing economies. The authors concluded that while resource availability is fundamental, export success with processed foods depends crucially on the nature of domestic trade policy.

Tariff escalation and effective rates of protection of processed food

The level and dispersion of tariffs on the raw material are not the only concern of processed food manufacturers. The relationship between the protection of the input items and that of the output is important. "Effective protection" is the concept used to describe the benefit of low input tariffs combined with high output tariffs for the food processor. The effective protection compares the value added (output value less the cost of purchased inputs) at protected and unprotected price levels. High effective protection (high protection of value-added) in an importing country will discourage the spread of processing to the exporter.

Many developing countries still derive a large percentage of their export earnings from the sale of agricultural raw materials. These raw materials often enter the developed markets with low or zero tariffs, either under a preferential system or as a reflection of the desire not to burden the processing sector. But it has long been recognized that this can have a negative impact on development in those countries supplying the raw materials. An escalation of tariff levels from low tariffs on raw materials to higher tariffs on processed goods results in high levels of effective protection of the processing activity. This can inhibit the growth of the processing activity in the developing country.

The high levels of tariffs on temperate zone farm products, in particular the basic commodities which once formed the backbone of the agricultural sector in industrial countries, is in sharp contrast to the low protection on imports of tropical products and raw materials. This will sometimes result in low or even negative protection of the processing activities. In other cases the processed product is protected by tariffs which themselves incorporate the duties paid on the raw materials. For this reason, care should be taken to avoid maintaining those processed tariffs whilst reducing the tariffs on the raw material.ⁱⁱ It is unlikely that the tariffs on temperate zone commodities will come down fast enough to cause a widespread problem of high protection to the processing sector: the tariffs on many processed goods are lower than on the raw materials.ⁱⁱⁱ

An examination of the evidence of protection on raw materials and processed goods illustrates this situation. Table 3 shows the level of effective protection for the 'other processed foods' sector (i.e. protection of value-added in sectors other than meats, dairy, vegetable oils, rice and sugar) for 14 countries and regions (and a "rest of world" category) as calculated from the

GTAP database. Effective protection was positive for all regions/countries except Japan, South Korea and the EU (and the rest-of-world aggregate). For the latter regions, this reflects high levels of protection on inputs which hamper the development of food processing industries.

The significance of this can be seen by comparing the effective protection with the nominal protection (i.e. the protection on the output goods). Moderate to high positive protection of the processed product is noticeable in South Asia, as well as in South Korea and the ASEAN countries, China, the former Soviet Union (FSU) and North Africa. In South Asia this is partially offset by protection on the input items. In ASEAN and Central-South America as well as in the FSU and North Africa, input protection is lower, giving a positive incentive to processing activities. Low levels of output protection for processed foods are apparent in the US, Canada, Australia and New Zealand. But in these cases protection of value-added in processing is positive though modest, indicating that high input prices do not imply a net tax on processing activities.

The implicit tax on processing which arises from the higher tax on inputs can be further broken down into that which comes from agricultural inputs and that which is due to manufactured inputs. The last two columns of Table 3 attempt this disaggregation. The highest implicit taxes on agricultural inputs occur in South Korea, Japan and South Asia (and the rest-of-world aggregate).^{iv} Implicit taxes on manufactured inputs are above 10 percent only in the case of South Asia. In all cases except Australia, the implicit tax from agricultural inputs exceeds that from manufactured inputs.

These results give an indication of what effects on this 'other processed food' sector might result from further liberalization of market access in agriculture and in manufactured markets. Agricultural input costs could be reduced considerably in South Korea, Japan and South Asia to the advantage of the food processing industry. In the case of Japan and South Korea the effect might be enough to remove the negative effective protection. The processing sector in these countries might be expected to expand and possibly secure some export markets. Reduction in nominal protection of the processed goods would lower this incentive to expand. Other countries have less to offer their processing sector in the way of relief from high agricultural input prices. In Central and South America, the FSU and North Africa the effective rate of protection could increase with liberalization of agricultural trade.

