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# THE APEC FOOD SYSTEM: IMPLICATIONS FOR AGRICULTURAL AND RURAL DEVELOPMENT POLICY

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## I. INTRODUCTION

THE APEC Food System (AFS) is an ambitious proposal originating from the APEC Business Advisory Council (ABAC 1998a). Its objective is to create a regional food system where "consumers have access to the food they desire at affordable prices; the productivity of the food sector is enhanced through region-wide availability of food-related technological advances and through efficient resource use; supply security is improved through co-operation and interdependence; [and] the vitality of rural communities is enhanced through improved infrastructural development and through access to viable non-farm employment and industry" (ABAC 1998b). The concept evolved from earlier calls for an open food system (U.S. National Center for APEC 1996).

To achieve this objective, the proposal calls for a comprehensive approach to food and agriculture policy, in which four main elements can be distinguished: rural infrastructure development; dissemination of technological advances in food production; trade and investment liberalization in the food sector; and achieving food security. Within the first two elements, extensive scope is seen for capacity-building initiatives among APEC economies to complement the efforts of individual economy governments and multilateral agencies. The common purpose of these initiatives is to build capacity to ensure that the food sector develops in ways that contribute to the achievement of overall development objectives in APEC economies, and to ensure that liberalization contributes to those objectives through a wider spread of benefits both between and within economies. In the APEC context

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the comprehensive approach advocated by ABAC thus involves an integration of trade and investment liberalization and facilitation (TILF) and economic and technical cooperation ("Ecotech") elements.

It is hoped that the comprehensive approach of the AFS will allow progress to be made in agriculture, which has proved a difficult issue for APEC. While reform remains a priority for the major food-exporting economies (the United States, Australia, and New Zealand) and the developing country members of the Cairns Group (Indonesia, Malaysia, Thailand, and the Philippines), APEC's Northeast Asian members (in particular the Republic of Korea and Japan) have very serious reservations about the roles of APEC and agricultural reform, typically involving food security. The inclusion of agriculture was a controversial issue in the lead-up to the Osaka meetings in 1995, as Northeast Asian economies lobbied to have agriculture excluded from the liberalization program. The push was countered by adopting "comprehensiveness" as one of the principles of APEC liberalization, thereby acknowledging that no sector should ultimately be excluded. The balancing adoption of "flexibility," however, leaves it open to member economies to delay agricultural liberalization well beyond other sectors.

The political impediments to agricultural trade liberalization are related to the high levels of protection found in the agricultural sector, with the result that the expected adverse effects of trade liberalization on agricultural incomes are severe. The problem is compounded if resources in the agricultural sector cannot be readily transferred to other sectors with greater economic potential. Another factor is the way that cultural, social, and political factors tend to combine to encourage the community to accept the view that reductions in agricultural incomes, along with any associated decline in the rural sector, are outcomes to be resisted. In many developing economies, furthermore, poverty tends to be heavily concentrated in the rural sector, so that the prospect of further declines in agricultural incomes may be a matter of grave concern.

Management of the political implications of distributional effects is often the biggest challenge of implementing trade liberalization. Lump-sum income support payments, which do not distort production and consumption decisions, would in principle be one way of effecting redistribution. However, this has not proved a popular approach among governments, which have tended to prefer assistance measures that encourage displaced workers to retrain or relocate. The capacity-building measures envisaged in the AFS proposal may offer another means to deal with distributional consequences of trade liberalization. By bringing about improvements in the performance of previously protected agricultural sectors, they may partially offset the negative impact of trade liberalization on agricultural incomes, and help to improve the overall performance of the economy. The objective of this paper is to explore the possibility that the AFS capacity-building measures may not only promote development objectives, but also enhance the benefits of liberalization and/

or their distribution between and within economies, and in so doing help to ease the problems of political management of trade liberalization in agriculture.

Several computable general equilibrium (CGE) studies have recently emphasized the importance of agricultural liberalization in the Asia-Pacific by highlighting the substantial welfare gains that could be expected. The findings of Dee et al. (1998), Anderson et al. (1997), Coyle and Wang (1998), and Scollay and Gilbert (2000), all indicate that agricultural liberalization would account for between 50 and 70 per cent of the total welfare gains available from APEC liberalization. This paper also provides confirmation of this important result.

The remainder of the paper is organized as follows. In the following section we briefly discuss our methodology. More extensive discussion can be found in the Appendix. Section III considers the effect of the reform package envisaged in the AFS proposal. Section IV discusses the types of policies that might be envisaged under the Ecotech components of the AFS, and presents the results of simulations that are suggestive of the likely impact of these policies. Finally, Section V contains a summary and concluding comments.

## II. METHODOLOGY

The commonly utilized techniques for evaluating the effect of trade liberalization can be broadly classified as partial and general equilibrium. Partial equilibrium (PE) methods range in complexity from relatively simple static models of the type used by Zhang et al. (1998) to analyze the costs of protection in China, to dynamic stochastic models of the type utilized by Anderson and Tyers (1990). However, all partial equilibrium models share similar limitations. They tend to lack a clear economic structure, being driven by reduced-form elasticities that cannot easily be related back to specific behavioral assumptions. Moreover, partial equilibrium models are not complete systems, in the sense that they cannot account for the interaction between the sector or sectors under consideration and the rest of the economy. Balanced against these disadvantages is the fact that the reduced-form specification of PE models makes econometric estimation feasible, something that is generally impractical with the much larger and more complex general equilibrium models.

Computable general equilibrium or CGE models take data from an actual economy or set of economies in some base year, and combine it (by calibration) with a complete structural description of the behavior of agents within the system, and the constraints that they face. The system is solved numerically, and the effect of policy intervention can be quantitatively examined within a consistent framework that accounts for important market interrelationships. This technique has several substantial advantages. Firstly, the assumptions underlying the models are explicitly set out in full. Secondly, the closed nature of the models allows the consistency of the model to be easily verified. Thirdly, and most importantly, because of the extensive

linkages incorporated in the models, the second-best implications of trade reform are adequately dealt with. This is particularly important where the policy reforms to be modeled are extensive, involve multiple sectors, or where the sectors involved are large enough to impact the rest of the economy in question.

The CGE model used in this paper links a series of static simulations with a set of growth assumptions—a technique known as recursive dynamic simulation. It is important to note the limitations of this approach. First, there is no inter-temporal optimization—agents are assumed to be myopic. Second, since the equilibrium model is static, the time frame that it represents is implicit in the assumptions that are made about what can and cannot vary (the closure). In this model we have assumed full capital and labor mobility, and so the model simulations should be interpreted as representing the long run—the results in any one simulation period should not be interpreted too literally. As with other CGE models, the purpose of this model is to tell a story that is consistent with a set of stylized facts, and to provide a consistent framework for the policy debate.

