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Policy Discussion Paper

No. 0016

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AGRICULTURE AND NON-AGRICULTURAL LIBERALIZATION IN THE MILLENNIUM ROUND

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March 2000

Revised September 2000

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CIES DISCUSSION PAPER 0016

AGRICULTURE AND NON-AGRICULTURAL LIBERALIZATION IN THE MILLENNIUM ROUND*

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March 2000

Revised September 2000

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* Paper to be presented at the1999 Global Conference on Agriculture and the New Trade Agenda from a Development Perspective; Interests and Options in the WTO 2000 Negotiations. Sponsored by the World Bank and WTO, Geneva October 1-2. 1999

The authors acknowledge valuable research inputs from Betina Dimaranan, Purdue University and Anna Strutt, The University of Waikato and helpful comments from Bernard Hoekman.

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ABSTRACT

Much remains to be done before agricultural trade is as liberal as world trade in manufactures. But agriculture is distorted by more than agricultural policies. In developing countries especially, farming is discouraged not only by farm protection policies in high-income countries but also by those countries' own manufacturing policies and distortions to services markets. This paper explores the extent to which multilateral liberalization of not only farm but also non-farm policies would affect welfare and the markets for farm products. It projects the global economy to 2005, when the Uruguay Round (UR) implementation will be complete, and assesses the potential impact of further cuts from that post-UR base. This is done using a modified version of the GTAP model of global trade, assuming 40% cuts in protection in agriculture, mining and manufacturing, and services. Results suggest agricultural and industrial liberalizations could yield similar-sized benefits for the global economy in 2005. However, the distributions of gains from those cuts are quite different as between rich and poor countries. We also examine the interaction between non-agricultural reforms and agricultural trade balances. For some regions, most notably for China, non-agricultural reforms dominate and reverse the sign of the change in the food trade balance following liberalization of both farm and non-farm trade. This suggests policy makers concerned with food and agriculture need to give attention also to non-agricultural policy reforms.

Keywords: WTO, multilateral trade negotiations, manufacturing trade reform, agricultural distortions

JEL Codes: F13, F14, F17, Q17

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NON TECHNICAL SUMMARY

Until the Uruguay Round, agricultural trade policies were subject to few multilateral disciplines. In this situation, the interplay of special-interest pressures has resulted in this sector becoming heavily distorted. In 1995, the average rate of protection faced by developing countries on their exports of agricultural products was 16.4 percent, more than twice the average rate of protection they faced on their exports of manufactures. On their exports to industrial countries, the average tariff they faced was 15.1 percent, close to five times as high as the tariff on their exports of manufactures to these countries.

Through the eight rounds of multilateral liberalization since 1947, the average tariff rates imposed on industrial products in the high income countries have fallen from over 40 percent to around 1.5 percent. By contrast, until the Uruguay Round, there were no effective international rules to discipline agricultural protection, and rates of protection, if anything, increased. Even after the Uruguay Round, agricultural support policies remain loosely disciplined—according to the OECD, the average rate of agricultural protection on bulk agricultural commodities in the OECD countries rose from 32 percent to 37 percent between 1997 and 1998.

In part because of the barriers to market access that they face, developing countries have been reducing their reliance on agricultural exports. The share of agriculture in developing country merchandise exports has fallen from close to a half in 1965 to just over 10 percent in 1995, and is projected to fall further by 2005. (Part of the reason for this projected decline is the absence of substantial cuts in applied protection by the OECD countries under the Uruguay Round.) Within these agricultural exports, developing countries remain much more reliant on exports of bulk commodities than do the industrial countries. In 1995, developing countries accounted for 44 percent of global exports of bulk agricultural commodities, but only 23 percent of non-bulk agricultural commodity exports. This reliance on exports of bulk commodity exports locks developing countries into a declining share of world markets for agricultural commodities. Since 1965, the share of bulk commodities in world agricultural trade has fallen from 70 percent to around 45 percent.

Agriculture remains much more important in the economies of developing countries than it does in the high-income countries. Developing countries remain small net exporters of agricultural commodities. Further, consumers in developing countries spend over 30 percent of their incomes on food—almost three times the share in industrial countries—making them much more vulnerable to shocks. Agriculture's contribution to GDP in developing countries, at 16 percent, is also around three times as high as its share in industrial countries.

Before performing the analysis of potential trade liberalization, we project the changes in the structure of the world economy from the initial database period, 1995, to 2005, by which time all of the Uruguay Round liberalization will have been phased in. Over this period, the share of manufactures exports from developing countries is projected to rise further, as the tariff cuts agreed in the Uruguay Round are phased in, while the openness of the agricultural sector tends to decline.

A 40 percent reduction in agricultural tariffs, export and production subsidies results in global welfare gains of around $70 billion per year. The largest dollar amounts of gain, and the largest gains as a share of agricultural value added accrue to developed countries. However, the gains relative to GDP are largest in developing country regions such as (non-India) South Asia and (non-Indonesia) Southeast Asia. Impacts of this liberalization on agricultural trade volumes are mixed—while reducing tariffs tends to increase import volumes, reductions in production and export subsidies tend to reduce volumes. If production subsidies are excluded from the cuts, the global gains decline to $60 billion per year, but trade volumes grow relatively more, and net food importers in regions such as the Middle East and North Africa, South Asia and China are relatively better off.

The gains from a 40 percent liberalization of manufactures trade are about the same order of magnitude as those from agricultural liberalization, despite the fact that agriculture is a much smaller percentage of global output than manufactures. The developing countries receive the lion's share of the manufacturing liberalization gains because they face higher rates of protection on manufactures exports, and because liberalization lowers the efficiency costs imposed by their own protection.

Liberalization of trade in manufactures and services has powerful impacts on agricultural trade through economy-wide linkages in each economy. Reductions in countries' own-protection to these non-agricultural sectors will affect agricultural exports through four major channels: (1) it lowers the cost of intermediate inputs in food production, (2) it tends to increase the availability of labor and capital for food production, (3) it encourages consumers to substitute away from agricultural products towards now-cheaper manufacturing and services goods, and (4) in the absence of increased net capital inflows, it gives rise to a real depreciation in the liberalization region. All of these forces tend to lead to an improvement in the food trade balance, and this is predicted to be the dominant force in the high-income countries.

Of course, increases in a country's market access to other countries' markets for industrial products and services will tend to work in the opposite direction, leading to higher-priced intermediates, more costly labor and capital, consumer substitution towards food products and a real appreciation. Thus we observe that multilateral liberalization leads to deterioration in the food trade balance in the developing countries of East and Southeast Asia, including China.

Overall, the combined effect of multilateral trade liberalization of agriculture and non-agricultural trade in 2005 is projected to lead to an increase in the food trade balances for most developing country regions, with the notable exceptions of India, China and the Middle East/North Africa region. The heavily protected markets of Western Europe and Japan experience the largest deterioration in their food trade balance under this WTO2000 scenario.

Agriculture and Non-agricultural Liberalization in the Millennium Round

I. Introduction

Prior to the 1980s agriculture was largely left undisciplined by the GATT (Josling, Tangemann and Warley 1996). One of the great achievements of the Uruguay Round of trade negotiations was the bringing of agricultural policies under much greater multilateral discipline. The Uruguay Round Agreement on Agriculture led to the conversion of non-tariff agricultural import barriers into bound tariffs, and those bound tariffs, together with subsidies to farm production and exports, have been scheduled for phased reductions between 1995 and 2000 (or up to 2004 in the case of developing countries). This represents a major reversal of the trend since the 1950s of substantial growth in agricultural protection and insulation in the advanced industrial economies, and its subsequently spread to a number of newly industrializing economies (Johnson 1973; Anderson and Hayami 1986; Tyers and Anderson 1992). More than that, the Agreement on Agriculture has altered the climate of farm policy making in both advanced and developing countries. Even though Uruguay Round commitments themselves will not result in large cuts in farm protection, attitudes have been irreversibly changed and the foundation has been laid for further reforms, including during the next WTO Round.

Having said that, it needs to be recognized that little reduction in actual agricultural protection rates will have occurred by the end of this decade, when barriers to trade in agricultural products will still be several times higher than barriers to trade in manufactures. Hence much remains to be done before agricultural trade is as liberal as world trade in manufactures. A key purpose of the next WTO round of multilateral negotiations is therefore to further reduce distortions to world food production, consumption and trade.

However, agriculture is distorted by more than agricultural policies. In developing countries especially, farming is discouraged not only by farm protection policies in high-income countries but also by those countries' own manufacturing policies and distortions to services markets. Farm lobby groups in developing countries therefore have an interest not only in the agricultural negotiations of the next WTO round, but also the non-agricultural ones. The purpose of this paper is to explore the extent to which multilateral liberalization of not only farm but also non-farm policies would affect the markets for farm products.

In the next section of this paper, we consider the patterns of production, consumption, trade and protection, as well as other structural features of the global economy that are likely to influence the welfare impacts of liberalizing agricultural and non-agricultural trade. We then turn to projections of the global economy to the year 2005 when the Uruguay Round (UR) implementation is complete. Our goal is to assess the potential impact of further cuts from this

post-UR base. Then, in the fourth section, we discuss the simulations performed and the key findings. The fifth section contains a summary and conclusions.

