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Asia-Pacific Food Markets and Trade in 2005: A Global, Economy-Wide Perspective[†]

by

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Abstract

Rapid industrialization in East Asia, particularly China, is raising questions about who will feed the region in the next century and how will Asia be able to pay for its food imports. The paper addresses this question by first reviewing existing food sector projections and then taking an economy-wide perspective using projections to 2005, based on the global CGE model known as GTAP. After showing the impact of implementing the Uruguay Round, the paper explores several alternatiev scenarios. A slowdown in farm productivity growth is shown to be very costly to the world economy, as is slower economic growth in China. Failure to honour Uruguay Round obligations to open textile and clothing markets in OECD countries would reduce East Asia's industrialization and thereby slow its net imports of food. On the other hand, the trade reform that is likely to accompany China's (and hence Taiwan's) membership of the World Trade Organization adds 30% to the estimated global gains from the Uruguay Round. Their WTO accession are projected to boost exports of manufactures and strengthen food import demand by not only China but also its densely populated neighbours with whom it trades intensively.

Keywords: Asia-Pacific, global CGE modelling, food and agricultural markets, economic projections.

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Asia-Pacific Food Markets and Trade in 2005: A Global, Economy-Wide Perspective

The 1995-96 season saw a dramatic rise in international grain prices and a drop in per capita world grain stocks to near-record low levels. That, together with concerns about the erosion of agriculture's resource base, and in particular the projections by the Worldwatch Institute suggesting massive grain imports by China in the 21st century, have called into question the long-term prospects for the world food situation. By contrast, a soon-to-be-published study by Mitchell, Ingco, and Duncan suggests grain will be abundantly available for the foreseeable future so long as investments in agricultural research are maintained. In between these extremes is a study by the FAO. Which of these sets of projections is most likely? What do they imply about food production, consumption, and self-sufficiency levels in the Asia-Pacific and elsewhere? Who would supply China and other food-deficit countries? How could the latter pay for their food imports?

This paper briefly reviews answers to these questions in so far as they are provided in available studies, and then provides a new set of projections for the next decade. The latter is based not on a sectoral model of food markets, as in the available studies, but rather on a global, economy-wide model of national and international markets for all products and regions. The advantages of our approach are many: it identifies the sources of economic growth that cause the expected expansion in the demand for and supply of food and other products; it ensures countries can import only what they can pay for through exporting or borrowing (leaving aside food aid); and it includes in the base scenario the inter-sectoral structural changes that normally accompany economic development. As well, this new set of projections incorporates the agricultural and other results of the Uruguay Round to be implemented over the next decade ("other" being as important for food markets as the Round's agricultural agreement, as it turns out).

The Global Trade Analysis Project (GTAP) data base and model are used to generate the new projections for the year 2005. The full model divides the world economy up into 37 sectors (11 are agricultural or processed food) and 30 countries or country groups (including

the 16 major APEC economies). In order to keep the present analysis and presentation of results tractable, however, the data base is aggregated up to the level of 13 product groups and 15 regions.

Many of the inputs into models such as GTAP necessarily are subject to considerable uncertainty. Hence much of the paper is devoted to exploring different growth assumptions and alternative policy shocks. These include slower growth in grain productivity worldwide, slower industrialization in China the entry of China and Taiwan into the World Trade Organization, and the failure to fully abolish the bilateral quotas on textiles and clothing trade as promised under the Uruguay Round. All of these scenarios are shown to have important implications for Asia-Pacific food markets. The paper concludes by drawing out the trade and policy implications for APEC countries and mentions briefly what could be expected additionally from APEC economies moving towards their espowsed goal of free trade in the region by 2020.

Available projections of world food markets

The simplest trends and projections to report are those based on World Bank data, since they are in the summary form of real international prices. Grilli and Yang (1988) suggests that throughout this century the price of food relative to industrial products has been on a downward trend, declining at about 0.5% per year. Even when careful adjustments are made for the rising quality of manufactures the relative price of food has not risen (Lipsey 1994). This is a remarkable achievement, implying that the global capacity to supply food has grown slightly more rapidly than global demand even though population and incomes have expanded, diets have been upgraded, and resources have been withdrawn to support dramatic expansion in the industrial and services sectors.

Will this pattern continue in the future? The latest projections by the World Bank (1996) for staple food and manufactured goods prices suggest so, because its projections for real prices to 2005 are lower than those prevailing in the first half of the 1990s.

However, a recent book by Lester Brown (1995) created major headlines by suggesting a very pessimistic food supply outlook. Specifically, Brown focused on China and pointed to

declines he expected in land and water availability for grain production there, which led him to project China needing more than 200 million metric tons of grain imports per year by 2030. That volume roughly equals the current volume of global international trade in grain, and implies China would be relying on imports for as much as half its grain consumption by then. Because he believes the rest of the world is incapable of satisfying that demand growth, Brown expects significant upward pressure on international grain prices over the next few decades. These projections are based on simple arithmetic rather than a formal economic modelhowever. In particular, they take no account of behavioral responses to the price changes that would occur should his projections of supply and demand changes in China and elsewhere materialize.

By contrast, a forthcoming book by Mitchell, Ingco, and Duncan (1996) argues that there is good reason to assume real prices of grains will continue to decline. Using the econometric model of world grain markets that was detailed in an earlier World Bank study (Mitchell and Ingco 1993), those authors project the real price of wheat and rice to decline by almost a third and of maize by a fifth between 1992 and 2010 (compared with declines of about 40% in the 1980s). This study accepts the caution in Crosson and Anderson (1992) that the global quantity of quality-adjusted cropland may be near its limits, not least because of the distaste for further widespread deforestation. It nonetheless concludes that Malthus must wait beyond the foreseeable future, assuming agricultural research continues to deliver sizeable increases in food production.

Another food modelling exercise, undertaken by the International Food Policy Research Institute (IFPRI), uses a global model that includes not only grain but also soybean and livestock product markets (Agcaoili and Rosegrant 1995). That study projects declines in real prices in international markets for all those products by 2010, some by as much as 15% compared with the late 1980s. The IFPRI projections are in most respects very similar to those produced by the FAO using yet another model of world agricultural markets (Alexandratos 1995).