A more detailed description of the model structure and data used here can be found in the Appendix. Briefly, our simulation procedure is as follows. We establish a baseline projection of the model to 2005. This baseline incorporates the major existing liberalization agreements in the region (the Uruguay Round Agreement on Agriculture [URAA], AFTA, and NAFTA). We then run our liberalization simulations, and the Ecotech simulations, and compare the results to this baseline. The following sections describe our results and the policy implications.

## III. THE AFS LIBERALIZATION AGENDA

The AFS proposal calls for extensive and rapid liberalization of food and agricultural products trade and production. We interpret the call for alignment of food prices with world market value and the absence of policies designed to distort production or marketing decisions as the removal of all import tariffs, export subsidies, and production subsidies on all agricultural and food products in the APEC region. The original AFS proposal calls for quick action to eliminate distortions before 2006, and we therefore assume that the liberalization is implemented as a set of linear reductions in distortion levels over the five-year period 2001–5.

The modality of APEC liberalization in general is still unclear. APEC is unique among regional trade initiatives in being based on the principle of "open regionalism," understood to mean that APEC member economies are to encourage intra-regional trade without discrimination to outsiders. Because of the different interpretations of this definition, the CGE literature has generally considered three potential implementation scenarios: preferential liberalization; MFN liberalization without reciprocation (unconditional MFN); and MFN liberalization requiring reciprocation (conditional MFN). We perform the simulations of AFS liberalization under all three assumptions.

TABLE I

ESTIMATED WELFARE EFFECT OF AFS: EQUIVALENT VARIATION DEVIATION FROM BASELINE 2005 AND AS A PERCENTAGE OF REAL GDP UNDER THE BASELINE IN 2005

(1995 U.S.$ billion; %)

| Region | Preferential APEC | | Unconditional MFN | | Conditional MFN | |
|---|---|---|---|---|---|---|
| | $ Billion | % | $ Billion | % | $ Billion | % |
| Australia | 7.8 | 1.7 | 5.6 | 1.3 | 9.3 | 2.1 |
| Canada | 2.4 | 0.4 | 2.1 | 0.3 | 4.3 | 0.6 |
| Chile | –0.6 | –0.6 | –0.7 | –0.7 | 0.0 | 0.0 |
| China | –3.6 | –0.3 | –0.1 | 0.0 | –0.4 | 0.0 |
| Europe | –7.6 | –0.1 | –11.2 | –0.1 | 18.8 | 0.2 |
| Indonesia | –0.2 | –0.1 | –0.6 | –0.2 | 1.6 | 0.5 |
| Japan | 18.9 | 0.3 | 26.2 | 0.4 | 23.1 | 0.4 |
| Malaysia | 3.8 | 2.5 | 5.2 | 3.5 | 14.5 | 9.6 |
| Mexico | –0.4 | –0.1 | –0.4 | –0.1 | 0.5 | 0.1 |
| New Zealand | 5.2 | 7.4 | 2.7 | 3.9 | 8.3 | 11.9 |
| Philippines | 1.1 | 1.2 | 1.6 | 1.7 | 1.2 | 1.3 |
| Rep. of Korea | 3.0 | 0.5 | 4.4 | 0.7 | 3.4 | 0.6 |
| ROW | –4.3 | –0.1 | 4.5 | 0.1 | 9.6 | 0.2 |
| Singapore | 1.1 | 1.2 | 0.7 | 0.8 | 1.0 | 1.1 |
| Taiwan | 1.8 | 0.4 | 2.0 | 0.5 | 2.0 | 0.5 |
| Thailand | 10.3 | 3.1 | 10.2 | 3.1 | 15.1 | 4.6 |
| United States | 11.2 | 0.1 | 8.7 | 0.1 | 24.8 | 0.3 |
| APEC developing | 13.4 | 0.4 | 19.6 | 0.6 | 36.0 | 1.1 |
| APEC developed | 48.3 | 0.3 | 48.1 | 0.3 | 72.8 | 0.5 |
| World | 49.8 | 0.1 | 61.0 | 0.2 | 137.3 | 0.4 |

In Table I we present the estimated welfare effects of the AFS proposal under the various scenarios. The figures are equivalent variation by region, and thus can be interpreted as the additional income available to domestic consumers at constant prices in 2005, relative to the baseline in 2005. The percentage of baseline real GDP figures give an indication of the relative magnitude of the welfare increases. It should be borne in mind that, due to the structure of the data, the perfectly competitive model, and the focus on efficiency considerations (harmonization of labeling standards, for example, may have a significant positive impact on trade and welfare, but is not amenable to this modeling approach), these results are probably lower bound estimates of the benefits of the AFS.

Nevertheless, the model results indicate substantial welfare gains for most APEC members. Total welfare gains to APEC members are estimated to lie between U.S.$61 to 108 billion. These gains are of the same order of magnitude as many studies have predicted for full APEC liberalization of trade restrictions (see Scollay and Gilbert 2000, for a recent survey), suggesting that protection in the food and agriculture

sectors is a major source of distortion in the region. In proportional terms it is New Zealand and the ASEAN economies of Thailand and Malaysia that experience the largest welfare gains. In absolute terms it is one of the countries that is most concerned over liberalization of food and agriculture, Japan, that gains the most. This is no doubt a reflection of the large allocative efficiency gains achieved with the removal of its substantial tariff barriers and domestic support. The AFS also appears to be good development policy, with developing economies as a group having the most to gain in proportional terms.

On the question of the form of liberalization, a number of interesting patterns emerge. Much has been written on the benefits of MFN liberalization relative to preferential liberalization, and on the closely related issue of free-riding by nonmembers. Our results indicate that, at least where the AFS is concerned, unconditional MFN liberalization, without any requirement for reciprocation by APEC nonmembers is superior to a preferential APEC agreement for APEC members overall, and free-riding is minimal. However, conditional MFN liberalization, with reciprocation required of nonmembers, clearly dominates both strategies. One implication is that transfer to the World Trade Organization (WTO) of liberalization agreements reached within APEC, with the aim of seeking participation by other WTO members, is by no means necessarily a negative outcome for APEC.