II. Patterns of consumption, production and trade

Agriculture is much more important for the developing countries than for the high income economies of the OECD. This fact is true whether one looks at food's share in consumption or the share of food and agricultural production in GDP. Table 1 reports these figures for nineteen regional groupings of the global economy (see appendix for definitions of these groupings). Here, we see from the first column that the estimated share of food in private consumption (at producer's prices[1]) in 1995 was in excess of 40% in South Asia, China, Indonesia and Sub-Saharan Africa. In contrast, the comparable share for OECD economies (bottom of Table 1) was generally less than 15 percent. The fourth, fifth and sixth columns of this table report the sectoral shares in economy-wide value-added across these economies. Here, we again see the relative importance of food and agriculture in the developing countries. This figure exceeds thirty percent in South Asia and much of Africa and it is above 20 percent in parts of East Asia. In contrast, the relative importance of the food sector in GDP in the OECD economies is only around 5 percent.

In light of the relatively greater importance of food and agriculture for the developing countries' economies, it is of considerable interest to examine what has been happening to protection and trade in this sector in recent decades. Figure 1 reports the evolution of developing countries' aggregate merchandise export shares from the early 1960's to the present (with projections from 1995 to 2005 – see Section III below). The share of agriculture exports has been on a path of continual decline over the entire period, falling from nearly half in 1965 to little more than 10 percent today. Mining and minerals exports over this same period have been quite volatile, reaching as high as fifty percent in the early 1980's, before dropping off again with the subsequent fall in energy prices. On the other hand, the share of manufactures in developing country exports has been steadily climbing – from about one-quarter in 1965 to three-quarters of merchandise exports today. Of course these averages mask considerable variation across individual countries, as may be seen from the third group of columns in Table 1. These report sectoral shares in total exports (both merchandise and services) for 1995. Food products' share in exports is highest (about one-quarter) for Latin America and Sub-Saharan Africa. In contrast, food's share of total trade is five percent or less in much of East Asia.

There are many factors influencing the evolution of developing countries' export shares over time. However, one of the most important has been the changing profile of protection in the OECD economies – which absorb most of the world's imports. Immediately following World War II, average manufacturing tariffs in the OECD economies were about 40%. Today, they are 1.5%! This dramatic drop in the barriers to international trade in manufactures has contributed strongly to the increased share of manufactures in world trade – for both developed and developing economies (Hertel and Martin, 2000). It stands in sharp contrast with agriculture,

[1] This means that wholesale, retail and transportation margins are not included. Compared to consumer expenditures at consumer prices, the budget shares for physical products are too low, while the budget share for services is too high.

where the OECD's nominal rate of assistance (this measure includes domestic support) has risen from about 30 percent over the 1965-74 period to nearly 60 percent in 1998 (ABARE reference). With agricultural protection rising, even as manufacturing tariffs have fallen, it is no wonder that their relative shares in trade have moved so sharply in opposing directions.

While the share of food in total trade has been falling, this aggregate figure masks a very significant development in the composition of global food trade – namely the shift from bulk products (e.g., grains) to non-bulk products (e.g., meat products, fresh fruits and vegetables, processed foods). This trend is clearly displayed in Figure 2, which shows both the evolution of bulk vs. non-bulk shares in world trade, as well as developing country exports. From this, it is clear that developing countries are relatively more reliant on the slow-growing, bulk food product trade. However, the composition of their exports is following the global trend towards non-bulk food exports. The latter have increased their share of total developing country food exports from only 16% in 1965 to 42% in 1995 (Figure 2).

Another important aspect of developing country agriculture is their limited *trade exposure*. The final two sets of columns in Table 1 report the share of exports in total production and the share of imports in total domestic usage, for each regional grouping. On average, the developing country ratio of exports to output for manufactures is three times as high as for food products, and for some countries (e.g., China) this discrepancy is much larger. While the low level of trade exposure for agriculture is partly due to the perishable nature of many food products, an important contributor has also been the very high level of agricultural trade protection around the world. Not surprisingly, a similar pattern exists for imports, expressed as a share of total usage in each region. Manufactures exhibits the highest exposure to imports, followed by food, and finally services.

The database underpinning the numbers in Table 1 is the version 4.0 GTAP database (McDougall, *et al.*, 1998). We have aggregated this up from the 45 region - 50 sector level at which it is maintained, in order to facilitate our analysis (see appendix). It represents a snapshot of the world economy in 1995, which is the first year of implementation for the Uruguay Round (UR) agreement. For our analysis of the potential gains from agricultural and non-agricultural liberalization in the next WTO round, we need to look ahead to 2005, when the UR agreement is due to be fully implemented. Of course, there will be many other changes to the world economy over this period, and some of these may affect the gains from a future WTO round. Therefore, we employ a formal projections approach to establish a 2005 starting point for our subsequent analysis. The next section details the underlying methodology and key assumptions.

III. Projections to 2005

Modeling Framework: We employ the widely used GTAP model of global trade (Hertel, 1997)[2]. This is a relatively standard, multi-region, applied general equilibrium model which features explicit modeling of international transport margins, a global "bank" designed to mediate between world savings and investment, and a relatively sophisticated, Constant Difference of Elasticities (CDE) consumer demand system designed to capture differential price

[2] The model is implemented using GEMPACK, (Harrison and Pearson, 1996).

and income responsiveness across countries. The latter is particularly important in the case of projections work and this demand system is calibrated to existing estimates of income and own-price elasticities, which are permitted to vary by region (McDougall, Dimaranan and Hertel, 1998). Of particular interest here are the income elasticities for disaggregated food demand, that are taken from the World Food Model of the FAO (FAO, 1993).

Trade flows are modeled using the Armington (1969) approach, by which products are differentiated by origin. They are assumed to substitute imperfectly for one another to form a composite import aggregate. This, in turn, substitutes imperfectly for domestically produced goods. In this way, the model is able to track bilateral trade flows. Validation efforts with the GTAP model (Gehlhar, 1994, 1998; Coyle *et al.*, 1998) show that it is able to track, to a reasonable degree, some of the major changes in trade patterns over the past two decades.[3] However, this work has also highlighted the key role of the trade elasticites. In particular, Gehlhar (1997) finds that he obtains a better fit over his long run (one decade) period of analysis, by increasing the size of these elasticities. Accordingly, it is now common practice to double the size of the trade elasticities in long run projections work (Hertel, Martin, Dimaranan and Yanagishima, 1997; Anderson et al., 1998; Hertel and Martin, 2000). However, this practice is rather *ad hoc* and, until recently, it has not been formally validated.

The standard GTAP trade elasticities are reported in the first column of Table 2. They are obtained from Jomini *et al.* (1991) who conducted a literature search in addition to performing some of their own estimation work for New Zealand. These elasticities were designed to apply to medium-run analyses. However, recent work by Liu *et al.* (2000) highlights the sensitivity of these trade elasticities to the length of run involved in the simulation. Those authors formally estimate the Armington parameters in the GTAP model for a 10x10 aggregation of the version 4 database. Their nine-year estimates of the elasticity of substitution between imports and domestic goods are reported in the third column of Table 2.[4] (The correspondence with commodity definitions used in the current study is only approximate.) Comparing these estimates to the entries in column one, we see that in most cases the standard GTAP parameters are too small over the nine-year period. This contrast is particularly striking for processed food products, where the Liu *et al.* (2000) estimate is nearly three times as large as the GTAP value.

The second column in Table 2 reports the elasticity of substitution between domestic and imported goods used in the present study. As can be seen, these values have been obtained by doubling the standard GTAP values. This adjustment brings us much closer to the recent estimates by Liu *et al.* (2000) for farm and food products. However, it results in excessively high trade elasticities for fuels and mining products, basic manufactures and autos, compared to the Liu *et al.* estimates. Thus, for purposes of the present study of agricultural liberalization, the higher trade elasticities would seem to be justified. However, it is possible that non-agricultural trade flows will be excessively responsive to changes in protection.

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[3] Gehlhar's work showed that projections over a period of one decade were improved by increasing the size of the trade elasticities. Accordingly, for this work, we have doubled the size of the standard GTAP trade elasticities

[4] In this study, as well as in the Liu *et al.* (2000) work, the authors follow the rule of thumb developed by Jomini *et al.* (1991) in setting the elasticity of substitution among imports from different sources equal to twice the value of the elasticity of substitution between domestic good s and imports.

Throughout the paper we employ the simplistic, but robust assumption of perfect competition and constant returns to scale in production activities.[5] While this is likely to be quite appropriate for characterizing much of the world's agricultural production, departures from perfect competition are well-documented in the manufacturing sectors. How is this likely to bias our results? Hertel (1994) explores the general equilibrium implications for agriculture of potential "pro-competitive" effects of trade liberalization on manufacturing markups. He shows that, by ignoring these effects, we are likely to overstate the amount of adjustment in agriculture due to tariff reductions in non-agriculture, in the context of a small, open economy. Of course, in the present, multi-region analysis these interactions become more complex. Nevertheless, it should be borne in mind that, by ignoring the potential downward adjustment in manufacturing markups in the presence of more intense foreign competition, we may be over-stating the impact of developing country manufactures liberalization on agricultural output.

Following earlier projections work with the GTAP model (Gehlhar *et al.*, 1994; Anderson *et al.*, 1997, Hertel *et al.*, 1997), we assemble external projections for population, skilled and unskilled labor, investment and capital stock. When combined with assumptions about likely productivity growth rates, this permits us to predict the level and composition of GDP in 2005, as well as trade flows, input usage, and a wide range of other variables. In addition, we obtain a new equilibrium snapshot of the world economy in 2005 which will provide the starting point for our subsequent WTO2000 simulations.