All three studies project large increases in both production and consumption of food in all parts of the tropics and in China, a large increase in food trade volumes, but small changes in grain self sufficiency ratios to 2010. Taking the average of the three sets of projections,

they suggest developing countries as a group (including China) would be importing around 180 MMT of grain from advanced industrial economies in 2010, double the volume of the early 1990s. East Asia would account for 25% of that, and the Middle East/North Africa for about 40%. All three food modelling exercises take into account the concerns of Lester Brown and others that farm land is being degraded, that it is being lost to non-agricultural uses, and that there may be limits to the expansion of irrigation (which rose from 11% to 18% of arable land globally during the past 35 years).

None of these models includes non-agricultural sectors of the economies, however. That means they do not have explicit constraints on a country's resource use (no more than the aggregate available), on its spending (no more than is earned plus borrowings) and on its imports (no more than is earned from exports plus net inflows of financial capital, which in turn have to come from other similarly constrained countries). Furthermore, the above studies have no direct means of ascertaining the impact of developments in the non-farm economy on trade in farm products. As we will see below, the nature of non-food production and trade growth in the Asia-Pacific region can have important implications for trade in food products.

Overview of the GTAP framework

In this paper we employ a modified version of an applied general equilibrium model known as GTAP (Global Trade Analysis Project -- see Hertel 1996, especially Ch. 2). The GTAP model is a relatively standard, multi-region model which is currently in use by over one hundred researchers in 30 countries on five continents. The data base builds on contributions from many of these individuals, as well as the ten national and international agencies represented on the GTAP advisory board.

With the exception of China, income elasticities of demand are drawn from the FAO data base, and are therefore comparable to those used in the study of Alexandratos (1995). Non-food income elasticities of demand are also required, due to the economy-wide nature of the model.[1] On the supply-side, differences in relative rates of factor accumulation interact with different sectoral factor intensities to drive changes in the sectoral composition of output. The GTAP production system distinguishes sectors by their intensities in four primary

factors of production: agricultural land, labor, physical capital, and human capital. Thus in a region where physical capital is accumulating rapidly, relative to other factors, we expect the capital intensive sectors to expand at the expense of labor intensive sectors such as agriculture in East Asia. These "Rybczynski effects" are not present in the partial equilibrium models reviewed above.

Unlike the agricultural commodity-oriented projections presented above, the GTAP framework is built on a complete set of economic accounts for each of the APEC and other economies, based on the year 1992. In particular, our model incorporates an exhaustive description of inter-industry linkages. In addition to differences in intermediate input intensities, import intensities are also permitted to vary across uses. Since much of the farm and food trade in the Asia-Pacific region represents trade in intermediate inputs, the distinction between sales to final consumers and sales to other firms can be quite important.

Another important distinction between the framework used here and the approach used in the partial equilibrium studies of food demand cited above is the treatment of product differentiation and inter-industry trade. In the IFPRI, FAO and World Bank studies cited above, individual products are assumed to be homogeneous and perfectly substitutable for one another. An alternative approach, adopted in this study, involves differentiating each product by country of origin. This approach has the advantage of permitting us to track bilateral trade, as opposed to simply reporting net total trade.

Throughout the analysis, we have used the standard GTAP parameters as documented in Hertel (1996, Ch. 4), with two exceptions. First, we have upgraded the income elasticities of demand for farm and food products (see footnote 1 above). Secondly, we have employed larger values for the Armington elasticities of substitution used to specify the extent to which similar products from different countries substitute for one another. In his analysis of changing trade shares in the Asia-Pacific region over the decade of the 1980s, Gehlhar (1994) found that the standard GTAP trade elasticities were too small to accurately predict changes in trade shares over this 10-year period. By doubling these parameters he obtained a much better prediction of historical changes in export shares in the region. Accordingly, we have used those doubled parameter values for the long-term (13-year) projections reported below.

Base case projections in GTAP

Assumptions about economic growth

The projections from 1992 to 2005 used in this paper are based on a relatively small number of exogenous shocks. Specifically, we utilize exogenous projections of each region's endowments of agricultural land, physical capital, human capital, the state of technology, population and the labor force. These are based on combinations of historical data and World Bank projections of the growth in population, labor force, real GDP, physical capital and human capital, with minor adjustments.[2] Physical capital stock projections were generated by adding investment in each year and subtracting depreciation using the methodology of Nehru and Dhareshwar (1994). The human capital projections were based on projections of the growth in the stock of tertiary educated labor in each developing country (Ahuja and Filmer 1995) and historical growth rates in developed countries to provide an indication of changes in the stock of those qualified for employment as professional and technical workers. The stock of agricultural land is held constant in the base case, but it is varied in one of the subsequent scenarios. Base case estimates of non-agricultural, neutral total factor productivity (TFP) growth rates for each region were obtained by subtracting the growth in total factor inputs from the real, non-agricultural GDP projections. Finally, instead of projecting commodity-specific total factor productivity growth for agricultural products, we calibrate our base case to IFPRI's world price projections (Rosegrant, Agcaoili and Perez 1995, Table 2) over this period and let TFP growth for agricultural products adjust endogenously. Having ascertained the rates of farm TFP growth implied by these projections, we then fix them exogenously in subsequent scenarios.

Trade policy assumptions

IFPRI's detailed agricultural commodity projections referenced above do not reflect the final results of the Uruguay Round agreement. Yet this agreement has important implications for agriculture. We implement the base case without the Uruguay Round first, and then add the Uruguay Round to establish our modified base case. An advantage of this approach is that

it allows ua to report information about the expected impact of the Uruguay Round on world markets in 2005.

Analysis of the modified base case (incorporating the Uruguay Round)

In order to see the effect of the Uruguay Round, we specify the associated cuts in tariffs, tariff equivalents of nontariff import restrictions, import access commitments for rice, and export subsidies. The nonagricultural information was obtained largely from the WTO's Integrated Data Base, and the agricultural cuts are based on work conducted at the World Bank. (For more details on the nature of these cuts, see Martin and Winters 1995.) Note that while these offers do not include protection cuts in China and Taiwan (since they were not yet WTO members), in one of our scenarios below we consider the implications of China joining the WTO. (Otherwise we assume China's and Taiwan's policies are unchanged from 1992 to 2005.)