Also from Table I, we observe that the major food-exporting economies (Australia, New Zealand, and the United States) gain more in net welfare terms under a preferential agreement, while the food-importing economies of the region (most notably Japan, Korea, and China, which is projected to become a major food importer) are better off under an MFN arrangement. The pattern can be explained with reference to Table II, which presents net agricultural exports by region, and the proportion of intra-APEC agricultural trade. With a preferential agreement, exporting economies are able to capture a larger share of importing member economy markets as a result of their preferential access. Taking New Zealand as an example, 81 per cent of its agricultural trade is within APEC under a preferential arrangement, but only 71 per cent under an unconditional MFN arrangement. This benefits exporting economies. However, it is the importing economies that bear the burden of trade diversion (costs associated with switching import sources in response to differential tariff rates). Hence, for example, 92 per cent of Japan's agricultural trade is within APEC under a preferential agreement, compared with 76 per cent under unconditional MFN. In the case of MFN liberalization, because importing economies are free to import from the cheapest source, they achieve greater efficiency gains, and trade diversion is eliminated.

In summary, the simulations indicate that an APEC Food System would have very positive net effects on economic welfare within APEC, regardless of the form the liberalization takes. Liberalization also, of course, results in significant structural changes, as is partially reflected in the composition of trade data presented in

TABLE II

ESTIMATED EFFECT OF AFS ON FOOD AND AGRICULTURAL NET EXPORTS AND INTRA-APEC AGRICULTURAL TRADE PROPORTION

(1995 U.S.$ billion; %)

| Region | 1995 | | Baseline 2005 | | Preferential APEC | | Unconditional MFN | | Conditional MFN | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $ Billion | % | $ Billion | % | $ Billion | % | $ Billion | % | $ Billion | % |
| Australia | 9.7 | 75.0 | 47.4 | 88.6 | 54.5 | 91.8 | 51.1 | 90.6 | 56.3 | 80.6 |
| Canada | 5.5 | 74.3 | 18.6 | 70.4 | 20.2 | 71.3 | 18.5 | 66.0 | 21.3 | 62.2 |
| Chile | 3.2 | 43.4 | 4.6 | 58.8 | 3.0 | 45.0 | 2.6 | 36.8 | 3.6 | 25.6 |
| China | –8.9 | 71.7 | –118.2 | 66.4 | –132.9 | 80.4 | –139.0 | 72.7 | –125.4 | 60.1 |
| Europe | –49.1 | 13.4 | 36.7 | 19.2 | 30.2 | 15.4 | 51.7 | 20.3 | –32.6 | 37.1 |
| Indonesia | 3.2 | 59.7 | 3.7 | 67.4 | 3.8 | 70.1 | 2.3 | 64.5 | 13.0 | 40.7 |
| Japan | –52.1 | 75.9 | –68.5 | 79.9 | –87.5 | 92.3 | –93.2 | 75.7 | –91.3 | 69.6 |
| Malaysia | 4.7 | 54.2 | –0.9 | 65.1 | 2.0 | 72.1 | 3.4 | 61.1 | 22.2 | 33.6 |
| Mexico | 0.8 | 81.9 | 4.4 | 67.7 | 4.0 | 72.1 | 3.5 | 66.2 | 5.8 | 58.7 |
| New Zealand | 5.7 | 58.0 | 15.8 | 49.1 | 21.9 | 80.7 | 18.5 | 70.8 | 28.2 | 34.2 |
| Philippines | –0.3 | 67.3 | –3.1 | 76.9 | –6.1 | 85.1 | –6.9 | 67.4 | –6.8 | 64.7 |
| Rep. of Korea | –7.7 | 77.8 | –15.2 | 77.4 | –13.7 | 89.4 | –15.1 | 75.0 | –13.8 | 72.2 |
| ROW | 20.6 | 29.1 | –79.6 | 37.3 | –81.3 | 32.2 | –59.3 | 41.0 | –129.8 | 64.2 |
| Singapore | –1.9 | 62.2 | 2.0 | 58.3 | 6.7 | 71.6 | 4.2 | 62.0 | 5.4 | 62.0 |
| Taiwan | –2.8 | 83.5 | –12.3 | 76.9 | –11.5 | 94.0 | –13.7 | 75.9 | –13.8 | 73.3 |
| Thailand | 10.9 | 69.1 | 10.7 | 72.1 | 18.6 | 85.1 | 15.8 | 73.3 | 24.1 | 56.6 |
| United States | 27.6 | 56.8 | 94.7 | 62.3 | 104.2 | 69.7 | 90.1 | 63.4 | 151.7 | 48.0 |

TABLE III

INDEX OF RURAL-URBAN WAGE INEQUALITY UNDER VARIOUS LIBERALIZATION SCENARIOS
(Rural Wage/Urban Wage: Equality = 100)

| Region | 1995 | Baseline 2005 | Preferential APEC | Unconditional MFN | Conditional MFN |
|---|---|---|---|---|---|
| Chile | 75.5 | 97.5 | 92.8 | 90.9 | 104.4 |
| China | 18.4 | 23.9 | 22.9 | 22.3 | 23.4 |
| Indonesia | 22.7 | 19.6 | 19.7 | 19.2 | 20.4 |
| Japan | 66.1 | 101.6 | 82.5 | 78.7 | 82.1 |
| Malaysia | 71.3 | 77.0 | 76.8 | 74.0 | 83.6 |
| Mexico | 66.8 | 80.3 | 77.3 | 76.2 | 80.4 |
| Philippines | 58.4 | 47.4 | 50.9 | 47.9 | 49.6 |
| Rep. of Korea | 76.5 | 92.1 | 98.3 | 92.4 | 95.6 |
| ROW | 16.6 | 22.2 | 22.4 | 22.8 | 21.9 |
| Taiwan | 37.5 | 80.5 | 98.5 | 92.1 | 98.0 |
| Thailand | 17.2 | 15.4 | 15.1 | 14.4 | 15.4 |

Table II. Of particular interest, from a political economy perspective, are the impacts on rural and urban wages. These are presented in Table III. The index used is the average unskilled agricultural wage expressed as a percentage of the average urban unskilled wage, thus 100 represents equality. The first column is the levels estimated for 1995. Note that because we have assumed that all developed economies except Japan and Taiwan have perfect labor mobility, the index in these economies is 100 by definition. The second column is the projected index at 2005 under the baseline scenario (without liberalization beyond that already committed).