Overall rates of economic growth: Our forecasts for the fundamental drivers of global economic change over the 1995-2005 period are reported in Table 3. These projections were generated by combining historical and forecast data from the World Bank. Projections for population and unskilled labor were obtained by cumulating the average growth rates between 1995 and the 2005. The skilled labor projections are based on forecasts of the growth in the stock of tertiary educated labor in each developing country (Ahuja and Filmer, 1995) and projected growth rates of skilled labor in developed countries from the World Bank They provide an indication of changes in the stock of those qualified for employment as professional and technical workers. Growth rates of physical capital were obtained from 1995 and the projected 2005 stock of physical capital. Projections of the stock of physical capital were calculated using the Harberger-style, perpetual inventory method, that is, by adding investment net of depreciation to update the capital stock in each year. Data for initial physical capital stock for 1995 as well as annual forecasts of gross domestic investment were obtained from the World Bank.

Our projections of total factor productivity (TFP) growth vary by sector and region. Regions are grouped into four categories according to their assumed rate of annual productivity growth in manufactures. These range from low productivity growth (0.33%/year), to medium (1%/year), and high (2%/year), with a final category -- very high (3%) reserved for China and Taiwan. The latter two countries seem to be growing at rates that cannot be explained with normal rates of productivity growth. Sectoral variation in productivity growth builds on the econometric work of Bernard and Jones (1996). They find that the annual rate of productivity

[5] Alternative versions of the GTAP model feature imperfect competition (Francois, 1998), but these are demanding of additional information and unstable for projections purposes.

growth over the 1970-87 period in OECD agriculture was about 40% faster than that of manufacturing. Similarly, services TFP growth was about one-half that in manufacturing, while they did not measure significant productivity growth in mining over this period. By combining these factors of proportion (1.4, 0.5 and 0.0) with the above-mentioned manufacturing TFP growth rates, we are able to obtain region/sector-specific productivity forecasts for the 1995-2005 period.

A difficult aspect of constructing such projections has to do with the rate at which natural resources are depleted -- or perhaps augmented through new discoveries. Rather than attempt to estimate changes in the natural resource endowments over this period, we have simply opted to target a particular rate of change in the prices of agricultural and other natural resource-based commodities over the projections period. Grilli and Yang (1988) report an average rate of price decline for metals in the 20th century of about 0.8%/year, while grains prices have fallen about 0.3%/year, on average. We allow the model to select a rate of farmland and natural resource augmentation in agriculture and mining which achieves a continuation of these downward trends in commodity prices throughout the 1995-2005 period.

In order to gauge the reasonableness of our projections, the last two columns in Table 3 compare our projected GDP growth rates over this period to those from the World Bank's International Economic Analysis and Prospects Division. By and large they are quite close. This is hardly surprising, since the two studies share many of the same basic assumptions. Significant departures arise in the cases of the South Africa Customs Union, the Economies in Transition (EIT) and Indonesia. In each case, our projected growth rates are substantially higher than the World Bank's. The only way the World Bank forecasts for these three regions could be achieved in our framework is to have negative productivity growth rates, or substantial increases in unemployment. We have opted not to do either of these, and so our forecasts are higher for these three regions. Our forecast for China's GDP growth is slightly higher than that of the Bank, however, the difference is negligible when viewed in terms of annual growth rates.

Assumptions about trade policy: Projected tariff rates for the year 2005 are reported in Table 4. These are based on the 1995 rates taken from the GTAP version 4, and updated to take account of anticipated changes owing to the Uruguay Round as well as China's accession to the WTO. [6] Consider first the agricultural tariffs. Here, it is important to note that the 1995 base year represented a period of high world prices -- and therefore low measured protection. This is because border protection for the OECD economies in 1995 was estimated using the OECD's Producer Subsidy Equivalent (PSE) methodology. This involves observing the difference between world and domestic prices and attributing that to the tariff-equivalent effect of national trade policies. As a result, when world prices are high, measured protection tends to be low in economies employing tariff rate quotas, variable tariffs and other tools for insulating their domestic producers from world markets. In contrast to 1995, UR agricultural commitments were made from a base period from the late 1980's when prices were very low and measured protection was at an historic high. In light of these facts -- and in light of the extensive "dirty

[6] In addition to the baseline shocks discussed here, it should be noted that several significant adjustments were made to the levels of protection in the initial database, prior to conducting the baseline projections. These are detailed in the appendix.

tariffication" in agriculture (Hathaway and Ingco, 1995), (Ingco, 1996)), we believe that it is sensible to assume that no further liberalization from 1995 levels is likely under the UR Agreement.[7] Accordingly, the tariffs reported in Table 4 are based on bilateral tariffs that are identical to those in the version 4 database for 1995. (Because these tariff averages are trade-weighted, and because intra-EU trade is not taxed, the EU average rate of protection is rather misleading.) In addition to tariffs, we take explicit account of domestic support for agriculture, again based on the OECD's database. This is treated as an output subsidy, which is differentiated by sector. To the extent that these support policies have been effectively decoupled from farmer decisions, this treatment will overstate the production impact of lowering these subsidies under a future WTO round.

For the developing countries these protection estimates are obtained from UNCTAD's TRAINS database. However, there are many country/commodity gaps and these are filled in using the pre-UR estimates of Ingco (1996). Due to the presence of very high WTO bindings in most developing countries, further reductions in agricultural protection are not likely to be required under the UR. Of course, these projected tariffs for 2005 abstract from domestic reforms that have been undertaken. For this reason, and because their current bindings are so much in excess of applied tariffs, we must view our later estimates of developing country WTO2000 liberalization in agriculture as upper bounds.

In the manufacturing arena, the most important trade policy developments over the 1995-2005 period are likely to be the completion of manufacturing tariff cuts under the Uruguay Round, implementation of the Agreement on Textiles and Clothing (ATC) and the accession of China and Taiwan to the WTO. We have incorporated these changes by drawing on the work of Francois and Strutt(1999) to specify the remaining UR cuts to be made from our 1995 base period. China's WTO offer was obtained from the World Bank and is based on their offer as of August, 1999. It is compared to their applied tariffs for 1997 and, where the bindings are lower, the offer is taken as a change in policy. Otherwise, the 1997 applied rates are used. Our treatment of Taiwan's offer is based on their announced target of 4% average tariffs for manufactures. We reduce all bilateral tariffs by an equi-proportionate amount sufficient to achieve this target in the updated database. The resulting 2005 tariff averages for mining and manufacturing are reported in the second and third columns of Table 4.

In moving to the 2005 database, we also take account of the Agreement on Textiles and Clothing. This is anticipated to have a large impact on trade as it implements accelerated growth of quotas established under the previous, Multi-fiber Agreement, culminating in their abolition at the end of the UR implementation period. China and Taiwan, as non-members of the WTO, remain constrained by the old, MFA quotas. Thus their accession brings important changes in the textiles and apparel trade. While it is unlikely that their accession will culminate in the complete elimination of China and Taiwan's clothing quotas by the year 2005, we believe that this will follow soon after, and that it will be largely be complete before any cuts under a Millennium

[7] Since China and Taiwan's offers are not linked to the UR base year, it would make sense to include their agricultural cuts in our baseline. However, we do not have solid estimates of their current protection rates and, at least in China's case, some of the bindings are clearly well-above current protection levels. Therefore, we do not change their agricultural protection rates in the baseline simulation either.

Round would take place. For this reason, we include their abolition in our baseline analysis as well.

Thus far the discussion of protection has been entirely in terms of merchandise trade. However, as noted in the introduction, services trade and investment is growing by leaps and bounds, and international services transactions remain heavily protected in many countries. The final four columns in Table 4 report estimates of the tariff equivalents of protection for the construction services, business and finance, trade and transport and government services sectors in the regions used for our analysis. These are taken from Francois (1999) who estimates a gravity model of services trade using bilateral services trade data from the United States.[8] He adopts Singapore and Hong Kong as free trade benchmarks and judges predicted imports from the US relative to these economies. Discrepancies are attributed to protectionist policies and tariff equivalents of these policies are obtained by assuming a constant elasticity of demand function. While this approach is relatively simple, it results in some very reasonable estimates of protection for the construction and business services sectors. Note from Table 4 that business and construction services trade barriers do not appear to be systematically related to the level of development. While India has the highest tariff equivalent in construction services, her business services trade appears to be more open, controlling for income per capita and aggregate GDP, than is the case for Japan. Protection for construction services in Japan is also quite high. It is followed closely by Australia and New Zealand.

Unfortunately Francois' estimates omit the trade and transport sectors, which comprise a very large share of world services trade. For these sectors, as well as for government services, we draw on the work of Hoekman (1995) developed for analysis of the Uruguay Round. These protection measures are much cruder and rely on critical assumptions about the level of prohibitive tariffs as well as the relationship between observed coverage ratios and the implied tariff equivalent of protection for different sectors. [9] In light of the very limited specific commitments made under the Uruguay Round's services agreement, we assume that these levels of protection will persist in 2005. As can be seen from the entries in Table 4, protection for transport services (maritime, rail and air) is particularly high.

Structural Changes: 1995-2005: When the macro-economic shocks in Table 3 are combined with the policy changes described above, we are able to simulate the model forward to the year 2005. While the evolution of the economy over this period is not the central focus of this paper, it is of interest to note a few of the major structural changes that occur. First of all, as a consequence of the lack of progress in reducing agricultural support under the Uruguay Round, agriculture's share of developing country exports is projected to be even lower in 2005 (Figure 1). Meanwhile, the relative importance of manufactures is further accentuated by UR tariff cuts, in conjunction with elimination of the textile and apparel quotas. This differential pattern of cuts

[8] The dependent variable in this model is US exports, and the explanatory variables are the log of per capita income and GDP. A dummy variable is used for exports from the US to Western Hemisphere nations.

