Quantifying APEC Trade Liberalization: A Dynamic Analysis

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ABSTRACT

The Bogor Declaration of 1994 proposed free trade in the Asia Pacific region by the year 2020. If implemented as announced, this program will have important implications for the world economy over the next few decades. This paper uses a new dynamic multi-sector global model called the Asia-Pacific G-Cubed Model (APGCUBED) to evaluate the economic impacts of the Bogor Declaration. The focus is on the adjustments between 1995 and 2020 in many of the APEC economies. A key aspect of the study is the role of international capital flows, expectations and physical capital accumulation in determining the size and distribution of income gains from this ambitious program of trade reform. The paper compares the implication of full APEC trade liberalization with liberalization between APEC members on a preferential basis and with liberalization that is restricted to ASEAN member economies. It is found that the largest gains for participating economies are realized by full non-preferential liberalization. Preferential liberalization only between APEC economies by discriminating against non-APEC economies only yields two thirds of these gains.

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1. Introduction

Since 1989, the member countries of the Asia Pacific Economic Cooperation (APEC) forum have been meeting regularly to discuss measures for greater economic cooperation. This forum which now has eighteen members from around the Pacific has been argued to be a potentially important vehicle for significant trade reform in the region[1]. The 1994 Bogor Declaration made by APEC members proposed ambitious goals to achieve free trade in the Asia Pacific region no later than the year 2020 and by 2010 for industrialized members of APEC. If this goal is achieved there are likely to be significant implications within the APEC economies as well as throughout the world. These implications will begin to be felt well before 2020. Indeed a key aspect of the APEC program is a commitment to trade and investment liberalization well in advance of implementation of the policies. If this commitment is taken to be credible, the role of expectations will be crucial during the adjustment phase from now until 2020. Depending on the extent to which the reforms are deemed to be credible, economies will begin to adjust well in advance of the actual implementation of the program. In particular it is shown below that international capital flows may respond to the program well in advance of the trade adjustment and this will be very important for the nature of the adjustment process. This is crucial because, as shown below, in some cases the short run adjustment are the opposite in sign to the long run equilibrium which has important implications for the adjustment of other policies over the next several decades.

To explore the role of expectations, international capital flows, physical capital

[1] See EPG (1994). Some authors argue that the regional forum can promote global trade reform if pursuing "open regionalism " (See Drysdale and Garnaut (1994)). Others argue that the incremental gain from APEC is small given the existence of the WTO (see Fane (1995).

accumulation and the time path of the liberalization process this paper analyzes the APEC Bogor Declaration using a newly developed dynamic intertemporal multi-sectoral model. This model is used to evaluate the long term implications of alternative paths of trade reform as well as the short run dynamic adjustment process to these reform. Full APEC trade liberalization on a non preferential basis is compared to preferential trade liberalization between APEC members. In addition this paper considers the case in which only ASEAN economies liberalize in order to get a measure of the size of gains from ASEAN economies being a part of the APEC process . It is found that for all APEC economies considered, full liberalization leads to larger gains than preferential liberalization. Full liberalization as part of APEC also leads to greater gains for ASEAN economies than liberalization within ASEAN alone.

It is important to stress that the main focus of this paper is to get an empirical measure of the gain to trade liberalization rather than a measure of the incremental gain due to APEC. This paper does not compare APEC liberalization to trade liberalization under a multilateral GATT process. The results are likely to be similar as argued by Fane (1995). The issue of whether APEC gives additional gains relative to the GATT/WTO multilateral process or whether the APEC process would deliver the form of trade liberalization modelled in this paper is not addressed in this paper.

This study can be distinguished from other studies of APEC and trade liberalization of a more general nature such as in Dee and Walsh (1994), Hertel et al (1995), Huff et al (1995) Martin et al (1995) or Murtough et al (1994) because the model used in this paper is not from the class of static CGE models that have been used in these earlier studies. This study follows the alternative intertemporal macroeconomic approach focussing on the dynamic approach to trade

reform evaluated in Manchester and McKibbin (1995), McKibbin (1994a,1994b) using the MSG2 model and McKibbin and Salvatore (1995) using the GCUBED model.