Distortions in economic incentives occur when protection levels, both among products and between stages of production, diverge. Such divergence is apparent at present, and could increase or decrease depending on the way in which market access is improved. If trade policy changes reduce this dispersion, there is a presumption of increased efficiency in the allocation of resources. The empirical estimates that are presented below attempt to put some quantitative meat on the bones of this proposition.

Simulation methodology and experiments

For the estimation of the benefits of certain types of market access modalities, the GTAP applied general equilibrium model was used (Hertel 1997) in conjunction with the GTAP version 4 database, aggregated as described earlier. This is a multi-region model built on a complete set of economic accounts and detailed inter-industry linkages for each of the economies represented. The GTAP production system distinguishes sectors by their intensities in five primary production factors: land (agricultural sectors only), natural

resources (extractive sectors only), capital, and skilled and unskilled labour. In trade, products are differentiated by country of origin, allowing bilateral trade to be modelled, and bilateral international transport margins are incorporated and supplied by a global transport sector. The model is solved using GEMPACK (Harrison and Pearson 1996).

The aspect of domestic trade policy which is particularly important for the processed food sector is that which governs the conditions of trade for primary products, generally of agricultural origin. Thus market access for agricultural goods is a key determinant of the development of processing activity. Agricultural markets have traditionally been ruled by a different set of regulations, institutions and political considerations than have those in manufactured goods. The process of making these two systems converge has proved difficult, but the Uruguay Round made a start in that direction. The task for the next agricultural round, which was launched in March 2000, is to continue this process. How successful these negotiations will be is a question of considerable interest to the processed food sector.

Josling and Rae (1999) explored three approaches to agricultural tariff reduction:

- (i) All tariffs were reduced by 36%, that is, a continuation of the process initiated by the Uruguay Round.
- (ii) Tariff reductions were computed using the Swiss formula^v. The effect of using this approach was to reduce higher tariffs proportionately more than lower rates, thus reducing the extreme variability amongst agricultural tariffs^{vi}. It would also tend to reduce tariff escalation (or de-escalation) within processed food production systems. We set $a=150$ in this formula, which implies that tariffs above 85% will be reduced by more than 36%.
- (iii) An integrated or 'cocktail' approach that combined various modalities for achieving tariff reductions as follows:
 - tariffs less than or equal to 10% were eliminated;
 - tariffs between 10% and 85% were reduced by 36%; and
 - tariffs greater than 85% were reduced by the Swiss formula ($a=150$).

Thus the Swiss formula was used to cut the highest tariffs, but lower tariffs (those between 10% and 85%) were cut by 36% rather than the lower amounts that would apply through use of the Swiss formula. The lowest tariffs (those less than 10%) were assumed to be completely liberalized.

The experiments simulated by Josling and Rae (1999) demonstrated that the global welfare gain was greatest for the 'cocktail' approach to agricultural tariff reductions. Further, of the three formulas the 'cocktail' approach gave the greatest welfare gains for the majority of developing regions in that application. For these reasons, we shall focus on the 'cocktail' formula here^{vii}, and apply it to all agricultural and food tariffs^{viii} in experiment 1.

Josling and Rae (1999) also showed that changes in the output of manufacturing sectors had a substantial impact on the realised welfare changes from agricultural tariff reforms in several regions. That study did not examine the reform of manufacturing tariffs, so a second experiment in the current study will apply the 'cocktail' formula to the reduction of manufacturing sector tariffs also. This could be of particular interest in a study of tariff reform and processed foods, since manufactured products are important inputs to processed foods production. While the level of agricultural tariffs is several times that of manufactured goods, changes in manufacturing protection could have substantial impacts on value-added in processed foods production and hence its effective rate of protection.