Table 1 summarizes the expected impact of the Uruguay Round on average world prices, trade, and real income by the year 2005 (as compared with the initial base case for 2005 if there were no Uruguay Round.) The combination of reduced export subsidies and improved market access for farm products translates into higher prices, with the largest increase being for wheat (more than 5%). Nevertheless, these increases are not enough to offset the structural decline in agricultural prices built into the pre-Round base case. Therefore, our post-Round base case still has agricultural prices declining, albeit by a lesser amount. Average world prices of textile and wearing apparel products decline considerably if the Round is fully implemented on schedule. This follows from the removal of bilateral quotas on the export of these products (except in the cases of China and Taiwan, which are assumed to continue being subject to VERs until they accede to the WTO).

As expected, the Uruguay Round also gives a significant boost to world trade in agricultural products. Table 1 shows rice exports being 147% higher and processed food exports being 53% higher than they would have been without the Round. Wheat exports increase by far less, due to the trade-reducing effect of cutting export subsidies. Textile and

wearing apparel trade also increases significantly with the removal of bilateral quotas on exports into North America and Europe.

The second set of columns in Table 1 report the percentage changes in regional exports and imports as a result of the Uruguay Round. These increases are largest for the East Asian economies making the deepest cuts. Asia also benefits greatly from the elimination of the Multifibre Agreement (MFA). Trade increases for the other major economies, but more modestly.

Table 2 reports the projected change in composition of the world economy over the period 1992-2005. Entries in each row refer to the percentage change in the relative importance of each sector in the real GDP of each region between 1992 and 2005. From the first column, we see that the projection suggests massive structural change in China over the coming decade. The share of farm and food activity in GDP is projected to decline rapidly (e.g. -44% for rice), in favor of growth in the relative importance of manufacturing and services (e.g. 97% for transport machinery and equipment). The non-farm exceptions are textiles and apparel. Due to their assumed exclusion from the Uruguay Round, Chinese exporters of the latter products do not benefit from elimination of the MFA. Rather, they are displaced by other exporters to developed country markets.[3]

The other Asian economies also shift resources out of agriculture, although the ASEAN-4 and the NIEs become more competitive in processed food production, due to cheaper agricultural imports in the wake of Uruguay Round cuts. Overall, only Australia/New Zealand and NAFTA see increases in the relative importance of agriculture in their economies over this period, fueled by the Uruguay Round liberalization in other countries, and by generally higher rates of productivity growth in agriculture relative to their nonagricultural sectors. For the world as a whole, we expect the relative economic importance of farming to continue to decline, as a consequence of the relatively low income elasticities of demand for primary agricultural products together with continuing relatively rapid farm productivity growth.

Table 2 also portends a continuing massive relocation of global production of wearing apparel, and to a lesser extent textiles, from advanced economies to the developing economies of Asia. Owing to its assumed exclusion from the MFA reforms, China and

Taiwan are not able to participate in this accelerated growth in market access. Resources in that region are therefore diverted to other manufacturing activities, particularly other light manufacturing, transport equipment and machinery, and other heavy manufacturing. Also, owing to China's WTO exclusion, the growth of the textile and wearing apparel sectors in ASEAN-4 is extremely rapid.

Table 3 shows the effect of combining the production-side changes enumerated in Table 2 with consumption-side changes. Here, regional trade balances are reported, by commodity. The final column shows the difference between fob and cif values for merchandise commodities, while for services it shows total exports of international trade and transport services. Column sums give the change in trade balance for each individual region. We have held each region's trade balance constant (by assumption) in these projections, which is why the column sums are all zero.

The first entry the first column of Table 3 shows the difference in the grains trade balance in 2005 relative to 1992, in billions of constant (1992) US dollars. At -$4.9 billion, this indicates that China is expected to be a significant net importer of grain in 2005. When converted to physical units, this amounts to imports (net of exports) of about 33 million metric tons. (China is 100% self-sufficient in grains in our intial data base for 1992 but drops to 96% in 2005 under our modified base case.)

Much more significant are the increases in China's net imports of non-grain crops ($13.7 billion) and meat products ($15.6 billion). Processed food imports also increase more rapidly than exports in this period, under the base case assumptions. Indeed, as the "All Food" row in Table 3 indicates, China's net imports of all farm and food products are $39 billion higher in the year 2005 than in the base year of 1992. Grains account for only 13% of this increase in China's food trade deficit.

China pays for this massive increase in farm and food imports by expanding its net exports of manufactures. Here, a critical point relates to China's potential entry to the WTO. As discussed in more detail below, until that accession occurs, China is assumed to be excluded from the liberalization of textiles and wearing apparel trade under the Uruguay Round. This is why the combined trade balance on these product categories in Table 3 does

not increase as in Asia's other developing countries. Instead, the increase in Chinese net exports is concentrated in other light manufactures.

Moving beyond China to the other columns in Table 3, note that the NIEs, Japan, and Western Europe all move into increased deficits with respect to grains and other crops. This is offset by increased net exports from ASEAN-4, Australia/New Zealand, North America and the rest of the world. With respect to processed food, which is a heterogeneous category, we see negative net trade changes for Japan and Western Europe and smaller ones for the other regions outside Southeast Asia. In ASEAN-4 and NIEs, cheaper raw materials, owing to Uruguay Round tariff cuts, result in a far more competitive food processing sector. In the case of ASEAN-4, this effect dominates the negative numbers for primary agriculture and the base case predicts that the value of total food exports will increase much more rapidly than that of imports over this period. However, the largest change of all for the ASEAN-4 region is the boost in wearing apparel net exports ($128 billion more than in 1992), owing to the abolition of quotas affecting clothing exports to North America and Western Europe.

Alternative scenarios for the Asia-Pacific region

The scenario presented above is a projection of the world economy based on myriad assumptions. How does the projection change as these assumptions are altered? In this section we seek to identify and examine some of the key forces shaping farm and food trade in the Asia-Pacific region over the next decade. We do so by exploring four alternative scenarios, each designed to highlight a different feature of this complex topic. The first scenario involves slower technical change in agriculture globally, while the others relate more specifically to China. In the first of these we examine the impact of slower industrial growth in China. The second involves China and Taiwan's accession to the WTO. Finally, we consider the impact of the failure to abolish the quotas on trade in textiles and wearing apparel -- a failure that is more likely should China join the WTO.