The APEC members identified in the model can be classified into three major categories, using the average rate of marginal agricultural labor growth (Appendix Table II), and the initial level of wage divergence. The first category is those developing economies where there is initially above average wage divergence, and above average rates of agricultural labor growth (Indonesia, Thailand, and China). In these economies the model projects little change in the relative wage under the baseline, and considerable divergence remains at the end of the simulation period. The second group consists of developing economies with initially higher relative wages, but above average rates of agricultural labor growth (Chile, Mexico, and the Philippines). With the exception of the Philippines, in these economies the trend is positive, divergences in rural-urban wages decrease quite substantially over time. This suggests that Philippine agricultural wages are hit particularly hard by the Uruguay Round reforms. The third group is those economies with very low rates of agricultural labor growth (Japan, Korea, Taiwan, and, to a lesser extent, Malaysia). In these economies the model projects the remaining divergence to be rapidly eliminated, the agricultural wage in fact overshooting the urban wage over the simula-

tion period in Japan (the properties of the model ensure that the overshooting is temporary).

The average value of the relative wage index increases from 48 in 1995 to 60 in 2005. The overall picture is thus one of declining agricultural-industrial wage divergence in APEC over the simulation period, although substantial divergences remain in some economies. There is a positive policy implication for APEC that emerges from the baseline projection: in the Northeast Asian economies, which have most strongly opposed agricultural reform, the rationale for agricultural protection may be diminished as agricultural wages rise. Since the main driving force behind the agricultural wage increases is declining agricultural populations, the formidable political strength of agricultural lobbies in these economies may also diminish over time. While we note the European-style counter-example, in principle it should be easier for these economies to reform in the face of rising agricultural incomes.

The remaining columns of Table III give the index figures at 2005 under the liberalization scenarios. The best scenario is again MFN with reciprocation. Under this scenario, income divergence in fact declines in many APEC economies relative to baseline. In the other two scenarios this is not the case, in most economies there is an increase in wage divergence relative to baseline as a result of reform, although the effects in most economies are projected to be moderate (1–6 per cent).

However, despite the fact that Japan appears to have the most to gain from agricultural reform, we can gain a clear understanding of its reluctance to support the AFS proposal by considering the agricultural wage dimension. The model projects substantial declines in rural wages, in the region of a 20 per cent fall relative to baseline by the end of the simulation period, under all scenarios. A fall of that magnitude is of understandable political concern. On this issue there are three main points to note. First, a significant proportion of Japanese rural incomes come from off-farm activities (over 75 per cent in 1994), so total incomes are unlikely to fall by as much as indicated by the wage reductions. Second, the dynamics of the model imply that rural wages in Japan should, as in the other economies, track back upwards over time as labor responds to the price shock. Third, the fall is large when compared to where the index would otherwise be in 2005 (a hypothetical baseline), but agricultural wages in Japan and elsewhere are rising. Agricultural wages still rise relative to 1995 under all scenarios.

In summary, the simulations do give us reason to be cautiously optimistic about the AFS proposal. The overall welfare gains are substantial, and appear to contribute positively to regional development. However, the negative impact of liberalization on agricultural incomes in some economies represents a political challenge that APEC will need to successfully address if it is to successfully implement liberalization and enjoy its attendant overall economic benefits. It is to policies that may help to alleviate this pressure that we turn in the following section.

## IV. "ECOTECH" AND THE AFS

The AFS proposal recognizes the difficulties associated with liberalization of agricultural markets and the legitimate role of effective rural policies to meet the specific development needs of individual economies. While the proposal argues that rural policies should not be designed to directly distort production or marketing decisions, this still leaves considerable scope for implementing policies that may mitigate some of the more painful aspects of reform, and also contribute in a positive way to APEC's overall development objectives. In the following subsections we consider the possible roles of promotion of off-farm activities, skill formation, technology transfer, rural development policies, and fiscal measures. All of these policies are strongly emphasized in the AFS proposal. They may be implemented as part of APEC-wide projects under the food system banner, as part of other APEC working group projects, on the part of individual governments, or in cooperation with other multilateral development institutions such as the World Bank. Technical details on the simulation assumptions are discussed in the Appendix.

It is important to emphasize the experimental nature of the simulations involving AFS capacity-building measures. By treating each type of measure separately we are able to isolate and compare the direction and possible magnitude of the effect that each type of measure may have. In practice it is likely that more than one type of measure will be used simultaneously. Furthermore, since the size of the effects by which each type of measure is represented are hypothetical, the reported results can be taken only as indications of the outcomes that could be expected from each type of measure. Finally, the costs of implementing the policies described here need to be weighed against the benefits.

### A. *Promotion of Off-Farm Activities*

Promotion of off-farm (nonagricultural) activities may refer to policies designed to supplement on-farm incomes by providing jobs during the off-season (Oshima 1998), or it may correspond to more permanent measures to shift labor out of agriculture and into other activities. We take the latter interpretation.

Promotion of off-farm activities may thus correspond to rural-urban migration, a policy that may not find favor among many development economists. Indeed, rural-urban migration is considered to be a significant problem in a number of APEC member economies, as flows from the rural sector overwhelm the limited urban infrastructure. Our model is not designed to deal with these issues, but rather the incentive structure that underlies movement from agricultural to industrial activities, and the long-run income changes that we expect to be a consequence. Hence, the appropriate interpretation of this simulation is increasing the opportunity for the agricultural population to be employed in industrial activities in rural or urban

TABLE IV

ESTIMATED WELFARE EFFECT OF AFS WITH ECOTECH: EQUIVALENT VARIATION DEVIATION FROM BASELINE 2005

(1995 U.S.$ billion)

| Region | Unconditional MFN | Off-Farm Activity | Skill Formation | Technology Transfer | Rural Development |
|---|---|---|---|---|---|
| Australia | 5.6 | 9.5 | 9.7 | 9.1 | 8.7 |
| Canada | 2.1 | 4.3 | 4.3 | 4.2 | 4.1 |
| Chile | –0.7 | 0.0 | 0.0 | 0.4 | 0.4 |
| China | –0.1 | 3.4 | 4.4 | 11.0 | 17.6 |
| Europe | –11.2 | 18.7 | 18.7 | 19.0 | 19.5 |
| Indonesia | –0.6 | 2.1 | 3.2 | 3.9 | 3.1 |
| Japan | 26.2 | 22.7 | 23.1 | 28.6 | 33.1 |
| Malaysia | 5.2 | 14.6 | 14.6 | 15.3 | 15.3 |
| Mexico | –0.4 | 0.5 | 0.7 | 1.9 | 1.8 |
| New Zealand | 2.7 | 8.4 | 8.5 | 8.3 | 8.2 |
| Philippines | 1.6 | 1.4 | 1.4 | 1.6 | 1.8 |
| Rep. of Korea | 4.4 | 3.4 | 3.5 | 5.7 | 6.0 |
| ROW | 4.5 | 21.0 | 9.6 | 10.3 | 10.1 |
| Singapore | 0.7 | 1.1 | 1.1 | 1.0 | 1.0 |
| Taiwan | 2.0 | 2.0 | 1.9 | 2.7 | 3.0 |
| Thailand | 10.2 | 15.9 | 17.2 | 16.8 | 15.7 |
| United States | 8.7 | 25.8 | 26.3 | 24.1 | 23.0 |
| APEC developing | 19.6 | 41.3 | 44.9 | 56.6 | 61.59 |
| APEC developed | 48.1 | 73.7 | 74.9 | 77.9 | 81.19 |
| World | 61.0 | 154.7 | 148.1 | 163.9 | 172.34 |

areas. Developing rural infrastructure along these lines is an area of significant current interest (Brookins 1999).