Results

Experiment 1: Reduction of agricultural tariffs

Impacts on the effective rate of protection of 'other processed foods'

An across-the-board reduction in agricultural tariffs could either increase or decrease effective rates of protection (ERP). For example, the impact of a fixed percentage tariff reduction will depend upon whether the processed food output, or the intermediate inputs, carried the largest tariffs. Differential tariff cuts, such as those achieved using a Swiss formula, will also have uncertain impacts on the ERPs as the tariff cuts applied to processed food outputs and inputs could differ, depending on the sizes of those tariffs.

Table 4 compares the ERPs of 'other processed foods' production following the reduction of agricultural tariffs^{ix} with base values. For Japan, Korea and the ROW (which includes the European Free Trade Association (EFTA) countries), the base ERP was negative and the tariff cuts have reduced this taxation of processed food production. For most developing regions apart from South Korea, the positive base ERPs are reduced under the agricultural tariff cuts, and the new ERP for South Asia is close to zero.

What changes in processed food outputs, exports and trade balances might have accompanied the above changes in effective protection? It is not possible to reach conclusions based on changes in protection alone, since the tariff cuts affect protection of all sectors in a general equilibrium world. Such changes are explored in following section.

Impacts on outputs and trade of processed foods

Of all regions (excluding ROW), the expansion of 'other processed foods' output as a result of tariff cuts was greatest in South Korea (Table 5). While the 'cocktail' formula reduced Korea's NRP in this sector from 16.9% to 9.4%, the reduction in the implicit tax on agricultural inputs to the processed food sector declined much more, from a base value of 62% to 32% (Table 6). Thus the negative Korean ERP of 'other processed foods' was reduced, and output expanded 5.5%. A similar story can be told regarding the ROW aggregate (which comprises both developing regions as well as the rich EFTA countries) – the 'other processed foods' NRP fell from 13.8% to 8.5% whereas the implicit tax on the agricultural inputs declined from 54% to 34% due to tariff cuts. As a result, 'other processed foods' output expanded 7%. Among remaining developing regions, the output of 'other processed foods' also expanded in several, including Sub-Saharan Africa and South Asia. It also expanded slightly in Japan, where the effective protection of the processed food sector became less negative as a result of the tariff cuts.

One objective of this paper was to explore the impact of increased openness to trade on exports of processed foods from the developing countries. Table 7 shows that the 'cocktail' cuts of experiment 1 resulted in an increase in 'other processed foods' exports from the developing world from the base value of US\$46 billion to over US\$50 billion. At the same time, 'other processed foods' exports from developed countries contracted somewhat. Thus this tariff reform resulted in the developing regions increasing their share of global 'other processed foods' exports. Further, while their exports of this product group to themselves increased by 7%, exports to the developed world rose by over 10% as improved access to those markets was obtained. In 1995, ASEAN and Central and South America were the major 'other processed foods' exporters from the developing world, and both increased the value of

those exports in this experiment. But by far the largest increase in ‘other processed foods’ exports, of 42%, occurred from Korea.

Regional changes in both exports and imports as a result of the simulated tariff cuts are readily summarised by the changes in trade balances, or net exports. Those of ‘other processed foods’ are also shown in Table 7. The ‘cocktail’ tariff cuts have increased net exports from developing regions and increased net imports of the developed countries. Among the former group, the surplus of exports over imports in the base year increased in ASEAN, South Asia, Central and South America and Sub-Saharan Africa as a result of the reforms in agricultural tariffs. Net exports from China were reduced, and the net imports of ‘other processed foods’ in the FSU/Eastern Europe and the Middle East/North Africa increased slightly. But again, the most noticeable change occurred in South Korea – in 1995 ‘other processed foods’ imports exceeded exports by US\$11 million, but this had reversed to a net export surplus of US\$722 million following the agricultural tariff cuts.