The model used in this paper is derived from the GCUBED model developed by McKibbin and Wilcoxen (1992, 1995, 1996). Because of this link, this new model is named the Asia-Pacific GCUBED model (AP-GCUBED). As with the GCUBED model, this new model captures simultaneously the macroeconomic and sectoral linkages in a global model with partially forward looking asset market and spending decisions. The extension in the AP-GCUBED model is the extensive country disaggregation in the Asia-Pacific region. The AP-GCUBED model has country/regional disaggregation of: Korea, Japan, Thailand, Indonesia, China, Malaysia, Singapore, Taiwan, Hong Kong, Philippines, Australia, United States, Rest of the OECD, Oil exporting developing countries, Eastern Europe and Former Soviet Union and all other developing countries. Each country/region has an explicit internal macroeconomic and sectoral structure with sectoral disaggregation in production and trade into 6 sectors based on data from standardized input/output tables. McKibbin and Sundberg (1995) showed elsewhere using an extension of the MSG2 model that the sectoral composition of trade and production can be important for the nature of the transmission of shocks within the Asia-Pacific region. This paper supports and significantly extends that earlier analysis.

In this paper the modelling approach is developed in some detail. Because the innovative approach of this new modelling strategy may be unfamiliar to readers from particular schools of economic modelling, Section 2 gives an overview of where the new approach fits into the various traditional streams of modelling. The theoretical basis of the AP-GCUBED model is then summarized (further details and some evaluation of model properties including macroeconomic

and sectoral policy changes can be found in McKibbin and Wong (1996).

The alternative scenarios for trade liberalization are analyzed in section 3. This paper considers three alternatives for trade liberalization under the assumption that significant financial liberalization is already in place. The role of financial liberalization will be examined in a future paper. The first scenario is full APEC liberalization of trade in goods (excluding services) with industrialized economies removing trade barriers by 2010 and developing economies removing barriers by 2020. The second scenario is trade liberalization between APEC members on a preferential basis. The final scenario is trade liberalization among the ASEAN economies alone. This indicates the gains for ASEAN economies of being part of the APEC process.

A conclusion is presented in section 4. Trade liberalization whether through an APEC process or through multilateral negotiations at the WTO will likely lead to significant gains for the economies in the Asia Pacific region over the next 25 years.

2. Integrating Macroeconometric and CGE models for Examining Trade Policy

I. Alternative Approaches to Economic Modeling

Until recently, computable general equilibrium (CGE) models[2] and macro-econometric (ME) models[3] co-existed with very little interaction between the modelers in the two modelling

[2] These are also referred to as Applied General Equilibrium (AGE) models. Hereafter I will only use the term CGE models. See de Melo (1988), Robinson (1989) and Shoven and Whalley (1984) for an overview of CGE models. Examples of this approach include models by Dixon et al (1982), Whalley (1985), Deardorff and Stern (1985), Hertel et al (1995).

[3] See Bryant et al (1988) for a summary of the major multi-country macro-econometric models and a list of references relating to each model.

streams or very little cross fertilization of the two approaches[4]. Both modelling techniques have made significant contributions to understanding various empirical aspects of economies yet attempts to combine existing models from the different approaches have been unsuccessful.[5]

The distinction between the two approaches is much the same as that between microeconomic and macroeconomic theory. However, as the distinction between microeconomic and macroeconomic theory has blurred, so has the distinction between CGE models, which have begun to incorporate dynamics[6], and a new generation of macro-econometric models which are more firmly based on optimization theory[7]. In addition to the theoretical basis of the models there is also a significant range of techniques for parameterizing both schools of models. Parameters are either based on econometric estimates by the modelers or are "calibrated" by creating parameters that are based on "empirical evidence".

CGE models are derived from microeconomic optimization theory, with considerable attention to individual behavior whereas macro-econometric models are based on aggregate

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[4] Attempts have been made to reconcile the two approaches. See for example Powell (1981) and more recently Parsell, Powell and Wilcoxen (1989).