Scenario 1: Slower technical change in agriculture globally

There has been considerable concern expressed recently to the effect that productivity growth in agriculture may be diminishing. If the rapid advances in agricultural productivity observed over the past 30 years have reflected, in part, the adoption of a one-off improvement in technology associated with the "green revolution," then it seems plausible that these gains might be close to exhaustion, particularly in Asia where adoption rates of these technologies are now very high in the areas to which they are suited. Consistent with this, Crosson and Anderson (1992, p.105) conclude that future productivity growth must come primarily from the generation of new knowledge, rather than from increased application of existing techniques.

Clearly, reliance on new knowledge accentuates the importance of maintaining high levels of research inputs. A wide range of studies has found that there is a strong link between investments in agricultural research and rapid agricultural productivity growth, and that such research continues to have at the margin very high economic rates of return (Alston, Craig and Pardey 1996). They have also shown that international grain research in the tropics has very considerable spillover benefits to temperate agriculture (Byerlee and Traxler 1996). Despite this, there is considerable unease about the willingness of national and international agencies to continue providing the levels of support to agricultural research and development that have been forthcoming in the past.

To explore the potential impact of reduced commitments to agricultural research and development spending on food trade and prices, we evaluate the impact of a decline in total factor productivity (TFP) in grain production worldwide of 0.5 of a percentage point per year. This reduction represents about one-fifth of the historical growth rate of agricultural productivity growth (Bernard and Jones 1996) and it cumulates over the 13-year projection period to a 6.7% decline in grain productivity.

The results from this adverse TFP shock for grains are reported in Tables 4 to 6. From Table 4 we see that there is a significant effect on world grain prices (a rise of 6.3% for rice, 4.8% for wheat and 5% for coarse grains). There is also a modest spillover onto the prices of meat and livestock products and of processed food. As shown in Table 5, the trade impact of this scenario is very modest. The welfare consequences of slower technical progress in grains are adverse, by definition. The world as a whole would be worse off by $28 billion per year

by 2005 if such a slowdown were to occur (Table 7, column 1). Due to its substantial export position in grains, only Australia/New Zealand, among the country groups shown, benefit more from the higher prices than it loses from the assumed slowdown in its own grain productivity growth. Because the slowdown is assumed to be global, it has little impact on grain self-sufficiency ratios for the different country groups (Anderson *et al.* 1996, Table 16).

Scenario 2: China's industrial growth slows

One of the major uncertainties associated with our base case projections pertains to the rate of Chinese GDP growth over this period. We assume an annual growth rate of 7.8%, or 6.9% per capita. Even though China has achieved and surpassed that rate of growth over the past 15 years, the agriculturally focused projections studies cited above have assumed slower growth rates. For example, Rosegrant, *et al.* (1995) asumes China's GDP grows at only 6% per year. When cumulated over our 13-year projection period, the impact can be quite substantial. In order to explore the implications of slower growth for patterns of trade and production, we consider an alternative scenario in which total factor productivity growth in the non-agricultural sectors is slower. In the base case that TFP growth rate is 3% per year. In this alternative scenario, we set this equal to only 1%, which in turn lowers savings, investment, and hence capital stock accumulation (-1.4% per year) over this period. The combined effect amounts to a slowdown in real GDP growth in China of 1.5 percentage points per year (6.3% instead of 7.8%). Moreover, the decline in non-agricultural productivity growth, relative to agricultural productivity growth, reduces the ability of the non-agricultural sector to attract resources away from agriculture.

The second set of columns in Tables 4 to 6 report the differences in world trade and welfare in the year 2005 that would result from such a slowdown in China. From Table 5 we can see that the effect on trade volumes is concentrated in China itself and that the impact on export volume from other regions is spread fairly evenly. On the import side, Hong Kong/Singapore and Australia/New Zealand are more significantly affected, but the total changes are relatively small.

Looking at the impact of slower non-farm growth in China on international commodity markets (Table 4), it is clear that wheat, other crops and meat/livestock products experience

sharp reductions in their global trade. Ironically, China's industrial growth rate is more important for world food markets than it is for non-farm sectors: slower non-farm growth means less resources are attracted from the Chinese countryside.

An earlier and longer version of this paper reports the changes in bilateral trade volumes for crops, meat and livestock products and processed food (Anderson *et al.* 1996a, Table 13). The impacts of slower growth in China include a slowdown of crop exports from NAFTA to China of $5.8 billion and of livestock products from Australia/New Zealand of $3.8 billion per year by 2005.

Those countries competing with China in the global marketplace might be expected to be pleased to see a slowdown in Chinese growth. However, the results in Table 6 indicate that economic welfare in *all* regions would be reduced by slower growth in China. Hertel, *et al.* (1996) have examined this phenomenon in considerable detail, and find that competitor regions, such as India and Indonesia, do indeed benefit from the changes in *average* world prices resulting from China's slower growth, but those gains are more than offset by increases in the prices of Chinese exports to them (relative to the world average), and decreases in demand for their exports to China. For the world as a whole, welfare is estimated to be about $200 billion lower in 2005 under the lower growth rate assumption in China. It would fall even more if China's slower growth caused a growth slowdown in other regions as well.

Scenario 3: China and Taiwan enter the WTO

The offer that China has made in seeking entry to the WTO involve very substantial tops-down reductions in its protection rates (Bach, Martin and Stevens 1996). Assuming that tariffs are cut only when the tariff binding offered to WTO is below the applied rate, the offer in 1995 involved a fall in the weighted average nominal rate of protection in China to 16% (from 30% in 1992). This reduction would be complemented by a substantial reduction in the coverage of nontariff barriers. In this paper, we have used the reductions in the trade-weighted bilateral tariffs as documented in Bach (1995) to give us an indication of the impact of such an offer.[4] Since China's accession to the WTO will be followed immediately by Taiwan's accession, we have combined these two events into one scenario. We assume that Taiwan's non-agricultural tariffs would be cut by 36% and its agricultural cuts would be only

half as deep (18%). We also assume admission to the WTO will confer an additional important benefit on China (and Taiwan to a lesser degree) in the form of increases in the growth rates of its quotas on textiles and clothing exports to North America and Western Europe under the provisions of the Uruguay Round Agreement on Textiles and Clothing (ATC).