Experiment 2: Reduction of agricultural and manufacturing tariffs

In this experiment, the ‘cocktail’ tariff reductions were extended to include the non-agricultural sectors, that is natural resources, textiles and manufacturing. Such non-agricultural liberalisation may impact on processed food sectors in at least the following two ways. First, they may reduce the cost of non-agricultural inputs to the processed food sector and second, any stimulation to manufacturing activity will impact on the costs of labour and capital and hence that sector will compete with food processing for such resources. The manufacturing sector is an important source of inputs to processed food production in many regions. Manufactured inputs comprise up to 14% of the total costs of ‘other processed foods’ production, and in many regions is the next most important input after services, capital and labour (GTAP database). The natural resources sector (which includes fishing) is also a significant supplier of inputs to food processing in some regions. While average tariffs on natural resources and manufacturing products do not exceed 10% in the majority of cases in the GTAP database, an average manufacturing tariff of over 50% was levied in South Asia.

Table 4 shows effective protection rates of ‘other processed foods’ following implementation of these additional tariff reductions. In all cases effective protection is increased, or negative protection becomes less negative. Effective protection increased substantially in South Asia -- from 2.8% to 7.3% -- since cuts to its relatively high manufacturing tariffs reduced the implicit tax on non-agricultural inputs to the food processing sector, from 12% down to 8% (Table 6).

When all tariffs are cut, manufacturing outputs expand in some developed regions relative to the situation where tariffs cuts were limited to agricultural goods. This is the case for the USA, the EU and Japan, but also for ASEAN among the developing regions. Similarly, textiles outputs in several developing regions -- South Korea, South Asia, the Middle East/North Africa and ASEAN -- increase by more in this experiment compared with the first. In the ASEAN region and South Korea, both the textiles and manufacturing sectors had contracted when only agricultural tariffs were reduced. Such expansions of the labour- and capital-intensive non-agricultural sectors of the developing regions places upward pressure on factor prices (Table 5), particularly in Korea, ASEAN, China and South Asia. Consequently Korean output of ‘other processed foods’ expands less compared with the first experiment, and this sector’s output actually declines in ASEAN. Processed food output in South Asia increases by less in this experiment than in the first, while processed food output in China

contracted more in the second experiment than in the first. Of all the developing regions, only in Central and South America and Sub-Saharan Africa did 'other processed foods' output increase relative to the first experiment, and with less competition from the non-agricultural sectors labour and capital price increases were relatively modest in these regions.

Does the developing world still increase its exports of 'other processed foods' relative to the developed world when tariff reforms are extended to all commodities? The answer is yes, but not to the same extent as when reforms are restricted to agricultural items (Table 7). The cuts to non-agricultural tariffs reduced the value of 'other processed foods' exports from all developing regions with the exceptions of Central and South America and Sub-Saharan Africa, and total developing countries' exports of this commodity were slightly down on those achieved when only agricultural tariffs are reduced. But even with this across-the-board reform of import tariffs, 'other processed foods' exports were above their 1995 values in all developing regions except China. The across-the-board tariff cuts also resulted in levels of net exports of other processed foods from several developing regions that were less than those from the first experiment, again with the exceptions of Central and South America and Sub-Saharan Africa, and increased net imports of processed food into Eastern Europe/FSU and the Middle East/North Africa. But aggregated over all developing regions, net exports of 'other processed foods' were greater than the base values under either tariff reduction scenario.

Conclusions

Processed foods are increasingly dominating bulk agricultural commodities in total food exports. Such a trend also applies to developing countries' food exports in recent times. While one-half of global processed food trade takes place between developed countries, that between the developing regions is increasing in response to rapid increases in demand for these foods in the developing world. The Uruguay Round generally did not reduce tariffs on processed foods by more than for bulk commodities, so escalation (or de-escalation) of tariffs remains along the processed food production chain. In many of the regions studied here, the implicit tax on agricultural inputs to processed food production exceeded the nominal protection on the processed output. Substantial positive or negative effective protection is computed for some countries, a situation that distorts patterns of processed food production and trade.