Our model incorporates the flow of labor from agricultural to industrial activities, and we can simulate the effect of policies designed to encourage the movement of people out of agricultural activities by increasing the base rate of movement. We consider the impact of increasing the base rate of migration by 25 per cent over the AFS implementation period (2001–5)—further details are in the Appendix. The results of this experiment are presented in column 2 of Tables IV and V. Considering the net welfare impacts first, we see that increasing the rate of migration out of agriculture has a substantial positive effect on welfare for developing economies relative to liberalization alone, and for APEC as a whole. All APEC member economies experience net welfare improvements under this scenario. The welfare results thus suggest that improving rural mobility, in particular in developing APEC members, should be a priority for area for APEC's Ecotech agenda.

Since it is migration flows that drive convergence of rural and urban wages over time, we also expect to see migration enhancement policies improve the wage problem. Table V indicates that this is indeed the case, with a small improvements over

TABLE V

INDEX OF RURAL-URBAN WAGE INEQUALITY UNDER VARIOUS LIBERALIZATION AND ECOTECH SCENARIOS
(Rural Wage/Urban Wage: Equality = 100)

| Region | Unconditional MFN | Off-Farm Activity | Skill Formation | Technology Transfer | Rural Development |
|---|---|---|---|---|---|
| Chile | 90.9 | 104.9 | 112.6 | 105.0 | 96.8 |
| China | 22.3 | 23.9 | 24.0 | 23.5 | 22.0 |
| Indonesia | 19.2 | 20.7 | 21.4 | 20.4 | 18.2 |
| Japan | 78.7 | 82.9 | 92.4 | 81.6 | 75.2 |
| Malaysia | 74.0 | 85.3 | 88.5 | 83.7 | 78.5 |
| Mexico | 76.2 | 81.7 | 83.9 | 80.6 | 75.7 |
| Philippines | 47.9 | 51.3 | 51.3 | 49.7 | 46.1 |
| Rep. of Korea | 92.4 | 96.3 | 102.3 | 95.8 | 89.1 |
| ROW | 22.8 | 22.4 | 22.0 | 21.9 | 21.8 |
| Taiwan | 92.1 | 105.2 | 104.8 | 98.6 | 95.1 |
| Thailand | 14.4 | 15.8 | 16.4 | 15.5 | 14.0 |

liberalization alone in all APEC economies. It is also clear that more substantial policy measures would be needed in the case of Japan, where the wage declines relative to baseline are most severe.

B. *Promotion of Skill Formation*

Promotion of skill formation and schooling can be thought of as an extension to the promotion of off-farm activities considered above, as both are concerned with improving the opportunity of agricultural workers to move into other occupations. Hence, our approach to modeling the potential impact of rural education policies is very similar to that used above. The model dynamics are altered by relaxing the initial assumption that movement from the unskilled to the skilled labor category occurs only among nonagricultural unskilled workers. Instead we consider a situation where the rate of movement among rural workers is equal to that among nonagricultural workers in those economies where we have not assumed perfect mobility. This can be interpreted as the effects of an "equal opportunity" policy providing for access to higher education among agricultural groups equivalent to that available among nonagricultural groups.

The results of this experiment are presented in column 3 of Tables IV and V. As we might expect, policies of this type have a similar, though more pronounced, effect to those investigated above on relative agricultural wages. The reason is that we have provided for greater movement out of agriculture—increasing the rate at which agricultural labor is becoming scarce and hence driving up its price. At the same time, because the skilled labor is increasing at the same rate as before, less unskilled urban labor is being drawn into this category, helping to keep the un-

skilled urban wage down. The net effect is a quite substantial improvement in rural-urban wage divergence. Net welfare gains are also positive, and again we see a larger improvement for developing APEC members than developed. The results thus suggest that policies designed to improve the access of rural communities to higher education, in addition to other policies designed to improve their ability to move into nonagricultural activities, can have a substantial positive impact on wage inequality and net economic welfare in APEC, and should thus form a core component of the AFS agenda.

### C. *Technology Transfer*

A central component of the AFS proposal is the dissemination of knowledge, and policies to ensure that technological advances in food production, processing, and distribution can improve the lives of all APEC citizens. By bringing about improvements in the performance of previously protected agricultural sectors, technology transfer may partially offset the negative impact of trade liberalization on agricultural incomes, as well as help to improve the overall performance of the economy.

To illustrate the possibilities in our model, we simulate the impact of improving agricultural and food-processing technology in APEC economies, as the result of an assumed technology transfer from the developed food-exporting economies. We shock the base rate of neutral technical progress in the agricultural and food-processing industries in the target economies by 10 per cent over the AFS implementation period. At constant prices we expect a neutral technical change to improve welfare and rural incomes, although there is always the potential for this to be diminished by endogenous declines in world prices, or by the effects of other distortions present in the system.

The results of this experiment are presented in column 4 of Tables IV and V. Once again we observe that technology transfer of this form substantially improves the net welfare situation of developing APEC members and APEC as a whole. There is also a positive impact on income divergence in all APEC members, but the effects are small. The results thus suggest that while there is a role for technology transfer in APEC as a development strategy, it should be combined with other measures (such as enhancing labor mobility and rural education) if the objective is to reduce income divergence.

### D. *Other Rural Development Policies*

Rural development policy is of course a wide-ranging term that encompasses land reform, programs aiming to increase the income and well-being of farmers through the provision of land, credit, extension services, and infrastructure (Oshima 1998). It may also refer to policies designed to raise the productivity of agricultural workers. Clearly, this definition encompasses a number of the policies outlined

above, involving aspects of infrastructure development, rural education, and technology transfer. We use the heading to present a brief cautionary note on the impact of ill-conceived policies along these lines. Let us consider the impact of a rural development policy that improves the efficiency of rural labor, without simultaneously allowing for more mobility. What are the likely effects? We can use our model to throw light on the issue by considering a biased technological change, improving the productivity of agricultural labor alone, in this case at the rate of 1 per cent per year over the AFS implementation period.