[9] The Hoekman protection estimates for the transport sector are quite high, while the protection estimates for wholesale and retail trade are much lower. While the former sector is the dominant one from a trade in services perspective, we seek to err in the direction of caution by cutting Hoekman's transport estimates in half in order to represent composite protection in the trade and transport sector of our model.

also leads to increased openness (exports/output) for developing country manufactures and a slight decline in agriculture's openness in the developing countries.

IV. Analysis of WTO2000

Description of the Experiment: In this section we begin from the projected 2005 database established based on the assumptions detailed in the previous section and proceed to analyze the impact of post-Uruguay Round liberalization on economy-wide activity and welfare, as well as changes in farm and food trade. Specifically, we consider across-the-board, 40% cuts in estimated 2005 agriculture protection, services protection, as well as mining and manufacturing tariffs. The depth of these cuts is slightly deeper than the one-third cuts agreed to in agriculture and manufactures trade during the Uruguay Round, and it is very much in line with what was being discussed at the time of this writing. More liberalization, and greater welfare gains, could be achieved by cuts that go deeper, or which focus more on reducing peak tariffs. The estimates presented in this paper are intended to provide a benchmark for comparing the differential impact of agriculture and non-agriculture reforms on the global economy – and food trade in particular.

Modeling Protection: Our analysis of trade liberalization hinges importantly on the way in which we model the effects of protection. In the case of manufactures, this is straight-forward, since we are just focusing on cuts in *ad valorem* tariffs. These are simply reduced by 40% across-the-board, for all sectors and regions. However, the situation is more complicated in agriculture and services, therefore requiring additional discussion.

Despite attempts to increase transparency of farm and food protection under the Uruguay Round, this has not yet been achieved. The introduction of tariff rate quotas (TRQs) on sensitive commodities is a major source of non-transparency. These instruments are dealt with at length in the papers by Abbott and Morse (1999) and Elbehri *et al.*(1999), also presented at this conference, and they are not explicitly modeled here. Nor will we model specific tariffs which remain widespread in agriculture, and which require supplementary data to properly evaluate. Rather we will model the 40% cut in agricultural protection as one that achieves a 40% reduction in the difference between the market price and the world price for all farm and food products. In the case of TRQs, we will assume this comes about either through an expansion of the quota or a reduction in the out-of-quota tariff, or perhaps a combination of the two. As Elbehri *et al.* (1999) demonstrate, these different approaches to reform will have very different implications for the distribution of quota rents, and hence welfare, between exporters and importers. Unfortunately we cannot shed additional light on this topic and we will simply assume that, like tariff revenues, all quota rents accrue to (and are lost by) importers.

A similar set of complications arises in the case of producer subsidies. Here, negotiators seek to distinguish between coupled and de-coupled support. As is the case with TRQ's, a proper assessment of reform will require modeling each policy explicitly. Furthermore, some would argue that there is no such thing as a "de-coupled" farm support policy. Any payments made to farmers will have the tendency to keep them in farming and thereby bolster production. Once again, a comprehensive investigation of this issue is beyond the scope of the present study. Rather, we will simply consider the consequences of a 40% reduction in the difference between producer prices – inclusive of producer subsidies – and domestic market prices.

This general approach to modeling reductions in agricultural support is also compatible with the way in which the GTAP database has incorporated protection for farm and food products. GTAP relies on price comparisons to assess the degree of border protection (market price support), and on producer subsidies to construct producer prices. Since these measures of protection are not instrument-specific, it makes sense to think of liberalization in the same, summary fashion. In fact, since the version 4 database incorporates the domestic-world price wedges on both the import and export sides, any reduction in support must logically reduce both the import tariff and export subsidy equivalents at the same rate. This is the route that we take here.

In the case of services protection the task is even more difficult. Here, since there is no physical product being traded, the idea of modeling protection with revenue-raising, tariff equivalents following the work of Brown *et al.* (1996) seems inappropriate. We assume instead that barriers to services trade consume real resources on the part of firms attempting to access the protected market. This limits the actual volume of services that can be delivered at a given cost. Conversely, liberalization of restrictions on services trade can be viewed as augmenting the amount of services delivered from a given level of export effort, thereby reducing the effective price of services in the domestic market. We capture this phenomenon by introducing a services import-augmenting technical change component into the model. We set the rate at which this technical change occurs according to the tariff-equivalent estimates of Francois (1999) and Hoekman (1995) as discussed above. For example, in the case of India's imports of construction services, Francois has estimated that prices must be 62% above their free trade level if one is to explain the relatively low share of imports in this market. Therefore, in our 40% services trade liberalization experiment, we will consider the impact of import-augmenting technical change which reduces the *effective* price of construction imports to Indian firms by 40% of 62% = 24.8%. This approach is applied to all services sectors, with the goal of reducing measured protection across-the-board by 40%.

Agricultural Liberalization: We turn first to the question of liberalizing agricultural trade in a post-UR environment. As noted above, this involves 40% cuts in border protection as well reductions in producer support. To aid in our analysis of results, Table 5 summarizes the global averages for these estimated protection and support levels, by agricultural commodity in 2005. Feedgrains top the list of protected commodities on a global basis. Here, very high rates of protection on large volumes of feed grain imports into East Asia result in a global, average tariff equivalent of 97 percent. This is followed by dairy, foodgrains, beverages and tobacco, and meat products with average tariffs that are all in the neighborhood of 20% on a global basis. Average protection for other food and agricultural products is much lower.

We can also examine protection from the exporters' perspective, whereby the export subsidy equivalents are aggregated across all regions and divided by exports at domestic market prices. These are reported in the second column of Table 5. They show that, on a global basis, dairy products are the most heavily subsidized exports, with total subsidy equivalents amounting to 27% of world trade (at domestic prices). This is followed by meat and livestock products (8%), feedgrains (4%) and foodgrains (3%). The share of global oilseeds exports that are effectively subsidized (market price in excess of world price) is too small to generate a measurable average subsidy worldwide.

When agricultural border price support is cut by 40% (AgrMkt40), a number of counter-balancing forces are unleashed. First of all, reduced protection in the importing regions tends to raise the demand for imported food products, thereby stimulating trade. However, reductions in implicit subsidies on exports tends to reduce supply from some of the major exporting regions. Thus the impact on world trade is ambiguous, as can be seen from the results in Table 6. Indeed, for dairy products, the sizable cuts in export subsidies result in a decline in world dairy trade. This decline is driven by a decline in subsidized EU dairy exports. The biggest increases in global trade volume come in beverages and tobacco and other processed food products, where initial protection is very high, and export subsidies do not play a role. World trade also increases significantly for other processed food products, other agriculture, and meat and livestock products.

Regional changes in food trade as a result of this 40% reduction in market price support are most readily summarized in the form of changes in trade balances. In order to simplify the analysis and accentuate the role of intersectoral competition, we have fixed the aggregated trade balance for each region. Thus the sum of each region's trade balance changes across all commodities equals zero. Table 7 reports the changes in regional *food* trade balances owing to the 40% reduction in border protection for agriculture. Western Europe shows the largest absolute change in 2005, amounting to an increase of $23 billion in the value of imports, relative to exports. This is followed by substantial increases in net food imports by Japan, China, the Middle East and North Africa and India. It is hardly surprising to see North and South America, and Australia/New Zealand as regions showing the largest increases in food trade balance. These are natural net exporters. However, it is somewhat more surprising to see Taiwan and the other NICs increasing their exports of food by more than they increase imports. This is a compositional phenomenon whereby Taiwan, for example, increases its grain and oilseed imports while exporting more livestock products. In the case of the other NICs, the increase is driven by greater processed food, and beverages and tobacco exports. These exports are made more competitive by the availability of cheaper raw materials.

It is also of interest to ask how simultaneous reductions in producer support might alter these findings. Projected global average farm support levels for 2005, by commodity, are reported in the third column of Table 5. From this, we can see that producer payments are highest for the grains and oilseeds sectors. Average producer subsidies for meat and livestock products, including dairy, are lower (2 – 3%). As noted above, these subsidies are treated as output subsidies, thereby ignoring the recent proliferation of "decoupled" support payments. We consider the impact of a simultaneous cut of 40% in producer payments to farmers, modeled as a reduction in output subsidies. To the extent that programs are partially decoupled, these estimates will overstate the change in output as a result of the reduction in producer subsidies. Future work will clearly need to refine this approach, by modeling domestic programs explicitly on a country-by-country basis.

The second column in Tables 6 and 7 reports the changes in global export volume and regional food trade balances owing to the 40% liberalization of both market and producer support in food and agriculture (Agr40). Apart from Western Europe, where the change in food trade balance drops by an additional 50%, the difference between this figure and the earlier one (market price support only) is relatively modest. Furthermore, the same broad ordering is

preserved. For the sake of completeness, we will proceed by reporting the welfare summary results for both simulation experiments, but we will emphasize the simulation including domestic support cuts. The reader may wish to view these two sets of results as upper and lower bounds on the impact of a 40% liberalization package for the global food sector.