Recent research has shown that developing countries with the most rapid growth in processed food exports tended to be those that were the most 'open' to international trade. An objective of the current paper was to explore the impacts of increased openness on such exports. Increased openness did indeed increase processed food exports from developing countries. The latter had a trade surplus in 'other processed foods' of \$13.8 billion in 1995 which increased to \$15.1 billion after implementation of the agricultural tariff cuts.

Another objective of this paper was to determine how non-agricultural tariff cuts would interact with processed food trade balances. In many developing countries, substantial increases in labour and capital costs resulted as resources were attracted out of the agricultural sector and into textiles and manufacturing. Nevertheless, 'other processed food' exports from developing countries were almost the same as in the first experiment. The land-abundant economies of South America, in contrast to most other developing regions, even increased their processed food exports under this scenario.

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Appendix Table 1

Aggregation of GTAP version 4 regions

Acronym	Description	Acronym	Description
AU	Australia	USA	USA
NZ	New Zealand	CSTH_AM	Mexico, Central & South America
JPN	Japan	EU	European Union (15)
KOR	South Korea	FSU_CEA	Former Soviet Union, Central European Associates
ASEAN	Indonesia, Malaysia, Philippines, Thailand, Singapore, Vietnam	ME_NAF	Middle East & North Africa
CHINA	China, Hong Kong, Taiwan	SSA	Sub-Saharan Africa and Southern Africa
STH_ASIA	India, Sri Lanka, rest of South Asia	ROW	Rest of world
CAN	Canada		

Table 1**Processed foods export growth rates (% per year)**

Processed food	Global		Developed Regions		Developing Regions ^a	
	1975-85	1985-95	1975-85	1985-95	1975-85	1985-95
Meats	6.7	10.0	6.1	10.0	9.4	10.1
Vegetable oils & fats	7.4	4.7	5.7	4.0	9.1	5.2
Dairy products	6.4	9.5	6.5	9.2	3.1	19.5
Processed rice	1.9	7.5	2.4	2.3	1.6	10.3
Sugar	-9.4	9.1	-4.1	13.6	-11.1	6.1
Beverages & tobacco	8.3	11.2	8.7	10.2	5.1	19.3
'Other processed foods' ^b	8.4	9.7	7.8	9.0	9.7	11.0
Total processed foods	5.3	9.4	6.6	9.2	2.8	9.9

a. Developing countries are all those in the GTAP database with the exceptions of Australia, New Zealand, Japan, Canada, USA, and the member countries of the EU and EFTA.

b. This is the 'food products n.e.c.' commodity in the GTAP database. It includes processed fish, fruits and vegetables, bakery products, confectionery, cereal products excluding rice and processed animal feeds. This group cannot be further disaggregated in the GTAP database.

Source: GTAP Version 4 database.

Table 2**Product shares of processed food exports (%): 1995**

	Developed Countries	Developing Countries
Meats	20.6	12.0
Vegetable oils & fats	4.1	13.2
Dairy products	13.9	1.7
Processed rice	0.8	5.1
Sugar	3.5	8.0
Beverages & tobacco	18.7	7.2
'Other processed foods'	38.8	52.8

Source: GTAP Version 4 Database

Table 3**The ‘other processed foods’ sector – 1995 protection data**

Region	ERP ^a	NRP ^b	Implicit tax ^c on:	
			Agricultural inputs	Manufactured inputs
AU	.043	1.031	1.023	1.029
NZ	.023	1.013	1.013	1.008
JPN	-.162	1.068	1.483	1.022
KOR	-.205	1.169	1.622	1.027
ASEAN	.237	1.156	1.161	1.005
CHINA	.241	1.116	1.118	1.045
STH_ASIA	.167	1.277	1.441	1.119
CAN	.058	1.034	1.037	1.007
USA	.014	1.018	1.039	1.006
CSTH_AM	.316	1.110	1.049	1.045
EU	-.013	1.022	1.085	1.002
FSU_CEA	.350	1.111	1.063	1.030
ME_NAF	.289	1.126	1.116	1.035
SSA	.170	1.081	1.076	1.030
ROW	-.076	1.138	1.543	1.021