Improving productivity is of course commendable for the economy as a whole, and hence we expect such policies to raise overall social welfare in much the same way as the neutral technological change we considered above, and the results bear this out (results in column 5 of Tables IV and V). However, in the case of rural incomes the picture is not so attractive. Biased growth in factor productivity is like a growth in factor supply, which results in price falls. While technological improvements of this type improve welfare overall substantially, they do so at the expense of rural incomes. Indeed, the impact of 1 per cent biased growth in most economies is more severe than the impact of the liberalization itself. The lesson for APEC and the AFS is clear: care will need to be taken in designing appropriate rural development and technology transfer programs. In particular, rural development programs that improve the efficiency of rural labor should not be undertaken without simultaneously implementing measures that improve the mobility of rural labor and/or improve access to nonfarm employment. The reason is that once full mobility of factors is allowed, factor prices are determined directly by goods prices. Biased productivity growth can then only cause wage falls of this type to the extent that it results in falls in the prices of final goods, which for developing countries are likely to be insignificant.

### E. *Fiscal Measures*

Fiscal measures are designed to mitigate adverse income distribution through welfare policies. Because the overall welfare results of the AFS liberalization are substantial and positive for most countries, it is clear that a redistribution strategy that leaves no group worse off than pre-reform is possible. In cases where the income falls are severe and do not seem to respond well to other measures, direct measures may be appropriate. The AFS proposal does not restrict countries in this respect, although such income transfers should not be linked to the volume of production.

From the perspective of neoclassical trade theory, direct income support payments are the ideal means of effecting redistribution, because they do not distort production and consumption decisions and thus are efficient. However, lump-sum taxes and transfers are rarely available, and as Oshima (1998) points out, care should be taken to ensure that the incentive structure is not altered to the detriment of

future growth potential. Nonetheless, it is clear that carefully designed fiscal measures can form part of an appropriate overall strategy for APEC in implementing agricultural reform.

## V. CONCLUSIONS

The AFS proposal is ambitious and far-reaching. This paper adds to the growing volume of evidence that the potential net gains from agricultural reform in the APEC region are substantial, and in so doing helps to highlight the importance for the APEC economies of finding some way to move forward in this area. The results also, however, provide confirmation of the expectation that agricultural liberalization will have negative effects on agricultural incomes in some economies. This poses a political problem that, along with other important issues such as ensuring food security, will have to be addressed if meaningful progress is to be made.

While it is obvious that the road ahead will not be easy for APEC in this area, the simulation results presented in this paper have given us reason to be cautiously optimistic. In addition to the large overall gains, the income distribution effects are moderate in most economies. Furthermore, the results also highlight the positive contribution that can be made to the liberalization endeavor by the capacity-building measures envisaged in the AFS proposal in a number of APEC economies (in particular those policies that enhance the mobility of agricultural labor). Numerous policies of the type considered in this paper are already in place in many APEC economies, and should be able to be rapidly extended to deal with the challenge of liberalization. Our results indicate the potential of a carefully selected and implemented set of Ecotech measures to offset the adverse effects on agricultural incomes that would be expected to follow from liberalization, and in so doing to play a role in overcoming political resistance to the AFS proposal. Just as importantly, the results also highlight the positive impact that capacity-building measures can have on overall welfare, in particular for the developing economies of the region. This suggests that they should not be viewed as the price that must be paid in order to achieve liberalization, but rather as an integral part of APEC food policy.

The critical test for APEC will be bringing its Northeast Asian members on board. Here too, there are some positive implications of the results of this paper. Because it incorporates agricultural-industrial labor movement trends into the recursive dynamic framework, our model suggests that in the Northeast Asian economies the rationale for agricultural protection should be considerably diminished as agricultural wages rise strongly and quickly over the next ten years. Since the main driving force behind the agricultural wage increases is high levels of movement out of agricultural sectors, the political strength of agricultural lobbies in these countries may also diminish over time. It may be easier for these countries to reform in the face of rising rural incomes.

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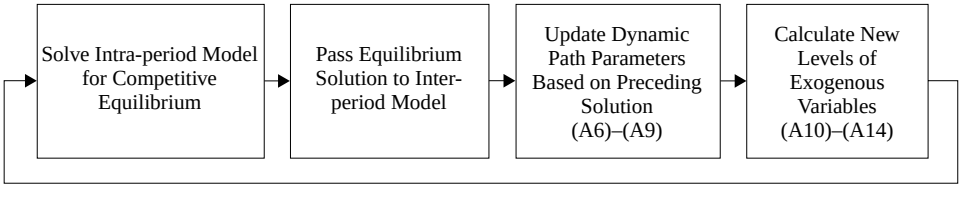
## APPENDIX

## MODEL CONSTRUCTION

The CGE model utilized in this paper consists of two components: an intra-period model and an inter-period model. The intra-period model is solved for a competitive equilibrium in each simulation period. Control is then passed to the inter-period model, where the exogenous parameters that define the growth path are updated according to a set of fixed rules. The intra-period model is then resolved for the new equilibrium. The process is repeated for the entire simulation period, a technique known as "recursive dynamic" simulation (Appendix Figure 1).

Appendix Fig. 1. Simulation Procedure




### A. *An Algebraic Sketch of the Intra-period Model*

The intra-period model is based on Rutherford (1998), and is of a well-established class. We therefore describe it here only in general terms and in greatly simplified form (a complete description is available from the authors). Let $\mathbf{V}$ be a vector (length $F$) of factor endowments in the home economy, and $\mathbf{P}$ be a vector (length $N$) of prices. We can then define the GNP function as $G(\mathbf{P}, \mathbf{V}) = \max\{\mathbf{P}\cdot\mathbf{Y} : \mathbf{V}\}$ and the expenditure function as $E(\mathbf{P}, U) = \min\{\mathbf{P}\cdot\mathbf{D} : U\}$, where $U$ is aggregate home utility. The aggregate budget constraint for the home economy is then:

$$S(\mathbf{P}, \mathbf{V}, U) = G(\mathbf{P}, \mathbf{V}) - E(\mathbf{P}, U) = 0. \qquad \text{(A1)}$$

From the first order conditions to the GNP maximization problem we obtain sectoral supply functions by Hotelling's lemma, and Hicksian demand functions follow simi-

larly from the derivative properties of the expenditure function, hence:

$$S_i(\mathbf{P}, \mathbf{V}, U) = D_i(\mathbf{P}, U) - Y_i(\mathbf{P}, \mathbf{V}), \qquad i = 1, \ldots, N, \tag{A2}$$

defines Hicksian net exports. Let a superscript * denote the foreign economy, for which similar conditions hold. With trade there can be only one price vector, which we denote using home notation. International equilibrium then requires:

$$S_i(\mathbf{P}, \mathbf{V}, U) + S_i^*(\mathbf{P}, \mathbf{V}^*, U^*) = 0, \qquad i = 1, \ldots, N. \tag{A3}$$