Based on such offers, the drop in average import prices for food products would range from a low of 0% for rice and wheat to 5-7% for other crops and livestock products and 15% for processed foods. Manufacturing import price cuts as a result of the offer would range from 10-22%. WTO entry results in a substantial increase in China's overall trade volume, with imports in 2005 being 55% greater and exports 40% greater[5] (Table 2). Imports of most industrial products would rise substantially because of the large reductions in protection rates on these goods. Amongst the crops, by contrast, only very small reductions in protection are being offered. Because of that, China's imports of wheat and rice are projected to fall as consumers substitute towards the goods whose prices drop. Imports of meats and processed foods, however, are projected to grow substantially as their non-food average price cuts are much larger.

Following WTO entry, China's exports of agricultural products as a group increase substantially, despite the modest declines in the output of these sectors. The key reason is the fall in domestic food consumption as consumers shift towards other, now cheaper non-farm goods. The strikingly large increases in China's exports of textiles and wearing apparel follow from the assumed phaseout of the MFA quotas on exports to North America and Western Europe. This causes reductions in exports from China's most direct competitors in these market, namely ASEAN-4, where output falls. Wearing apparel exports from ASEAN-4 are diverted from the MFA markets of North America and Western Europe to the other high-income markets of Japan and Australia/New Zealand. Large increases in export sales to China arise in processed food from the NIEs, NAFTA, and Western Europe. NAFTA increases its exports of livestock products to China by $6.8 billion, while Western Europe and the rest of the world supply an added $3.4 billion of these products to China (Anderson *et al.* 1996a, Table 14). These regions achieve these increases in part by diverting exports from

other destinations. This is not the case with the ASEAN-4, which increases its total volume of farm and food exports by almost $9.3 billion as a result of China's entry into the WTO.

Turning to the welfare results, Table 6 shows that the trade liberalization resulting from China and Taiwan joining the WTO increases world welfare by a total of $50 billion per year in 2005. This figure represents a 30% boost to the real income gains from the Uruguay Round. The main gainers from this boost are Western Europe, Japan, North America, and Hong Kong/ Singapore. The results suggest the other ASEAN countries experience a combined loss of $14.5 billion, because of the expansion of China's exports of textiles and clothing. But it should be recalled that this result is based on the assumption that these economies do not grow any fasdter with China's WTO accession. The results aunder alternative scenario 2 above ('China slows') suggest that even a smalll increase in China's growth rate would benefit ASEAN significantly, probably more than offsetting the small projected loss reported in Table 6.

One other caveat needs to be kept in mind. We have assumed in the base case that China would not alter its policies between 1992 and 2005. In fact, however, the projected decline in grain self-sufficiency over that period might prompt China to raise domestic food prices above international levels (Tyers and Anderson 1992, Ch. 8; Anderson and Hayami 1996). Under such circumstances, acceding to the WTO, thereby preventing increased protection in agriculture, becomes even more significant than suggested by the above projection (which assumes no change to current protection in the base scenario).

Scenario 4: Incomplete textile and clothing liberalization

Commitments under the Uruguay Round toeliminate the bilateral quotas associated with the MFA is designed to occur gradually. The first step involves increases in the growth rates of MFA quotas under the Agreement on Textiles and Clothing during the ten-year transition period through to 2005, accompanied by a progressive integration of textile and clothing items into the GATT system, at which point the quotas are abolished altogether. The tariff lines to be integrated under GATT are selected by the importing countries, and it appears that few commodities subject to binding quotas will be integrated until near the end of the transition period.

Our earlier analysis (Hertel, *et al.* 1995) shows that the degree of quota acceleration under the Agreement on Textiles and Clothing is not sufficient to reduce the quota rents for most of the bilateral flows. Therefore, we expect abolition of the quotas to remain a contentious issue, especially if China joins the WTO and receives expanded market access.

Failure to fully eliminate the trade-restricting effect of the MFA would substantially reduce the export opportunities for the high-performing East Asian economies, and hence their ability to finance imports such as agricultural products from more-advanced economies. Within East Asia, failure to abolish the MFA would weaken the incentives to attract resources out of agriculture and into industry. Thus, from the supply side, this scenario can be expected to lead to a higher level of agricultural output and reduced food imports in Asia.

We explore the quantitative implications of this scenario by permitting the MFA quotas to "snap-back" to the same level of restrictiveness (the same quota rent per unit of sales) that was observed in our initial data set for 1992. While this may seem extreme in light of the quota acceleration built into the Agreement on Textiles and Clothing, such is not the case. Hertel, *et al.* (1995) find that even if the ATC quota growth rates are honoured, quota rents are expected to increase over the period to 2005 for 37 of the 44 bilateral flows examined. Given that finding, our MFA snapback scenario may be more modest than the true consequences of failing to abolish these quotas in 2005.

The results stemming from the MFA snapback scenario are reported in the fourth set of columns in Tables 3 to 6. (This snapback scenario assumes China and Taiwan have joined the WTO.) The most striking impact of this scenario is the very large reduction of world trade in textiles and wearing apparel (12% and 31%, respectively -- see Table 4). This is large enough to cause a 2% contraction in total global trade (Table 5). The trade impact of this scenario is felt most severely by Indonesia, India and the Philippines -- countries which benefited significantly from the removal of the quotas in our base case with China not in the WTO. Since we have constrained regions to retain a fixed trade balance, this export reduction means that imports are also reduced. Indeed, from Table 4 we see that Indonesia's total imports fall by 16%, followed by India (-7%) and the Philippines (-3%).

These import reductions have important ramifications for those regions seeking to expand farm and food exports to Asia. For example, the volume of NAFTA's exports to

ASEAN-4 falls by $US 733 million for crop products, $US 217 million for processed foods, and $US 47 million for livestock products. Ironically, the reduction in ASEAN-4 exports of textiles and wearing apparel is accompanied by higher levels of farm and food exports -- much of this to the MFA-importers. Food exports from ASEAN-4 are $9.5 billion per year greater, reflecting the fact that when the ASEAN-4 countries are stymied in one export market they move into other ones. In practical terms, what this means is that the projected shift of resources out of agriculture in our base case (Table 2) will be slowed if the MFA is less than fully reformed. As a result, the bilateral balance in food trade (at constant prices) between NAFTA and ASEAN-4 deteriorates by a total of about $2.4 billion, relative to the 2005 base and NAFTA's food exports are $5.6 billion lower per year in this scenario (Anderson *et al.* 1996a, Table 15).