The real income impacts of these manufacturing tariff cuts are quite complex to analyze. Welfare gains from such multilateral liberalization are fundamentally determined by two factors: the change in the efficiency with which any given economy utilizes its resources, and changes in a country's terms of trade (TOT). We will begin by focusing on the efficiency gains. The first column in Table 8 reports the efficiency gain in each region, as a share of food and agricultural value-added, from the combined 40% reduction in market price and producer support. The largest proportional gains are in Western Europe, followed by ROW, Japan, East and South Asia. For example, in the case of Western Europe, Table 8 reports that the annual gains from this 40% cut in support amount to more than 8% of the entire food sector's value-added. This is a substantial gain. At the other end of the spectrum, efficiency in the Australia/New Zealand region actually falls slightly. This result is driven by a large increase in dairy exports for which the domestic price exceeds the world price (an implicit subsidy). However, this decline in efficiency does not mean that real income falls in that region, since we have not yet accounted for the terms of trade effects.

Adding the terms of trade effects permits us to calculate the regional Equivalent Variation (EV) – or the amount of money that could be taken away from consumers, at initial prices, while leaving them at the same level of post-simulation utility. If the region in question experiences a terms of trade improvement, i.e. export prices rise relative to import prices, then the EV gain will be larger than the efficiency gain. If the terms of trade deteriorate, then the opposite will be the case. The second column in Table 8 reports the ratio of these two terms. Thus it may be seen that India, with an Efficiency/EV ratio of 137%, experiences a terms of trade loss. In the case of Other Southeast Asia, the two are virtually the same (101%) and we conclude that there is no change in the terms of trade. Despite the small efficiency loss in ANZ, that region gains welfare due to the rise in its export prices, relative to the price paid for imports. Latin America, including Brazil, Sub-Saharan Africa, and North America are also terms of trade gainers, which makes sense, given their net export positions in food products. The biggest terms of trade losses are experienced by South Asia, China and the Middle East/North Africa region.

While it is useful to consider the size of these efficiency and welfare gains relative to the size of the sector being liberalized, it is ultimately desirable to compare these gains with national income – or better yet, relative to national expenditure. Recall from Table 1 that the share of agriculture and food in overall GDP is largest for the South Asian economies and for Sub-Saharan Africa (outside of South Africa). Thus, Other (non-India) South Asia looks like it will be one of the biggest winners in this analysis, since the increase in efficiency per $ value-added is high, as is the overall importance of this sector to the economy. On the other hand, the high efficiency gain in Europe per $ value-added will be diluted by the fact that the food sector represents only about 5% of GDP in that region. These points are confirmed by the third column in Table 8 that reports the percentage of the EV relative to pre-WTO simulation, 2005 expenditure. Here the largest gains are generated in Other South Asia, followed by ROW and Other (non-Indonesia) Southeast Asia, the Other NICs and then Western Europe.

In order to compute the global welfare impacts of various liberalization experiments, we report the regional EV's in $ US millions in the second part of Table 8. Here we see that the global welfare impact of the 40% cut in agricultural protection amounts to roughly $70 billion in the year 2005 ("world" total in Table 8). This contrasts with the somewhat smaller gains ($60 billion) when producer subsidies are left off the table (AgrMkt40). Comparing the regional impacts of these two simulations, we find that most regions are little changed, or even a bit better off under the more comprehensive protection cut (most notably Australia/New Zealand, Western Europe and Latin America). However, some regions benefit from leaving the producer support unaltered (AgrMkt40). The Middle East and North Africa, in particular, have their terms of trade losses diminished when only market price support is cut.

It should be noted that these welfare findings are quite sensitive to the size of the trade elasticities that are used in the analysis. In this study, we have doubled the usual, medium term elasticities to account for the longer term nature of our analysis (10+ years). In separate simulations, we have cut these assumed values in half. This reduces the change in trade volumes by 50% and consequently cuts the welfare gains in half as well. This rule of proportionality works very well in predicting the effect of across-the-board changes in trade elasticities on global welfare gains. However, by accentuating the regional terms of trade effects for regions engaging in the deepest tariff cuts, the distribution of these smaller welfare gains across regions is altered in favor of the regions making the smallest cuts in protection.

Non-agricultural Liberalization

We now turn to analysis of the impact of *non*-agricultural liberalization on trade in food products. We focus here on the changes in regional food trade balances. There are four main mechanisms through which these impacts are likely to be felt. The first is through reductions in the cost of inputs for food and agriculture. Manufactures and services represent important inputs to agriculture and food processing, particularly in the high-income economies. By lowering the cost of imported, non-food inputs to agriculture, liberalization may have an important impact on food production. A second mechanism through which non-agricultural liberalization can affect agriculture is through the factor markets. If non-farm liberalization stimulates production of manufactures, the cost of labor in farming will rise. Clearly this can work in the opposite direction of the first mechanism – or it can reinforce it in those cases where manufactures liberalization leads to an exodus of labor and capital from a non-competitive manufactures sector. The third mechanism operates through consumers' budget constraints. If non-agricultural liberalization lowers the price of manufactures and services, consumers may substitute away from food products. Finally, there is a direct interaction through the aggregate trade balance constraint. When a country cuts its own manufacturing tariffs and increases imports, this opens the possibility of other commodities – including agriculture – increasing net exports to fill the resulting void.

Consider what happens when a country unilaterally cuts it non-agricultural protection. Since we hold net capital inflows (outflows) constant, increased imports of non-food products must be offset by increased exports of all products. Thus there must be a real depreciation in the region. This translates into lower prices for labor and capital as well as for intermediate inputs, thereby making it easier to export food products. In addition, the lower priced manufactures encourages

consumers to substitute away from food products, so domestic demand falls, thereby adding to the export availability. On the other hand, if manufactures or services liberalization in other regions results in increased exports, it may become harder for food producers to export. Thus it is useful to consider what actually happens to the balance of trade for food products under alternative liberalization scenarios.

The final two columns of Table 7 report the changes in aggregated food trade balances, by region, under extraction and manufacturing liberalization, as well as a 40% cut in services barriers. These results may be compared with the changes in food trade balances under agricultural liberalization alone (first two columns) in order to assess the relative importance of direct and indirect policies on a given region's food trade. As noted earlier, Western Europe and Japan show very strong deterioration in their food trade balance under agricultural liberalization. The Americas, Australia and New Zealand offset these changes with increasing surpluses. In all of these regions, the direct effect of agricultural liberalization on the food trade balance far outweighs the indirect effect of non-agricultural liberalization. Therefore, it is more interesting to focus on the developing countries in Asia and Africa.

Some regions show improvements in their food trade balance under agricultural liberalization. This includes the Asian NICs (mentioned above) where lower priced raw materials facilitate increased exports of processed food products, Sub-Saharan Africa, Eastern Europe and the FSU, and Southeast Asia. In the Asian economies, this is counteracted by a decline in the food trade balance in the presence of manufacturing liberalization. This decline arises because the 40% cut in manufacturing tariffs stimulates the demand for Asian exports of manufactures, thereby drawing resources away from agriculture and food production. In Indonesia and Other South Asia, the impact of manufacturing liberalization on the regional food trade balance dominates the direct effect of agricultural liberalization, and the food trade balance declines as a result of the combined 40% liberalization across all sectors. In the case of Other Southeast Asia, the combination of manufactures and services liberalization overrides the direct effect of agricultural liberalization and the food trade balance declines in the combined liberalization case. In the case of the NICs, while the non-agricultural effect is strong, it is still dominated by the direct effects of agricultural liberalization.

In China, Middle East and North Africa, India and ROW, food trade balances deteriorate under agricultural liberalization. But in the Middle East and North Africa, the trade balances for manufacturing and services deteriorate under non-agricultural liberalization and the combined effect is a marginal increase in the food trade balance. In the case of China, as with the other East Asian economies, manufacturing liberalization has a very strong negative effect on the food trade balance, in this case reinforcing the direct effect. The combine outcome is a decline of about $6 billion in the annual food trade balance as of 2005.

The right-most columns in Table 8 report the regional welfare impacts of these non-agricultural cuts on global real income in 2005. The global gains from 40% cuts in mining and manufactures tariffs are very similar to those offered by agricultural reforms (roughly $70 billion). However, their distribution across regions is rather different, with relatively more of the gains accruing to developing countries. The case of China is particularly striking. Her welfare gains under Agr40 are quite small, $172 million. However, in the case of Emfc40, China's

welfare gains rise to more than $22 billion. In fact, with the sole exception of Sub-Saharan Africa, all of the developing regions gain more under the manufactures cuts than they do under agricultural liberalization.

The gains from services liberalization are much more speculative, given the difficulty of measuring services protection discussed above. We have broken the services experiment into two parts. The 40% cuts in business services and construction protection are based on the work of Francois (1999) discussed above. It represents a considerable improvement over earlier attempts to estimate the effects of services protection. These gains are relatively modest, given the still limited trade in these services. They amount to a total of $22 billion in 2005. The second portion of the services liberalization experiment is based on protection estimates that are highly speculative. However, the trade and transport sector to which these rates apply represent a very large share of global trade in services and are therefore very important. Here the potential gains are very large indeed, as indicated by the estimated global gain of $332 billion in 2005. Clearly accurately modeling restrictions on trade and investment in these services sectors should be a high priority for future research.

V. Summary and Conclusions

The objective of this study was to evaluate the implications of agricultural and non-agricultural liberalization on the farm and food economy and global welfare. Our approach, based on a modified version of the GTAP model of global trade, takes into account the dramatic changes in the pattern of trade since the lead-up to the Uruguay Round. Furthermore, we have developed projections of the global economy to the year 2005, when the UR is to be fully implemented. Of particular note is the continuing decline in developing countries' food export share as a consequence of limited progress, relative to manufactures liberalization under the Uruguay Round. Our analysis of liberalization is conducted in the wake of our projections to 2005, and involves 40% cuts in protection in agriculture, mining and manufacturing, as well as services.