[5] A number of attempts to link macro-econometric models and CGE models do exist. See Cooper and McLaren (1983) for one such attempt using Australian models.

[6] The treatment of dynamics varies considerably across CGE models. Some are very simple while others are integrated more completely into behavior. Examples of dynamic CGE models include Burniaux et al (1991), Goulder and Eichengreen (1989) and Jorgenson and Wilcoxen (1990).

[7] The Multimod econometric model at the International Monetary fund outlined in Masson et al (1988) and the MSG2 multi-country model in McKibbin and Sachs (1991) are examples. It should be noted that the MSG2 model is very different to the MSG model that appears in Bryant et al (1988). That earlier model was a typical macroeconomic model whereas MSG2 is more like a dynamic CGE model.

behavior with reliance placed heavily on correlations found in time series of aggregate data. There is by now a vast literature containing applications of computable general equilibrium models. The reader is referred to papers by Dervis et. al. (1982), de Melo (1988), Robinson (1989) and Shoven and Whalley (1984) for a detailed overview of CGE models.

The CGE modeling work descends directly from the work of Arrow and Debreu (1954). These models use the Walrasian general equilibrium framework together with real world data to attempt to explain economic behavior. They contributed quantitative results to the theoretical literature on microeconomic general equilibrium analysis. Given the focus on individual optimization, the key parameters in these type of models are parameters such as expenditure shares and the elasticities of substitution of households and firms. These parameters are sometimes "calibrated" to a data set given an assumption about functional form of utility and production functions. Or they are estimated from extensive cross sectional data on households and firms. In addition to parameter calibration, it is often the case that the data behind the model is adjusted to be consistent with the equilibrium of the model.

The applied aspects of CGE modelling descend from the fixed coefficient work of Wassily Leontief. By using input-output tables constructed for fixed coefficient models, introducing relative prices and empirical evidence on substitution in production and consumption, the CGE approach added a new dimension to this earlier modelling strategy. An early example of this type of work is Johansen (1960).

With the focus on micro-economic theory, CGE models are particularly well suited to analyzing questions in tax policy and international trade (see Shoven and Whalley (1984)). In addition they have played an important role in the literature on economic development (see the

survey by de Melo et. al. (1982)).

The advantage of this approach is the transparency of the key mechanisms in many of the models. Also considerable sectoral detail can be handled and even the results from the larger models can be understood from theoretical intuition. One problem with this approach is interpreting the time horizon over which the results are relevant. This partly relates to how long it takes for markets to clear. The early static CGE models were used for comparative static analysis of the change between equilibria given a change in some policy. They were particularly useful for analyzing the long run effects of policies. Recent work has attempted to incorporate dynamics to allow for simple adjustment between equilibria (e.g. Bourgignon et al (1989), Burniaux et.al. (1991), and Feltenstein (1986)). However these extensions have usually had macroeconomic closures which are considered unsatisfactory by macro-economists. The absence of an aggregate price level or any role for money (or nominal exchange rate fluctuations) in particular is an important omission from most CGE models.

Other attempts to introduce dynamics through explicit intertemporal optimization of agents, such as papers by McKibbin (1986), Goulder and co-authors (1989,1990), Jorgenson and Wilcoxen (1990), McKibbin and Sachs (1991), McKibbin and Wilcoxen (1992), Laxton and Tetlow (1992), and Servin and Schmidt-Hebbel (1992) are more promising. The approaches by McKibbin and Sachs (1991) and McKibbin and Wilcoxen (1992) form the basis for the remainder of this paper.

In contrast to the approach taken in CGE models, the standard approach in macro-econometric models developed during the 1960s and 1970s was for macroeconomic theory to be used as a guide as to the appropriate variables to use in regression equations. These

variables were then tested and either included or excluded based on various tests of statistical significance. Because of the focus on aggregate relationships, it was rare that these models imposed the types of constraints across equations to satisfy conditions from microeconomic optimization theory. In some cases, the conditions of homogeneity were not even imposed. With fewer theoretical constraints or seldom any imposition of steady state conditions to impose stability, the larger econometric models tended to be explosive over long periods and were only really useful for simulations over short time horizons. This was less of a problem when the models were used for short term forecasting but was a fundamental problem for medium term policy analysis.