The solution to the system of equations defined by (A1), its foreign equivalent, and (A3) yields the price vector and aggregate utility levels. Again utilizing Hotelling's lemma, we can now derive factor prices from the GNP function:

$$W_j = W_j(\mathbf{P}, \mathbf{V}), \qquad j = 1, \ldots, F, \tag{A4}$$

and similarly for foreign. Finally, since each sector is price-taker in factor markets, from the first-order conditions of sectoral cost minimization $C_i(\mathbf{W}, Y_i) = \min\{\mathbf{W} \cdot \mathbf{X} : Y_i\}$ we obtain factor demands:

$$X_{ij} = X_{ij}(\mathbf{W}, Y_i), \qquad i = 1, \ldots, N; \; j = 1, \ldots, F, \tag{A5}$$

and similarly for foreign. In this simple model we have $2 + N + 4F + 2FN$ variables, but only $1 + N + 2F + 2FN$ independent equations (the equilibrium conditions are not independent by Walras's Law). In a neoclassical closure $\mathbf{V}$ and $\mathbf{V}^*$ are declared exogenous, and one element of $\mathbf{P}$ is declared a numéraire price, enabling the model to be solved. Other closures are possible.

The simulation model adds considerable complexity, but does not alter this basic framework. We allow for many economies. Production utilizes intermediate inputs. Final demands are distinguished between households, government, trade, and capital creation. There is imperfect substitution between foreign and domestic goods, and between alternative sources of imports (the Armington assumption)—and thus a three-stage optimization procedure in both production and final demand. Specific functional forms define the substitution relationships (CES functions in value-added and Armington, Leontief in intermediate use, Stone-Geary in household demand). Finally, we introduce distortions to the system by allowing taxes and subsidies to drive wedges between the prices faced by the various agents in the system.

### B. *Recursive Dynamics*

The equations that make up the recursive dynamics are presented in Appendix Table I. The equations are of two types. Equations (A6)–(A9) might be called "adaptive" equations. Their purpose is to adjust the growth parameters in response to the equilibrium outcome in the preceding period. These equations are unique to this model. Equations (A10)–(A14) are the actual "growth" equations. They calculate the values of the technical shift parameters and factor endowments that will be used

APPENDIX TABLE I

RECURSIVE DYNAMIC EQUATIONS

$$\lambda_r^t = \lambda^* + (\lambda_r^0 - \lambda^*)\,\phi_r^T / (GDP_r^{t-1}/POP_r^{t-1})^{\phi_r^T} \quad \text{(A6)}$$

$$\Delta_r^t = \Delta^* + (\Delta_r^0 - \Delta^*)\,\phi_r^L / (GDP_r^{t-1}/POP_r^{t-1})^{\phi_r^L} \quad \text{(A7)}$$

$$\Lambda_{Sr}^t = \Lambda_{Sr}^0\{1 - (pf_{Lr}^{t-1}/pf_{Sr}^{t-1})\}^{\psi_{Sr}} / \{1 - (pf_{Lr}^0/pf_{Sr}^0)\}^{\psi_{Sr}} \quad \text{(A8)}$$

$$\Lambda_{Ar}^t = \Lambda_{Ar}^0\{1 - (pf_{Lr}^{t-1}/pf_{Ar}^{t-1})\}^{\psi_{Ar}} / \{1 - (pf_{Lr}^0/pf_{Ar}^0)\}^{\psi_{Ar}} \quad \text{(A9)}$$

$$a_r^t = e^{\lambda_r^t t} \quad \text{(A10)}$$

$$S_r^t = S_r^{t-1}(1 + \Delta_r^t)(1 + \Lambda_{Sr}^t) \quad \text{(A11)}$$

$$A_r^t = A_r^{t-1}(1 + \Delta_r^t)(1 + \Lambda_{Ar}^t) \quad \text{(A12)}$$

$$L_r^t = (1 + \Delta_r^t)L_r^{t-1} + (pf_{Lr}^0/pf_{Ar}^0)A_r^{t-1}\Lambda_{Ar}^t - (pf_{Lr}^0/pf_{Sr}^0)S_r^{t-1}\Lambda_{Sr}^t \quad \text{(A13)}$$

$$K_r^t = (1 - \delta_r)K_r^{t-1} + I_r^{t-1} \quad \text{(A14)}$$

Notation:

| | |
|---|---|
| $t$ | Time period |
| $r$ | Regions |
| $\lambda$ ($\lambda$*) | Factor productivity growth rate (target) |
| *GDP*/*POP* | Real GDP per capita |
| $\phi$ | Convergence parameter for (T)echnology, (L)abor |
| $\Delta$ ($\Delta$*) | Aggregate labor growth rate (target) |
| $\Lambda$ | Marginal growth rate for skilled/agricultural labor |
| $\psi$ | Convergence parameter (labor movement) |
| $pf$ | Factor return |
| $a$ | Technological shift parameter |
| $S$ | Skilled labor |
| $A$ | Agricultural unskilled labor |
| $L$ | Industrial unskilled labor |
| $K$ | Capital stock |
| $\delta$ | Depreciation rate on capital |
| $I$ | Investment |

in the search for the subsequent equilibrium. Equations of this basic form appear in all recursive dynamic models.

Equations (A6) and (A7) both reflect a widely accepted stylized fact of development, a decline in growth rates as economies mature. Hence in (A6) the rate of productivity growth in developing economies approaches average developed economy levels as per capita GDP rises. Equation (A7) adjusts labor force growth rates in the same fashion. These adjustments are made to ensure that the growth path does not produce unreasonably large changes in the structure of the global economy over the simulation period. The paths of these parameters are calculated in an initial simulation with no liberalization, and thereafter fixed for subsequent simulations.

Equations (A8) and (A9) adjust the marginal growth rates of skilled and agricultural unskilled labor, respectively. Using (A9) as an example, when the ratio of industrial to agricultural unskilled wages is the same as in the initial equilibrium,

the rate of labor movement from agricultural to industrial activities equals its initial level. Should the ratio rise/fall, so will the rate of movement in the subsequent period. When the wages are equal, movement between the two activities in the next period will be zero. Hence, shocks that alter the returns to different classes of labor in the intra-period model cause factor supply responses in subsequent periods, and movement between categories declines as the incentive diminishes.