We find that agricultural liberalization in the wake of the Uruguay Round could still yield substantial benefits for the global economy in 2005. The total gains amount to about $70 billion for 40% cuts in both market price support and domestic producer subsidies. These gains shrink to $60 billion if domestic subsidies are left unaltered. Overall, these welfare improvements are comparable to the gains that could be obtained from similar cuts in manufacturing tariffs. However, as Hertel and Martin (1999) have pointed out, the distribution of these gains is quite different. In the case of manufacturing tariff cuts, the developing countries make the biggest cuts in protection (i.e. initial tariffs are higher), but they also enjoy the lion's share of the gains. In the case of agricultural liberalization, the rates of protection are highest in the industrialized economies and they are the ones to capture the majority of the absolute gains from liberalization of food markets. However, when measured relative to initial income, developing countries are also some of the biggest winners from cuts in agricultural protection.

We also examine the interaction between non-agricultural reforms and agricultural trade balances, by region. Overall, reductions in agricultural protection have the strongest impact on the regional food trade balances. However, for some regions, most notably Southeast Asia and

parts of South Asia, as well as the Middle East and North Africa, non-agricultural reforms actually dominate and reverse the sign of the change in food trade balance following liberalization. In the case of China, manufacturing tariff cuts are equally as important as agricultural liberalization in determining the change in China's food trade balance. Both sets of multilateral reforms lead to a substantial decline in China's aggregate food trade balance, and when combined, the total decline is approximately $6 billion in 2005.

All of the estimates in this study should be viewed as preliminary and subject to revision as improved estimates of protection become available. There are several areas which require immediate attention. Agricultural protection in non-OECD countries is very poorly documented at present. It is hoped that the recent collaborative initiative between Agriculture Canada, the European Commission, the OECD, the USDA/ERS, and UNCTAD will rectify this. With regard to the OECD countries, more work is needed on the appropriate representation of "decoupled" policies in this type of quantitative framework. Some progress has already been made along these lines (Frandsen and Bach, 1998). In addition, the explicit modeling of tariff rate quotas will be an important item for future analysis, since the distribution of the associated rents will become increasing important (Elbehri, et al., 1999). Finally, while we have reported on some innovative work aimed at coming to grips with services protection, much more research along these lines will be needed in order to understand the implications of services liberalization. It is important, not only for services trade, but also for the food and agricultural sector. The latter are increasingly dependent on services as a production input, as well as a mechanism for transporting, and adding value to, food products.

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Figure 1. Share of merchandise exports from developing countries.

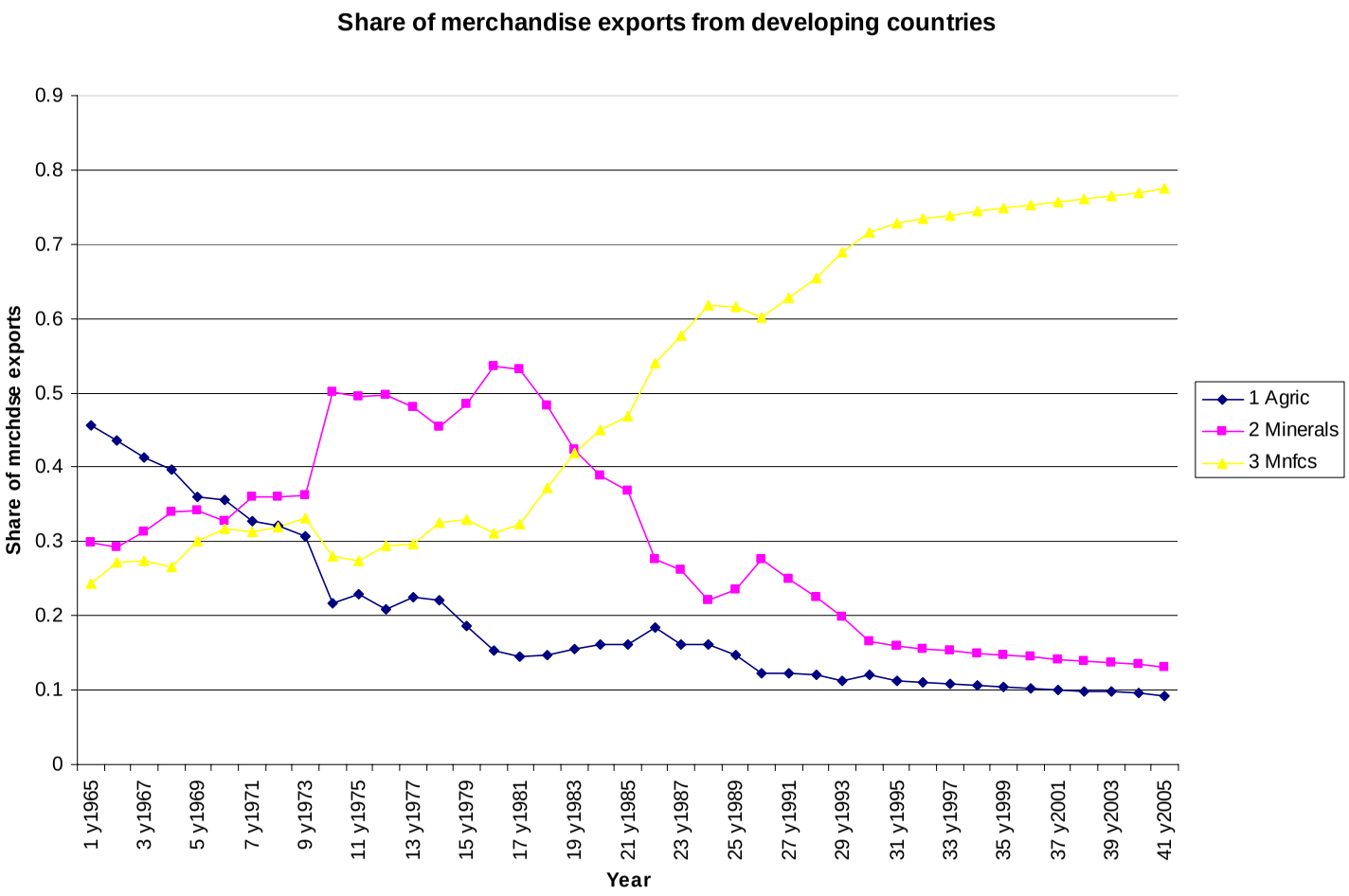

Figure 2. Bulk/Nonbulk Food Trade: World vs. Developing Countries

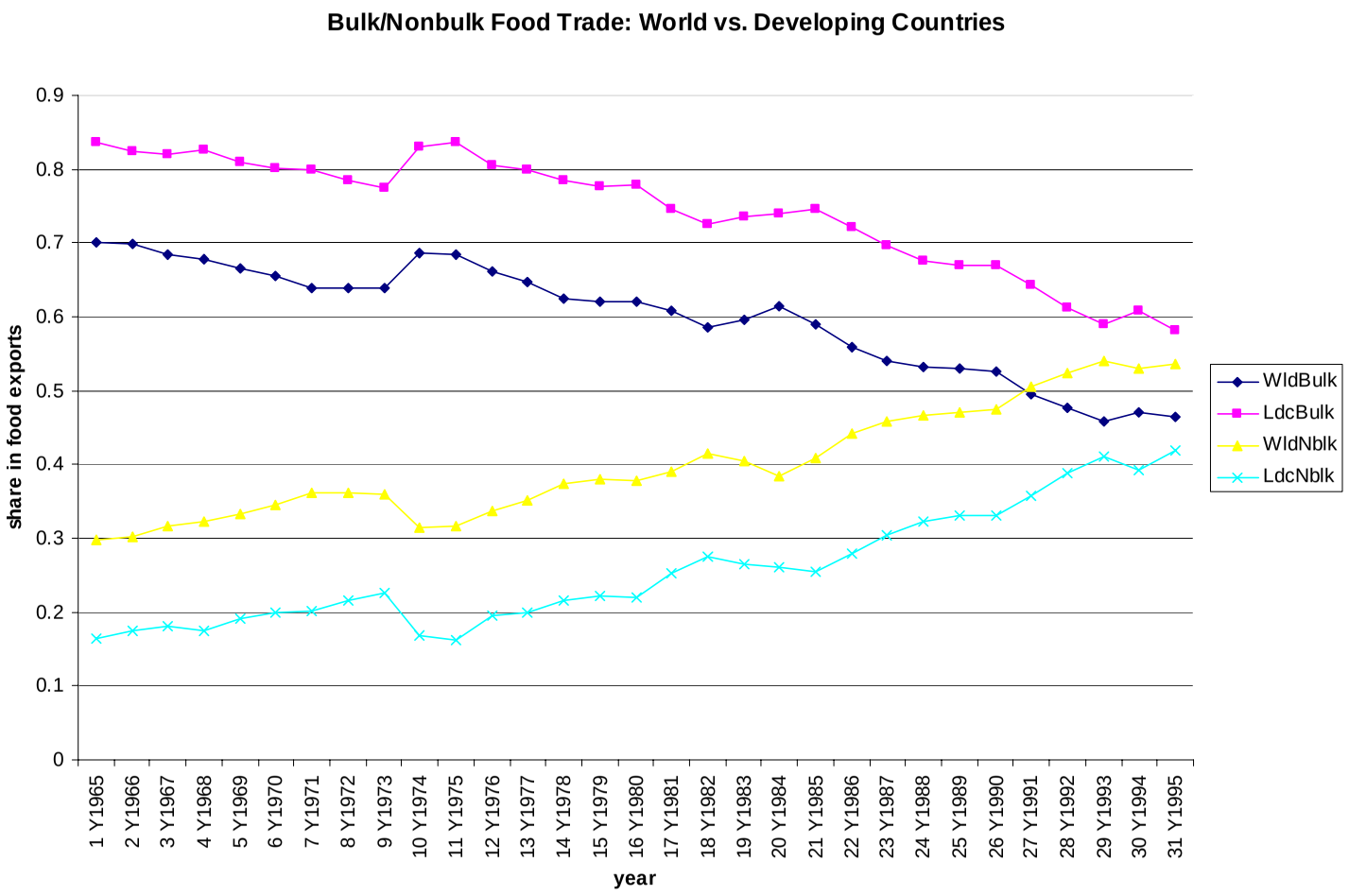

Table 1. Structure of the Global Economy in 1995: Comparison between Agriculture, Manufactures and Services