In short, by refusing to *import* additional textiles and wearing apparel from East Asia, North America indirectly limits the ability of its farm and food producers to *export* to Asia, and meanwhile indirectly stimulating additional net food exports from that region.

In addition to limiting trade within the Asia-Pacific region, the MFA-snapback is an adverse development for overall global welfare. The annual global loss is equal to $45 billion in 1992 US dollars. Table 6 suggsts that not all regions lose from the MFA-snapback scenario though. Indeed, the transfer of quota rents back to the restricted exporters is shown to be beneficial in many cases. However, the mechanisms for allocating these quotas in many developing countries are highly inefficient (Trela and Whalley 1995), and some rent is disappated in socially unproductive lobbying, so those gains reported in the final column of Table 6 may be illusory -- particularly if incomplete reform slows income growth.

Summary and conclusions

Contrary to earlier studies and the fears of many food-importing developing countries, the global economy-wide model results presented in this study suggest implementing the Uruguay Round will have very little impact on real international food prices. Those prices are projected to be only 2 to 4% higher than they otherwise would be

in a decade's time -- a rise that will be imperceptable compared with the usual year-to-year fluctuations in food prices and foreign exchange rates.

There are two main reasons for this price effect being much smaller than was anticipated earlier in the decade. One is that, on close inspection, the agricultural commitments under the Round by the most farm protectionist countries are far more modest than was hoped for. The other reason is one that was not picked up by earlier studies that focus only on food markets. It is that many markets for non-farm products also are to be liberalized under the Uruguay Round. As a result, their prices will rise in international markets as well. This moderates the increase in farm relative to non-farm prices -- and it is *relative* prices that influence decisions of producers and consumers.

This result is based on the assumption that farm productivity growth continues at the relatively high rates of the past few decades. Such an assumption may be too optimistic though, given the slowdown in the past decade (a) in funding for the international agricultural research that generated rapid technological change in farming and (b) in irrigation developments. Our analysis shows that even a modest slowdown of about one fifth (half a percentage point per year) in the growth rate of grain total factor productivity globally could have a sizeable impact on food prices. Grain prices in international markets, for example, would be 5% or 6% higher than otherwise by the year 2005 (twice the estimated shock to be expected from the Uruguay Round). While this may not bother high-income countries much, it on top of the Round would be felt keenly by low-income food-deficit countries -- especially if, as often happens when grain prices rise, it were to be accompanied by less food aid. The world economy would be $28 billion per year worse off from such a grain productivity slowdown, suggesting the need to re-assess the decision to re-direct aid funds away from agricultural research.

The results suggest the accession of China (and hence Taiwan) to the World Trade Organization could provide a very significant boost to the gains from the Uruguay Round. We have assumed that on accession (but not otherwise) the advanced industrial countries would offer China and Taiwan the same degree of expanding access to textile and clothing markets as if China had been a GATT contracting party and had signed the Uruguay Round agreements in 1994. With that assumption, international grain price rises due to the Round

would be twice as large with China participating, and livestock product prices would be 40% greater. China in that case would import 4%, instead of just 1%, of its grain needs by 2005. And aggregate world trade would be 13% instead of just 10% greater thanks to the Round; and the annual gain in global welfare by 2005 would be boosted by almost a third as much again with China becoming a WTO member.

Furthermore, these results are lower-bound estimates, because they do not include important dynamic effects of reform. Specifically, they ignore the inducement to domestic and foreign investments that would accompany trade liberalization. Should those investments boost China's industrial productivity to the extent of causing its economy to grow 25% faster, for example, the gains from China's accession to WTO could be as much as four times greater and its grain import dependence twice as great (inferring from the opposite signs on the results presented in the 'China slows' scenario).

There is, however, a risk that advanced industrial countries will not deliver all their promised reform to the MFA under the Uruguay Round's Agreement on Textiles and Clothing. That risk will be considerably larger if/when China joins the WTO, given China's very considerable potential to expand its textile and clothing exports over the next decade. Should there be such backsliding on MFA reform, a great deal of the projected gains from the Uruguay Round and from China's WTO accession would evaporate, industrialization in Asia's dynamic economies would slow, and the growth in East Asia's demand for food imports (and hence the rise in world food prices) would be less.

While net food exporters such as North America and Australasia would be harmed by such a slowdown in Asia's food import demand, might that not be welcome news for poorer food-importing countries in Africa and elsewhere? The answer is no, not least because that dampening of international food prices would be a symptom of a slower-reforming and hence slower-growing world economy, which would dampen development prospects everywhere, including in Africa.

Clearly there is a commonality of interest between farm and food producers in Australasia, North America and elsewhere on the one hand, and manufacturers in East Asia on the other. The Multifibre Agreement (MFA), which restricts imports of textiles and clothing into North America and Western Europe, indirectly penalizes exports of food and

agricultural products from OECD countries. The failure to fully reform the MFA will ensure more labor and capital remains in the agricultural sector in ASEAN-4, resulting in an increase in net exports of food products from that region. Meanwhile, food exports from Australasia and NAFTA to ASEAN-4 are projected to fall substantially if the MFA is not abolished. That is, trade is a two-way street, and any delay in the removal of obstacles to textile exports from Asia could well come back to haunt countries seeking to export farm products to this region.

It turns out that none of these scenarios has much of an impact on grain self-sufficiency ratios in 2005. Certainly there are some changes to be expected between 1992 and 2005 as the Uruguay Round agreements are implemented and as China's industrialization continues at a rapid pace. But Table 16 of our earlier paper (Anderson *et al.* 1996a) shows that those grain self-sufficiency ratios vary little with the shocks considered, with one exception.[6] A clear implication is that the ability of world grain markets to handle changes is not likely to be threatened even by substantial shocks of the sort considered in this paper.