These macro-econometric models broke down empirically in the 1970s, in part because they relied on data periods in which events such as supply shocks were relatively unimportant. While these models were criticized for their poor tracking performance in the face of shocks that were not in their estimation sample, the Lucas Critique dealt a theoretical blow by pointing out the role of expectations and the need to worry about theoretical structure and policy regimes[8]. The modelling profession responded to this challenge by introducing rational expectations into a number of models. The multi-country models that incorporated the assumption of rational expectations such as the Liverpool, Taylor, MSG and Minimod (parent of Multimod) tended to be small models with relatively simple dynamics. This was partly due to the size constraints placed by the numerical techniques used to solve RE models. It was also because the long distributed lag structures in the traditional macroeconometric models made it virtually impossible to numerically solve these models including rational expectations. The main problem

[8] See Lucas (1973).

was that in many, if not all cases, these models were basically unstable. The instability which gradually appeared over a simulation horizon of a decade or less, manifested itself into the first year when attempting to introduce rational expectations. To give the saddle path stability that is required in rational expectations models required a tighter structure and more careful constraining of parameter estimates. Even today it is not a matter of size of models that prevents the use of rational expectations. The key problem is related to model stability. It is not that rational expectations was necessarily a desirable assumption to incorporate into these models. However, attempts to implement this assumption showed that the conventional style of macroeconometric model building produced models with medium term properties that were less transparent and less stable than more theoretically constrained models.

Global macro-econometric models that have been developed in the 1980s spanned the spectrum of macroeconomic and microeconomic theory with a variety of reliance on estimation versus calibration techniques. Models such as Multimod[9], Liverpool model[10], the Taylor Model[11] and perhaps GEM are closer to the microeconomic theory part of this spectrum than the derivative models of the large scale models of the 1970s such as the DRI, EPA, INTERLINK, LINK, MCM or WHARTON models[12]. The MSG model is close to the macroeconomic theory part because it is based on macroeconomic theory and is calibrated to a data set. The MSG2 model in contrast, lies closer to the microeconomic theory end of the spectrum because it has

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[9] See Masson et al (1988).

[10] See Minford et al (1986).

[11] See Taylor (1988).

[12] For an overview of these models see Bryant et al (1988).

explicit structural parameters and it is calibrated to a data set rather than estimated over a time series of data.

In building a new model such as undertaken for this paper, it is natural to ask which approach should be followed? Total or excessive reliance on aggregate data with very little regard to theoretical structure is the wrong modelling strategy to follow for a number of reasons. Firstly, the data at the aggregate level are so poor that theoretical restrictions are required for any useful analysis of the information contained in the data. Secondly many shocks we care about (e.g. German unification, the breakup of the Soviet Union, regime changes such as shifts from fixed to floating exchange rates, moving into or out of the EMS or the shift from exchange controls to free capital mobility etc.) are not in our data samples or at least not with sufficient numbers of observations. Thirdly, for a model to be useful in a practical sense, it must be able to adequately replicate the data to a significant extent but it also must be understandable so the user gets quantitative information and a better intuition of the main issues in any analysis. This suggests a tradeoff between constraining a model to a tight theoretical structure and following data-intensive approaches to modelling. There is also an apparent tradeoff between capturing macroeconomic phenomena and sectoral detail although we will show below that recent developments in dynamic general equilibrium modelling have apparently resolved this tradeoff. Estimated models that are to be used for policy work should, in full model simulation, be able to explain recent major events rather than just give a good single equation fit on average over a thirty year sample. We also need to understand the intuition as to why the results come out as they do. Theoretical models should be subject to these same evaluations. If they do not explain statistical relationships in the data or the consequences of large observed shocks then they are

not so useful for applied policy.