Region	Consumption share			Value-added share			Share in region's exports			Exports/Output			Imports/Usage		
	Food	Mnfcs	Svces	Food	Mnfcs	Svces	Food	Mnfcs	Svces	Food	Mnfcs	Svces	Food	Mnfcs	Svces
NAmerica	0.085	0.169	0.746	0.047	0.226	0.727	0.081	0.684	0.235	0.088	0.175	0.028	0.063	0.221	0.019
WEurope	0.128	0.213	0.658	0.055	0.233	0.711	0.086	0.696	0.218	0.172	0.340	0.051	0.190	0.346	0.041
AusNZL	0.124	0.144	0.732	0.070	0.163	0.767	0.271	0.465	0.264	0.299	0.233	0.045	0.071	0.351	0.041
Japan	0.157	0.138	0.705	0.052	0.243	0.705	0.005	0.846	0.149	0.003	0.131	0.013	0.094	0.089	0.020
China	0.461	0.296	0.243	0.225	0.355	0.420	0.052	0.848	0.100	0.038	0.199	0.035	0.051	0.195	0.029
Taiwan	0.175	0.183	0.641	0.047	0.297	0.656	0.032	0.884	0.085	0.087	0.438	0.041	0.188	0.377	0.062
OthNICs	0.259	0.250	0.491	0.093	0.266	0.640	0.021	0.669	0.310	0.047	0.389	0.142	0.166	0.466	0.083
Indonesia	0.407	0.141	0.452	0.228	0.300	0.472	0.131	0.753	0.117	0.088	0.364	0.039	0.065	0.358	0.049
OthSEA	0.234	0.352	0.414	0.181	0.357	0.462	0.143	0.654	0.203	0.223	0.471	0.146	0.156	0.580	0.123
India	0.445	0.231	0.325	0.301	0.223	0.477	0.156	0.697	0.146	0.040	0.140	0.025	0.026	0.215	0.024
OthSoAsia	0.439	0.264	0.297	0.312	0.209	0.479	0.121	0.711	0.169	0.049	0.233	0.049	0.124	0.414	0.060
Brazil	0.249	0.292	0.459	0.125	0.225	0.650	0.254	0.605	0.141	0.064	0.068	0.011	0.033	0.110	0.017
OthLatAm	0.253	0.258	0.489	0.194	0.276	0.530	0.257	0.531	0.212	0.144	0.181	0.057	0.069	0.273	0.048
Turkey	0.311	0.234	0.455	0.198	0.182	0.620	0.098	0.449	0.452	0.067	0.203	0.119	0.080	0.327	0.033
OthMENA	0.288	0.212	0.500	0.108	0.363	0.529	0.033	0.812	0.155	0.043	0.320	0.050	0.181	0.316	0.069
EIT	0.234	0.264	0.502	0.097	0.308	0.595	0.075	0.694	0.231	0.080	0.219	0.061	0.136	0.223	0.050
SoAfrCU	0.239	0.237	0.524	0.082	0.266	0.652	0.097	0.703	0.200	0.096	0.252	0.040	0.082	0.292	0.042
OthSSA	0.429	0.242	0.329	0.303	0.283	0.414	0.233	0.594	0.172	0.134	0.230	0.067	0.087	0.293	0.071
ROW	0.274	0.358	0.369	0.203	0.296	0.501	0.119	0.582	0.299	0.046	0.131	0.056	0.110	0.273	0.043
World	0.156	0.196	0.648	0.074	0.244	0.682	0.082	0.707	0.211	0.096	0.238	0.040	0.114	0.257	0.033

Source: McDougall et al, 1998

Notes: Consumption share refers to private household consumption at producers' prices. Therefore, wholesale/retail/transport margins are not included.

Table 2. Elasticities of Substitution between Domestic and Imported Goods

Commodity	GTAP	This Study	Liu et al*
foodgrains	2.2	4..4	4.1
foodgrains	2.2	4.4	4.1
oilseeds	2.2	4.4	4.1
meatlstk	2.5	5	6.5
dairy	2.4	4.8	6.5
othagr	2.2	4.4	4.1
othfood	2.2	4.4	6.5
bevtobac	3.1	6.2	6.5
extract	2.8	5.6	1.0
textiles	2.2	4.4	4.1
wearapp	4.4	8.8	4.1
woodpaper	2.15	4.3	4.7
pchemineral	2.05	4.1	3.3
metals	2.8	5.6	2.5
autos	5.2	10.4	6.3
electronics	2.8	5.6	4.7
othmnfcs	3.25	6.5	4.7
houseutils	2.35	4.7	n/a
tradetrans	1.9	3.8	n/a
construction	1.9	3.8	n/a
busfinance	1.9	3.8	n/a
goveservice	1.9	3.8	n/a

Table 3. Cumulative Percentage Growth Rates over the Period 1995-2000
(% annual growth in parentheses)

Regions	Pop.	Unskilled Labor	Skilled Labor	Capital	Total Factor Productivity	GDP	
						This Study	World Bank
North America (Namerica)	11 (1.05)	14 (1.29)	39 (3.33)	39 (3.33)	low	31.76 (2.8)	31.99 (2.8)
Western Europe (Weurope)	1 (0.10)	0 (0.03)	29 (2.60)	9 (0.83)	high	25.04 (2.3)	27.55 (2.5)
Australia/NewZealand (AusNZl)	10 (0.97)	11 (1.09)	66 (5.20)	20 (1.84)	low	29.77 (2.6)	36.00 (3.1)
Japan	2 (0.20)	-3 (-0.29)	32 (2.83)	4 (0.37)	low	9.45 (0.9)	9.91 (0.9)
China	9 (0.83)	12 (1.17)	43 (3.66)	139 (9.08)	very high	118.06 (8.1)	109.43 (7.7)
Taiwan	8 (0.73)	13 (1.21)	51 (4.18)	56 (4.52)	very high	68.37 (5.3)	70.20 (5.5)
Other NICs (OthNICs)	9 (0.84)	8 (0.73)	66 (5.18)	23 (2.09)	high	41.37 (3.5)	44.72 (3.8)
Indonesia	14 (1.31)	21 (1.96)	126 (8.47)	20 (1.82)	low	30.21 (2.7)	21.38 (2.0)
Other Southeast Asia (OthSEA)	19 (1.73)	26 (2.36)	84 (6.29)	33 (2.87)	low	37.77 (3.3)	38.86 (3.3)
India	17 (1.59)	23 (2.11)	73 (5.65)	116 (8.01)	medium	76.22 (5.8)	71.24 (5.5)
Other South Asia (OthSoAsia)	23 (2.10)	33 (2.92)	77 (5.87)	40 (3.39)	medium	57.23 (4.6)	56.78 (4.6)
Brazil	13 (1.26)	22 (2.04)	70 (5.46)	-7 (-0.69)	high	27.05 (2.4)	26.56 (2.4)
Other Latin Amer. (OthLatAm)	18 (1.63)	23 (2.11)	89 (6.55)	27 (2.41)	medium	42.18 (3.6)	42.82 (3.6)
Turkey	15 (1.44)	22 (2.02)	104 (7.41)	35 (3.06)	high	57.09 (4.6)	55.65 (4.5)
Other Middle East & N. Africa (OthMENA)	27 (2.43)	37 (3.17)	109 (7.64)	11 (1.07)	low	32.96 (2.9)	34.18 (3.0)
Economies in Transition (EIT)	3 (0.27)	6 (0.60)	69 (5.37)	36 (3.09)	low	30.46 (2.7)	20.72 (1.9)
South Africa Customs Union (SoAfrCU)	23 (2.06)	29 (2.59)	162 (10.11)	-1 (-0.10)	low	39.12 (3.4)	32.30 (2.8)
Other Sub-Saharan Africa (OthSSA)	33 (2.87)	37 (3.19)	88 (6.50)	25 (2.23)	medium	46.72 (3.9)	48.48 (4.0)
Rest of World (ROW)	18 (1.65)	21 (1.90)	83 (6.22)	50 (4.15)	medium	52.97 (4.3)	49.46 (4.1)

* The low, medium, high, and very high growth assumptions for total factor productivity (TFP) in manufacturing correspond to annual growth rates of 0.3%, 1%, 2%, and 3%, respectively. TFP growth in other sectors is based on a proportion of this rate. These proportions are: 1.4 (agriculture), 0.5 (services) and 0.0 (mining).