a. ERP = effective rate of protection = $(VAM-VAW)/VAW$, where VAM and VAW are value-added at market prices and world prices, respectively. (See Hertel 1997, p.105)

b. NRP = nominal rate of protection = value food processing output at market prices / value output at world prices

c. Implicit tax on agricultural inputs equals the processing food sector’s purchases of agricultural inputs at market prices / value of those purchases at world prices. Implicit tax on the food processing sector’s purchases of non-agricultural inputs has a similar interpretation.

Source: GTAP Version 4 Database

Table 4**Impact of tariff cuts on the ERP of ‘other processed foods’**

Region	ERP		
	Base	Experiment 1	Experiment 2
AU	.043	-.037	-.011
NZ	.023	-.015	-.003
JPN	-.162	-.139	-.135
KOR	-.205	-.135	-.107
ASEAN	.237	.147	.157
CHINA	.241	.059	.103
STH_ASIA	.167	.028	.073
CAN	.058	-.014	-.007
USA	.014	-.018	-.013
CSTH_AM	.316	.183	.217
EU	-.013	-.042	-.040
FSU_CEA	.350	.213	.256
ME_NAF	.289	.180	.205
SSA	.170	.065	.096
ROW	-.076	-.071	-.064

Table 5**Changes in 'other processed foods' output and some factor prices (%)**

Region	Output		Market prices of:			
	exp#1	exp#2	Unskilled labour		Capital	
	exp#1	exp#2	exp#1	exp#2	exp#1	exp#2
AU	-1.42	-0.59	2.37	2.92	2.42	3.04
NZ	-3.77	-2.03	3.86	4.11	3.23	3.54
JPN	1.03	1.04	0.06	0.84	0.1	0.89
KOR	5.54	5.12	0.3	4.6	0.39	4.65
ASEAN	0.19	-3.82	0.27	5.59	0.26	5.92
CHINA	-2.38	-2.68	0	2.68	0.05	2.84
STH_ASIA	2.35	1.99	-0.23	2.07	-0.14	1.69
CAN	-0.41	0.94	0.01	-0.46	-0.01	-0.45
USA	0.29	0.33	0.1	0.61	0.09	0.6
CSTH_AM	0.69	1.16	0.56	0.65	0.53	0.67
EU	-1.64	-1.36	-0.27	-0.18	-0.22	-0.12
FSU_CEA	-0.15	-0.52	0.01	1.91	-0.04	1.85
ME_NAF	-0.23	-0.74	-0.22	3	-0.23	2.95
SSA	4.73	5.53	0.96	1.81	0.62	1.42
ROW	7.0	7.38	-0.44	0.07	-0.64	-0.09

Table 6**Impacts of tariff reductions on the components of effective protection: 'other processed foods'**

Region	NRP		Implicit tax on:			
	Base	Exp#1	Agricultural inputs		Manufactured inputs	
	Base	Exp#1	Base	Exp#1	Base	Exp#2
AU	1.031	1.000	1.023	1.001	1.029	1.008
NZ	1.013	1.001	1.013	1.005	1.008	1.000
JPN	1.068	1.004	1.483	1.166	1.022	1.018
KOR	1.169	1.094	1.622	1.320	1.027	1.000
ASEAN	1.156	1.097	1.161	1.096	1.005	0.993
CHINA	1.116	1.059	1.118	1.066	1.045	1.019
STH_ASIA	1.277	1.173	1.441	1.287	1.119	1.078
CAN	1.034	1.000	1.037	1.010	1.007	1.000
USA	1.018	1.000	1.039	1.022	1.006	0.999
CSTH_AM	1.110	1.065	1.049	1.011	1.045	1.021
EU	1.022	1.000	1.085	1.049	1.002	1.000
FSU_CEA	1.111	1.068	1.063	1.020	1.030	1.007
ME_NAF	1.126	1.079	1.116	1.063	1.035	1.019
SSA	1.081	1.041	1.076	1.036	1.030	1.008
ROW	1.138	1.085	1.543	1.339	1.021	1.007