ii. The Theoretical Structure of the AP- GCUBED model

The AP-GCUBED multi-country model is based on the GCUBED model developed in McKibbin and Wilcoxen (1992, 1995, 1996). It combines the approach taken in the MSG2 model of McKibbin and Sachs (1991) with the disaggregated, econometrically-estimated, intertemporal general equilibrium model of the U.S. economy by Jorgenson and Wilcoxen (1989). The MSG2 model had one sector per country. The Jorgenson-Wilcoxen model breaks the economy down into 35 separate industries, each of which is represented by an econometrically estimated cost function. The GCUBED model was constructed to contribute to the current policy debate on global warming, trade policy and international capital flows, but it has many features that make it useful for answering a range of issues in environmental regulation, microeconomic and macroeconomic policy questions. It is a world model with substantial regional disaggregation and sectoral detail. In addition, countries and regions are linked both temporally and intertemporally through trade and financial markets. Like MSG2, GCUBED contains a strong foundation for analysis of both short run macroeconomic policy analysis as well as long run growth consideration of alternative macroeconomic policies. Intertemporal budget constraints on households, governments and nations (the latter through accumulations of foreign debt) are imposed. To accommodate these constraints, forward looking behavior is incorporated in consumption and investment decisions. Unlike MSG2, the GCUBED model also contains substantial sectoral detail. This permits analysis of environmental policies which tend to have their largest effects on small segments of the economy. By integrating

sectoral detail with the macroeconomic features of MSG2, GCUBED can be used to consider the long run costs of alternative environmental regulations yet at the same time consider the macroeconomic implications of these policies over time. The response of monetary and fiscal authorities in different countries can have important effects in the short to medium run which, given the long lags in physical capital and other asset accumulation, can be a substantial period of time. Overall, the model is designed to provide a bridge between computable general equilibrium models and macroeconomic models by integrating the more desirable features of both approaches. The AP-GCUBED model differs from the GCUBED model because of the focus on the Asia-Pacific region as well as having 6 sectors compared to 12 for GCUBED.

The AP-GCUBED model is still in the very early stages of development but it is already a large model. In its current form it contains 7,100 equations and 140 intertemporal costate variables. Nonetheless, it can be solved using software developed for a personal computer[13]. In addition, an extensive set of software exists that will permit the AP-GCUBED model to be used for game theoretic analysis of how one or more countries might respond strategically to unilateral policies adopted by other nations.

The key features of AP-GCUBED are summarized in Table 1. The country and sectoral breakdown of the model are summarized in Table 2. It consists of sixteen economic regions with six sectors in each region. The sixteen regions in AP-GCUBED can be divided into two groups: 13 core countries/regions and three others. For the core regions, the internal macroeconomic structure as well as the external trade and financial linkages are completely specified in the model. We begin by presenting the structure of a particular one of these economies: the United

[13] See the Computer manual by McKibbin (1995).

States. The other countries have similar structure and differ only in the values of behavioral parameters, so our description of the United States applies to the other industrial regions as well. This is more problematic for the countries in the Asia-Pacific Region. Our approach for these countries is to first model them assuming the theoretical structure we use for the "generic" country but calibrating each country to actual country data. We then propose to proceed country by country to impose institutional features, market structures, market failures or government regulations that

cause certain aspects of these economies to differ from our generic country model. In this paper we have only just begun this process, therefore the countries we represent in the region are endowed with resources, trading patterns, saving and investment patterns etc that are based on actual data for these countries but in many important ways may not be truly representative of these countries because of institutional factors that we are still implementing into the model.

Each core economy or region in the model consists of several economic agents: households, the government, the financial sector and the 6 production sectors listed in table 2. We now present an overview of the theoretical structure of the model by describing the decisions facing these agents. The reader is referred to McKibbin and Wilcoxen (1995,1996) for more details on the GCUBED model and McKibbin and Wong (1996) for the AP-GCUBED Model.