To conclude, mention should be made of one other potential development that is likely to influence Asia-Pacific food markets significantly during the next decade or so. It is the Bogor Declaration of November 1994 by APEC Heads of Government, since reaffirmed at Osaka and Subic Bay in the follow-up annual meetings. That declaration commits APEC economies to move to MFN (non-discriminatory) free trade by 2010 in the case of developed countries and 2020 in the case of developing countries. Space limitations did not permit us to analyse this scenario in the present paper, but we have since done so in a companion paper (Anderson *et al.* 1996b).Iin that analysis we assumed China joins the WTO and examined the effect of all APEC economies liberalizing trade beyond their Uruguay Round commitments to the extent of a further 50% tariff cut by 2005. A key finding is that the results depend very heavily on whether agriculture is included in the reform (as demanded by the APEC food-exporting countries but contrary to what APEC's Northeast Asian members want). Specifically, the welfare gains from this regional liberalization when all goods markets are liberalized are two-thirds greater than when agriculture is excluded. (Services trade liberalization was ignored for want of reliable estimates of services protection rates.) If agriculture *is* included, this APEC reform would add one-thirdto the global welfare gains discussed above from the reforms under the Uruguay Round. It would also boost world trade

in all products by an additional 6% (over and above the 10% boost due to the Uruguay Round plus the additional 4% boost due to China and Taiwan's WTO accession). Agricultural trade would be only 2% greater by 2005 if farm products are excluded from the APEC reform, but would be 18% greater if included. What this clearly indicates is that distortions to agricultural trade in the APEC region remain very large, and that a further reform in the region that excludes farm products will be missing a large part of the gains that remain to be reaped from trade liberalization.

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Table 1. Impact of the Uruguay Round on World Prices and Trade Volume by 2005 (percentage changes).

	World			Trade Volume		Welfare	
Commodity	Price	Volume	Region	Exports	Imports	% change	US $
							(1992 bill.)
Rice	2.1	147	China	2	2	0.2	2.1
Wheat	5.2	8	Indonesia	38	30	4.5	11.1
Crsgrns	2.3	32	Philippines	28	19	1.8	1.4
OthCrops	2.5	13	Thailand	23	18	2.8	6.5
LstkProd	4.1	25	Malaysia	22	18	7.2	10.4
ProcFood	-0.4	53	R. of Korea	23	20	1.7	9.5
NatRes	0.7	0	Taiwan	3	4	0.9	3.5
Textiles	-2.7	29	HK/Singapore	2	1	-0.3	-0.5
WearApp	-10.3	80	Japan	8	9	0.5	19.9
OLightMnfc	0.6	6	Australia/NZ	8	8	0.4	1.9
TMEq	0.5	6	NAFTA[a]	7	8	0.4	31.8
OHeavyMnfc	0.6	7	Western Europe	6	8	0.4	38.6
Services	0.7	4	Former Soviet Union	1	1	0.0	-0.2
			India	72	54	1.5	5.9
			Rest of the World	17	15	0.7	21.1
			WORLD	10	10		163.0

[a] Includes Canada, Mexico and the United States.
Source: Authors' model results.

Table 2. Cumulative Percentage Change in Composition of Real GDP, 1992 to 2005 (modified base case incorporating the Uruguay Round).

	China	ASEAN-4[a]	NIEs[b]	Japan	Aus/NZ	NAFTA	WEurope	ROW
Rice	-44	-29	-39	-22	-9	3	-14	-16
Wheat	-54	-33	-50	-41	2	15	-31	-11
Crsgrns	-46	-24	-79	-57	0	1	-27	-20
OthCrops	-42	-28	-37	-9	-7	13	-13	-9
LstkProd	-33	-34	-32	-34	2	-2	-14	-2
ProcFood	-31	8	5	-13	-11	-7	-15	-7
NatRes	18	-38	-1	23	-2	1	-2	-2
Textiles	-16	95	29	-9	-29	-27	-27	7
WearApp	-6	295	-39	-23	-62	-77	-80	48
OLightMnfc	30	-17	15	-0	-11	-5	-7	-0
TMEq	97	-12	2	1	-8	6	8	-19
OHeavyMnfc	38	-12	15	2	-8	-2	-1	-5
Services	14	-0	-0	0	2	0	2	2

[a] Includes Thailand, Malaysia, Indonesia, and the Philippines.

[b] Includes Hong Kong, Singapore, Korea, and Taiwan.

Source: Authors' model results.

Table 3. Change in Trade Balance, by Commodity and Region, 1992 to 2005, in billions of 1992 $US (modified base case incorporating the Uruguay Round).

	China	ASEAN-4	NIEs	Japan	Aus/NZ	NAFTA	WEurope	ROW	WORLD[a]
Grains	-4.9	0.3	-5.4	-5.6	0.8	11.4	-3.2	4.5	-2.0
OthCrops	-13.7	-10.7	-8.1	-0.9	1.1	22.4	-2.9	5.5	-7.3
LstkProd	-15.6	0.8	-7.1	-10.1	9.3	15.9	-6.7	8.5	-5.1
ProcFood	-4.7	38.5	18.5	-14.3	-0.5	-2.8	-42.9	-7.9	-16.1
AllFood	-38.9	29.0	-2.1	-30.8	10.6	47.0	-55.8	10.6	-30.4
NatRes	-4.5	-7.8	-57.7	-23.9	11.4	-5.8	-28.5	102.5	-14.3
Textiles	-11.6	-29.4	40.8	4.1	-1.1	-4.5	-17.7	5.8	-13.6
WearApp	19.5	128.4	2.7	-15.3	-2.5	-71.2	-93.8	14.6	-17.7
OLightMnfc	35.4	3.8	44.4	1.3	-3.9	-41.1	-60.6	-0.5	-21.1
TMEq	5.3	-57.2	-39.0	24.8	-10.8	0.9	124.0	-91.7	-43.7
OHeavyMnfc	-1.3	-50.3	7.5	41.4	-5.4	0.6	24.5	-48.4	-31.5
Services	-3.8	-16.4	3.4	-1.6	1.7	74.1	107.9	7.1	172.3
TOTAL[b]	0	0	0	0	0	0	0	0	0

[a] Row totals for merchandise commodities equal the difference between *fob* and *cif* value for services, the row total equals total trade and transport service exports.

[b] Column totals equal zero due to our assumption of a fixed trade balance over the projection period.

Source: Authors' model results.

Table 4. Impact of Alternative Scenarios on International Prices and Exports of Different Products in the Year 2005 (percentage change).