The remaining five equations have straightforward interpretations. Equation (A10) calculates the technical shift parameter given the rate of productivity growth. Equations (A11)–(A13) calculate the new stocks of skilled, and agricultural and industrial unskilled labor. Finally, (A14) calculates the new capital stock as the sum of the previous period's depreciated capital stock, and investment (savings is a fixed share of income). This allows the model to capture changes in income that result from investment expansion with trade liberalization. The steady state properties of the model do, however, imply that shifts in the growth rate are temporary.

### C. *Model Data*

The primary source of the input-output and protection data for this model is the GTAP4 database, described in McDougall, Elbehri, and Truong (1998). Substitution parameters are also from GTAP4, with the exception that Armington elasticities at both levels are doubled (as in Anderson et al. 1997; Yang, Duncan, and Lawson 1998). We supplement the data with information on agricultural and nonagricultural labor body counts from the FAOSTAT database and the *Taiwan Agricultural Yearbook*, using the skill breakdowns in Liu et al. (1998) to obtain consistent measures of the average unskilled agricultural wage, unskilled industrial wage, and the skilled wage.

The aggregation used in this model identifies fifteen commodities (paddy rice, wheat, other grains, vegetables and fruit, other non-grain crops, livestock, forestry, fisheries, processed rice, meat products, dairy products, other food products, light manufactures, heavy manufactures, and services), seventeen regions (Australia, Canada, Chile, China, Europe, Indonesia, Japan, Malaysia, Mexico, New Zealand, Philippines, Singapore, Republic of Korea, Taiwan, Thailand, United States, and ROW), and five endowment commodities (skilled labor, unskilled labor, land, natural resources, and capital) with agricultural and industrial unskilled labor distinguished.

The data used in specifying the dynamic growth path of the model, along with its sources, is presented in Appendix Table II.

### D. *Experimental Design*

In CGE models, experiments are conducted by "shocking" exogenous variables, and observing the changes in the equilibrium solution. In the case of liberalization scenarios this means fully or partially removing the tax/subsidy distortions in the

APPENDIX TABLE II

ASSUMPTIONS USED IN THE PROJECTIONS
(Annual Percentage Growth Rates)

| Region | Labor[a] | Agricultural Labor[b] | Skilled Labor[c] | Capital[d] | TFP[e] |
|---|---|---|---|---|---|
| Australia | 0.80 | –0.68 | 6.65 | 3.20 | 0.30 |
| Canada | 0.60 | –4.54 | 4.67 | 4.60 | 0.30 |
| Chile | 2.10 | –0.96 | 5.39 | 5.20 | 1.00 |
| China | 0.90 | –0.39 | 2.58 | 11.30 | 1.30 |
| Europe | 0.00 | –3.35 | 9.30 | 2.40 | 0.30 |
| Indonesia | 2.10 | –0.26 | 7.64 | 7.40 | 1.50 |
| Japan | –0.03 | –4.20 | 4.73 | 5.80 | 0.30 |
| Malaysia | 2.80 | –3.77 | 7.30 | 9.20 | 1.00 |
| Mexico | 2.30 | –1.88 | 2.93 | 1.10 | 0.90 |
| New Zealand | 0.40 | 0.57 | 7.07 | 2.90 | 0.30 |
| Philippines | 2.50 | –1.23 | 3.22 | 1.50 | 0.50 |
| Rep. of Korea | 1.20 | –6.05 | 4.94 | 7.60 | 1.40 |
| ROW | 1.70 | –0.50 | 4.92 | 3.20 | 1.00 |
| Singapore | 0.70 | –11.39 | 4.07 | 7.60 | 0.30 |
| Taiwan | 1.10 | –3.99 | 5.04 | 8.00 | 1.50 |
| Thailand | 0.90 | –0.43 | 6.34 | 7.70 | 1.30 |
| United States | 0.70 | –2.00 | 4.57 | 2.70 | 0.30 |

[a] World Bank (1999) projections, 1997–2010.
[b] Cumulative rates of growth, based on trend in preceding ten-year period (five years in China). Figures from FAOSTAT, except Taiwan from *Taiwan Agricultural Yearbooks*.
[c] Cumulative rates of growth, based on projections of Ahuja and Filmer (1995) and trends from UNESCO (1997).
[d] Growth rate based on projections in Anderson et al. (1997) for China, Europe, Singapore, Malaysia, Indonesia, and ROW, and ten-year historical trend (Penn World Tables) for other economies. Depreciation rates on capital selected to calibrate to this rate in base year, thereafter growth rates endogenous.
[e] Implemented as a Hicks neutral change across all inputs. Figures based on estimates from Young (1994), Drysdale and Huang (1997), and World Bank (1997).

system. For the AFS liberalization experiments we have three scenarios:

1. *Preferential:* Removal of import taxes, export subsidies, and output subsidies on all agricultural and food products by all APEC members on a preferential basis. Cuts are implemented as linear reductions over the period 2001–5.
2. *Unconditional MFN:* As in (1) above, but border reductions are extended to nonmembers.
3. *Conditional MFN:* As in (2) above, assuming nonmembers reciprocate with APEC (but not between each other).

In the case of capacity-building measures we shock various parameters in the recursive dynamic specification as follows (in all cases implemented over the period 2001–5, in conjunction with MFN liberalization):

1. *Promotion of off-farm activities:* Increase the base rate of migration ($\Lambda^0_{Ar}$) in developing APEC members, Japan, and Taiwan by 25 per cent.
2. *Promotion of skill formation:* Allow direct movement from agricultural labor to skilled labor in developing APEC members, Japan, and Taiwan. Skilled labor grows at the same rate, but now draws labor directly from unskilled agricultural in addition to unskilled industrial. Hence (A12) becomes $A^t_r = A^{t-1}_r (1 + \Delta^t_r)(1 + \Lambda^t_{Ar}) - \Omega(pf^0_{Ar}/pf^0_{Sr})S^{t-1}_r \Lambda^t_{Sr}$, where $\Omega$ is a weight based on the size of the initial agricultural labor force. A similar weight is also applied to the last term of (A13).
3. *Technology transfer:* Increase the base rate of technical progress ($\lambda^0_r$) in developing APEC, Japan, and Taiwan by 10 per cent.
4. *Other rural development policies:* Introduces biased technical progress (a new shift parameter $b$ such that $Y_{ir} = a_r Y_{ir}(\mathbf{P}, b_r A_i, \mathbf{V})$, where $\mathbf{V}$ is the vector of endowment commodities other than $A$) on agricultural labor at the rate of 1 per cent in developing APEC, Japan, and Taiwan.