Table 7**'Other processed foods' total and net exports (1995 US\$million)**

Region	Total exports			Net exports		
	Base	# 1	# 2	Base	# 1	# 2
DEVELOPED						
AU	1,693	1,656	1,715	374	175	244
NZ	1,158	1,130	1,162	775	705	737
JPN	1,275	1,651	1,676	-18,574	-18,552	-18,621
CAN	3,824	4,001	4,150	202	132	310
USA	11,826	12,764	12,884	24	431	512
EU	52,278	50,555	51,136	-5,023	-8,442	-7,869
Sub-total	72,055	71,756	72,724	-22,222	-25,551	-24,687
DEVELOPING						
KOR	1,865	2,656	2,592	-11	722	619
ASEAN	10,782	11,516	10,816	5,742	5,847	4,962
CHINA	5,556	5,481	5,461	590	26	-92
STH_ASIA	2,497	2,706	2,705	2,153	2,281	2,274
CSTH_AM	14,882	16,225	16,669	9,369	10,130	10,616
FSU_CEA	4,825	5,407	5,385	-3,151	-3,228	-3,344
ME_NAF	2,834	3,175	3,070	-1,759	-1,808	-2,069
SSA	2,775	3,254	3,297	852	1,161	1,200
Sub-total	46,016	50,420	49,996	13,786	15,130	14,165
Totals	118,071	122,176	122,170	-8,437	-10,421	-10,521

Note: Excludes the ROW

ⁱ Meats, vegetable oils and fats, dairy products, processed rice, sugar, beverages and tobacco products and 'other processed foods', as defined in the GTAP Version 4 database (McDougall *et al.* 1998).

ⁱⁱ An example of this phenomenon is the setting of tariffs for pigmeat in the EU. The MacSharry reforms lowered grain prices by 30 percent. This should have lowered pigmeat tariffs. But the formula used for calculating the tariff for pigmeat did not reflect the drop in grain prices, and thus left that activity with a higher level of protection as a result of tariffication.

ⁱⁱⁱ This phenomenon of negative effective protection for food processing is one reason to expect pressure from the processing industry to lower tariffs on agricultural goods (Josling 1999).

^{iv} In this case Europe has a relatively low implicit tax from agricultural inputs, but for this category of 'other processed foods' the highly-protected meat, dairy and sugar-based products comprise less than 10% of the processing sector's total cost. Even this small tax is enough to drive the effective protection negative.

^v The Swiss Formula was used for tariff reductions in industrial goods in the GATT Tokyo Round. The basic Swiss formula can be written as $T(1) = a \cdot T(0) / (a + T(0))$, where $T(0)$ is the existing tariff and $T(1)$ is the new tariff. A value of $a=16$ was used in the Tokyo Round (Laird and Yeats 1987).

^{vi} Such extremely high agricultural tariffs (many are well above 100%) pose a problem since the economic cost of a tariff is roughly proportional to the square of the height of the tariff. Cutting such high tariffs is the surest way to achieve gains from trade.

^{vii} The above three experiments were repeated with the current data and aggregation, and confirmed that the 'cocktail' formula did result in the greatest increase in global welfare. Further, the developing regions as a group obtained by far the greatest welfare gain from that approach to tariff reductions.

^{viii} The GTAP database includes instances of negative tariff equivalents (market prices less than border prices). In our simulations, these negative tariffs were not adjusted. Further, the version 4 GTAP database applied observed domestic/world price gaps at the commodity level on both the import and export sides. Thus in the simulations where tariffs are reduced, an equivalent reduction is also made to export subsidies.

^{ix} These were computed from the updated post-simulation database.