	Grain TFP Slowdown		China Slowdown		China and Taiwan in WTO		MFA Snapback	
Commodity	Prices	Exports	Prices	Exports	Prices	Exports	Prices	Exports
Rice	6.3	-0.3	-2.6	-0.4	0.1	0.7	-1.6	0.8
Wheat	4.8	3.2	-2.7	-10.3	0.0	0.1	-1.3	-1.2
Crsgrns	5.0	1.9	-5.0	-0.8	0.5	1.1	-1.3	-0.3
OthCrops	0.3	-0.3	-2.7	-5.8	0.1	2.4	-1.4	-2.3
LstkProd	0.5	0.3	-1.5	-7.7	0.3	11.6	-0.9	-1.8
ProcFood	0.3	-0.4	-0.4	-0.1	0.1	3.7	-0.9	0.8
NatRes	-0.1	-0.1	0.1	-0.4	0.4	1.0	-0.8	0.0
Textiles	0.0	-0.1	-0.3	-2.3	-1.1	7.8	2.3	-11.9
WearApp	0.0	-0.1	-0.2	-0.3	-2.6	8.6	11.0	-30.7
OLightMnfc	-0.1	-0.1	0.0	-1.4	0.2	4.3	-0.8	1.4
TMEq	-0.1	-0.1	0.2	-0.8	0.3	2.8	-0.8	0.2
OHeavyMnfc	-0.1	-0.1	0.1	-1.2	0.3	1.5	-0.8	-0.2
Services	-0.1	-0.1	0.0	-1.3	0.3	2.6	-0.7	-1.4

Source: Authors' model results.

Table 5. Impact of Alternative Scenarios on Regional Export and Import Volumes, 2005 (percentage change).

	Grain TFP Slowdown		China Slowdown		China and Taiwan in WTO		MFA Snapback	
Region	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports
WORLD	-0.1	-0.1	-1.2	-1.2	3.0	3.0	-2.0	-2.0
China	-0.1	-0.2	-23.1	-20.7	39.6	54.8	-8.4	-3.1
Indonesia	-0.2	-0.3	0.1	0.0	-5.9	-9.0	-19.7	-15.8
Philippines	0.1	0.0	0.4	0.2	-1.8	-5.5	-8.0	-3.4
Thailand	-0.5	-0.1	0.4	0.2	-0.8	-3.0	-4.3	-1.4
Malaysia	0.0	0.0	0.3	0.3	-0.4	-1.8	-2.4	-1.3
R. of Korea	-0.1	-0.1	-0.2	-0.2	0.6	0.1	-1.0	-0.6
Taiwan	0.0	0.0	-0.3	-0.5	6.0	7.7	-0.5	-0.4
HK/Singapore	0.0	0.0	-0.7	-1.4	1.1	2.8	0.1	0.9
Japan	0.1	-0.1	-0.2	-0.2	3.6	2.6	0.3	0.3
Australia/NZ	-0.1	0.1	-0.5	-1.2	0.8	-0.1	-0.1	-0.2
NAFTA	-0.1	0.0	-0.3	-0.4	1.6	0.9	-2.2	-3.7
Western Europe	-0.1	-0.1	-0.1	-0.1	1.6	1.0	-1.6	-3.2
Former Soviet Union	0.0	-0.2	-0.7	-0.8	2.5	1.1	0.2	0.2
India	-0.5	-0.5	0.1	0.0	-1.6	-6.2	-12.9	-6.7
Rest of the World	-0.1	-0.1	-0.1	-0.2	0.5	-0.3	0.4	0.9

Source: Authors' model results.

Table 6. Annual Welfare Effect (Equivalent Variation in Income) from Various Scenarios, 2005 in billions of 1992 $US.

	Grain TFP Slowdown	China Slowdown	China and Taiwan in WTO	MFA Snapback
WORLD	-27.6	-199.6	50.5	-44.8
China	-6.5	-184.3	42.1	5.5
Indonesia	-0.9	-0.4	-6.6	-7.4
Philippines	-0.3	-0.1	-1.3	0.6
Thailand	-0.1	-0.6	-4.4	0.8
Malaysia	-0.4	-0.1	-2.2	-0.8
R. of Korea	-1.6	-0.6	-0.2	0.8
Taiwan, China	-0.4	-0.8	2.2	0.1
HK/Singapore	0.0	-2.5	4.1	2.8
Japan	-2.9	-2.5	6.0	1.5
Australia/NZ	0.1	-1.3	0.0	0.0
North America	-2.1	-2.1	5.9	-28.5
Western Europe	-3.2	-2.0	10.2	-29.9
Former Soviet Union	-1.1	-0.1	0.4	0.1
India	-2.1	-0.3	-4.2	0.1
Rest of the World	-6.0	-1.9	-1.7	9.5

Source: Authors' model results.

Endnotes

[1] These are obtained from international cross-sectional studies conducted by Theil, Chung, and Seale (1989). In the case of China, we obtain the income elasticities of demand from Zhi and Kinsey (1994) and Fan, Wailes, and Cramer (1995). A complete listing of the values used in the present study is provided in Anderson *et al.* (1996a, Appendix Table 1).

[2] In particular, the rate of nonagricultural total factor productivity growth was set at 3.0 percent, consistent with the evidence provided by Jefferson, Rawski and Zheng (1996). For a full tabulation of the projected factor supply and GDP growth rates for each economy, see Anderson *et al.* (1996a, Table 3).

[3] In our earlier study of the Uruguay Round (Hertel, *et al*. 1995) we assumed that Chinese quotas were eliminated. A comparison of the two studies shows that this makes a big difference in the pattern of expansion of the Chinese economy over this period, and hence that this is a potentially large source of gain from China acceding to the WTO (see below).

[4] This specification omits two important, but partially offsetting, features of the situation. The neglect of the current system of tariff exemptions tends to overstate the impact. The omission of NTB abolition tends to underestimate the effect. Dealing with the tariff exemptions will clearly change the specific results, but does not appear to change the broad conclusions (Bach, Martin, and Stevens 1996).

[5] An important byproduct of China's accession into the WTO is the reduction in cost of investment goods arising from the tariff cuts. As a result, investment in China becomes more attractive. In order to permit this investment flow to take place, we relax the fixed trade balance restriction in this simulation. As a result of the capital inflow following accession, exports do not increase as rapidly as do imports. This blunts the adverse terms of trade effect associated with China's liberalization.

[6] The exception is the case of slower growth in China. Consistent with earlier studies (e.g., Tyers and Anderson 1992, Ch. 8), this is shown to cause China's grain self sufficiency to *increase*. The key reason is that projected livestock product demand growth slows, hence there is less need for imported feedgrains. For more on how China will be fed in the 21st century, see Anderson and Peng (1996).