Table 4. Average Rates of Protection, by Region and Sector, 2005

Region	Food	Extract	Mnfcs	Constr	BusFin	Trd&Trn	GovSvces
NAmerica	5	0	3	10	8	69	34
WEurope	8	0	1	18	9	84	40
AusNZL	4	0	7	24	7	91	31
Japan	58	0	2	30	20	71	32
China	18	3	20	41	19	96	42
Taiwan	41	3	4	5	3	93	36
OthNICs	21	2	2	10	2	82	37
Indonesia	5	0	8	10	7	85	43
OthSEA	25	2	12	18	5	88	40
India	40	3	35	62	13	96	41
OthSoAsia	37	19	20	46	20	92	41
Brazil	4	1	16	57	36	71	44
OthLatAm	9	7	10	26	5	79	43
Turkey	31	0	6	46	20	92	40%
OthMENA	15	9	14	10	4	92	40%
EIT	12	2	9	52	18	71	35%
SoAfrCU	8	0	8	42	16	58	26%
OthSSA	13	9	9	11	0	94	43%
ROW	76	21	33	46	20	97	38%

Table 5. Average Protection (percent ad valorem) for Food and Agriculture, By Sector, Worldwide, 2005

	Import Tariff	Export Subsidy	Production Subsidy
foodgrains	23	1	6
feedgrains	97	4	11
oilseeds	4	0	9
meatlstk	17	8	2
dairy	23	27	2
othagr	11	0	0
othfood	1	0	0
bevtobac	18	0	0

Table 6. Change in World Trade Volume (percent change)

Commodity	Experiment			
	AgrMkt40	Agr40	Emnfc40	Svces40
foodgrains	1.9	-7.2	1.2	0.5
feedgrains	4.1	1	0.7	0.5
oilseeds	0.6	5.8	0.1	0.3
meatlstk	5.6	4.9	1.1	0.3
dairy	-6.7	-6.9	0.1	0.7
othagr	8.3	8.1	0.5	0.4
othfood	12.1	11.8	0.5	-0.1
bevtobac	27.5	27.6	0	0.8
extract	0	-0.1	1.8	0.3
textiles	0.2	0.2	16.3	0.3
wearapp	0.7	0.4	22.3	0.6
woodpaper	0	0	3.6	0.4
pchemineral	0	-0.1	4.6	0.6
metals	0	0	5.5	0.4
autos	0.3	0.5	9.4	0.9
electronics	0.1	0.1	4.1	-0.1
othmnfcs	0.1	0.2	5.2	0.2
houseutils	0	0	0.1	1
tradetrans	0.5	0.5	1.5	59.8
construction	0.3	0.5	0.4	18.3
busfinance	0.1	0.1	0.5	10.8
govservice	-0.1	-0.1	0.8	39.2

Table 8. Welfare and Efficiency Gains due to 40% Liberalization in Agriculture: 2005

	Agr40 experiment ratios (percentages)			Total EV by experiment ($mill.)				
Region	Eff/$VA	Eff/EV	EV/Exp	Agr40	AgrMkt40	Emnfc40	BusFinSvces	T&Tsvces
NAmerica	9	11	0.035	3401	1436	3310	4517	52532
WEurope	6	104	0.369	36959	27810	8180	8532	128593
AusNZL	6	-12	0.377	1786	1348	207	209	8421
Japan	6	120	0.253	12552	13461	6607	2564	33358
China	6	1067	0.012	172	753	22593	826	8710
Taiwan	4	143	0.060	265	295	3288	83	6072
OthNICs	3	115	0.333	2672	2996	5270	612	23228
Indonesia	2	1183	0.002	6	26	792	270	1474
OthSEA	2	101	0.465	1931	1247	2631	393	11092
India	1	137	0.200	1058	927	3084	19	3989
OthSoAsia	1	118	0.852	1176	1181	1645	9	2213
Brazil	1	64	0.245	1988	1683	4491	457	3625
OthLatAm	1	48	0.360	3055	2366	1449	652	8611
Turkey	1	123	0.142	338	332	619	70	3524
OthMENA	0	-15	-0.202	-1506	-718	1074	231	16667
EIT	0	142	0.033	301	282	1391	1865	10265
SoAfrCU	0	46	0.080	129	54	283	128	1897
OthSSA	0	31	0.194	436	529	249	30	4496
ROW	-1	115	0.741	2601	2611	2399	137	3798
World				69320	58619	69564	21604	332565

Appendix

Definition of Sectors and Regions

As discussed in the text, we base our analysis on the version 4 GTAP database (McDougall *et al.*, 1998). Appendix tables A2 and A3 detail the mapping between our aggregate regions and commodities and those in the GTAP database. Table A1 shows the grouping into "high-income" and "developing" economies used for expository purposes in places in this paper.

Revision of Version 4 Protection Data

In addition, a number of important adjustments were made to the version 4, GTAP database prior to implementation of the baseline simulation described in the body of this paper. Protection data in the GTAP version 4 database was modified to reflect more recent agricultural protection data for selected, non-OECD countries by drawing on recent work done by David Vanzetti of the Australian Bureau of Agriculture and Resource Economics. Vanzetti undertook a survey of other available data including the UNCTAD TRAINS database, the APEC tariff database, and WTO notifications from member countries. Based on his comparison of other protection data with the protection rates in the GTAP database, import tariffs were significantly reduced for Korea (rice, wheat, and milk), Malaysia and the Philippines (rice, wheat, sugar, beef, and milk), Thailand (wheat, beef, and milk) and India (wheat). Tariff rates were increased for China (sugarcane, sugar beet and sugar), and disprotection of grains products (import subsidies implied by domestic prices below world prices) was eliminated, Taiwan and Korea (beef), Philippines (sugar), and Brazil (rice, wheat, maize and cotton).

Export subsidy data in the version 4 database for non-OECD countries were based on protection estimates from the pre-Uruguay Round period, adjusted for changes in the OECD countries. Using information from notifications to the WTO on export subsidy expenditures, agricultural export subsidy equivalents for coarse grains, wheat, beef, and dairy products in Korea, and the ASEAN countries were removed from the database. Output subsidies on paddy rice in Malaysia, Thailand and the Philippines and for wheat and sugarcane in South Africa were also removed from the database. In the case of China, where export subsidy-equivalents are widespread (including non-agriculture), based on estimates by the contributing authors for that database, we eliminated all such interventions. Our reasoning was that these taxes and subsidies, which feature very large in our analysis, were based on price comparisons which may not be accurate.

All of the new tax rates were attained via use of the ALTERTAX tool (Malcolm, 1998) which targets the revised tax rates while at the same time seeking to preserve the value flows in the database.

Estimates of post-Uruguay Round tariff rates were obtained from work done by Francois and Strutt (1999) which drew on information from the GTAP version 3 database and the GATT/WTO integrated database (IDB). Due to some spurious results for beverages and tobacco, the Francois/Strutt estimates of post-UR tariff rates for beverages and tobacco were amended by applying the same percentage price cuts from pre- to post-UR in the version 3 database to the pre-UR rates in version 4.

Appendix Table A1. List of 19 regions used in this analysis

High-income countries	
Namerica	& North America
Weurope	& Western Europe
AusNZL	& Australia-New Zealand
Japan	& Japan
Developing countries	
China	& China
Taiwan	& Taiwan
OthNICs	& Other NICs
Indonesia	& Indonesia
OthSEA	& Other Southeast Asia
India	& India
OthSoAsia	& Other South Asia
Brazil	& Brazil
OthLatAm	& Other Latin America
Turkey	& Turkey
OthMENA	& Other M East and N Africa
EIT	& Economies in Transition
SoAfrCU	& South Africa Customs Union
OthSSA	& Other Sub-saharan Africa
ROW	& All other regions

Table A2. Mapping from GTAP's (version 4) 45 Regions into the 19 Regional Groupings used in this Analysis

aus	Australia	& AusNZL
nzl	New Zealand	& WEurope
swe	Sweden	& WEurope
fin	Finland	& WEurope
reu	Rest of European Union	& WEurope
eft	EFTA	& WEurope
cea	Central European Associates	& EIT
fsu	Former Soviet Union	& EIT
tur	Turkey	& Turkey
rme	Rest of Middle East	& OthMENA
mar	Morocco	& OthMENA
rnf	Rest of North Africa	& OthMENA
saf	South African Customs Union	& SoAfrCU
rsa	Rest of southern Africa	& OthSSA
rss	Rest of sub-Saharan Africa	& OthSSA
row	Rest of World	& ROW

Table A3. Description of the 22 sectors used in this Analysis

Agriculture	
Foodgrains	&rice, wheat, coarse grains and
Feedgrains	& coarse grains
Oilseeds	& oilseeds
Meatlstk	& ruminants and non-ruminants and processed meats dairy& dairy
Othagr	& other farm products
Othfood	& other processed foods
Bevtobac	& beverages and tobacco
Minerals and energy	
Extract	& mining, fish, forestry
Manufactures	
Textiles	& textiles
Wearapp	& wearing apparel
Woodpaper	& wood and paper products
Pchemineral	& petcoal, crp, nmm
Metals	& metals and metal products
Autos	& motor vehicles and parts
Electronics	& electronic equipment
Othmnfcs	oth trans equipment, mach and equipment, other mnfcs
Services	
Houseutils	& housing and utilities
tradetrans	& trade and transport services
construction	& construction services
busfinance	& business and financial service
govservice	& government services

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