A key aspect of the model is the integration of data from input-output tables with conventional macroeconomic data. An example of an interindustry accounting matrix and the relationship between sectoral and aggregate data is shown in figure 1. This data mapping lies behind the behavioral assumptions which follow. In the top left hand quadrant is a 6 X 6 matrix which tracks the flows of goods between the 6 sectors in country k. The first column contains the

number of each industry. Each row corresponds to the use of an industry's output. The first six elements of the row is the use of an industry's output in each of the twelve industries. To the right of this is the use of each industry's good for Consumption (C), Investment (I), Government purchases (G), exports (X) and imports (IM) from foreign countries of the same good to satisfy domestic demand. For example the first row is the production of sector 1 good. This output is used by the industry columns 1 through 6 representing use by each other sector and also for final demand. For each industry there is a row which gives similar information. Below the six sectors in the lower left hand corner, are the uses of the primary factors of production: sector specific resources (R), Capital (K) and labor (L). Note that some capital and labor are used in final consumption, investment and government spending. Gross output of sector 1 is the sum of each element along a row. The sum across the columns of final demand for each row gives the value added of that sector. Gross output for sector 1 is also the sum of each element of a column, since the value of inputs equals the value of outputs.

Table 1: Summary of Main Features of AP-GCUBED

☻ Specification of the demand and supply sides of economies;

☻ Integration of real and financial markets of these economies;

☻ Intertemporal accounting of stocks and flows of real resources and financial assets;

☻ Imposition of intertemporal budget constraints so that agents and countries cannot forever borrow or lend without undertaking the required resource transfers necessary to service outstanding liabilities;

☻ Short run behavior is a weighted average of neoclassical optimizing behavior and ad-hoc "liquidity constrained" behavior;

☻ The real side of the model is disaggregated to allow for production and trade of multiple goods and services within and across economies;

☻ Full short run and long run macroeconomic closure with macro dynamics at an annual frequency around a long run Solow/Swan/Ramsey neoclassical growth model.

☻ The model is solved for a full rational expectations equilibrium at an annual frequency from 1995 to 2100.

Table 2: Overview of the AP-GCUBED Model

Regions

United States
Japan
Australia
Rest of the OECD
Korea
Thailand
Indonesia
China
Malaysia
Singapore
Taiwan
Hong Kong
Philippines
Oil Exporting Developing Countries
Eastern Europe and the former Soviet Union
Other Developing Countries

Sectors

Energy
Mining
Agriculture
Durable Manufacturing
Non-Durable Manufacturing
Services

a. Firms

Each of the six sectors is represented by a single firm in each sector which chooses its inputs and its level of investment in order to maximize its stock market value subject to a multiple-input production function and a vector of prices it takes to be exogenous. The nesting for the production decision is set out in Figure 2. For each sector h, output (Q_h) is produced with inputs of capital (K_h), labor (L_h), energy (E_h), materials (M_h) and a sector-specific resource (R_h). The nature of the sector specific resource varies across sectors. For example in agriculture and mining it is land which is substitutable between these two sectors.[14]. Energy and materials are an aggregate of inputs of intermediate goods. These intermediate goods are, in turn, aggregates of imported and domestic commodities which are taken to be imperfect substitutes. Due to data limitations we assume that all agents in the economy have identical preferences over foreign and domestic varieties of each particular commodity. We represent these preferences by defining twelve composite commodities that are produced from imported and domestic goods. For commodity h the production function for composite good Y_h in terms of domestic output Q_h and imported good IM_h. For example, agricultural products purchased by agents in the model are a composite of imported and domestic agricultural products. By constraining all agents in the model to have the same preferences over the origin of goods, we require that (for example) the agricultural and service sectors have the identical preferences over domestic energy and energy

[14] In the version of the model in this paper there is assumed to be an infinite supply of these resources but in future papers the authors intend to explore the implications of exhaustible resources and sequestration of land for tree planting etc.

imported from the middle east.[15] This accords with the input-output data we use and allows a very convenient nesting of production, investment and consumption decisions.

Following the approach in the MSG2 model, we assume that the capital stock in each sector changes according to the rate of fixed capital formation and the rate of geometric depreciation. The investment process is assumed to be subject to rising marginal costs of installation, with total real investment expenditures in sector h equal to the value of direct purchases of investment plus the per unit costs of installation. These per unit costs, in turn, are assumed to be a linear function of the rate of investment. One advantage of using an adjustment cost approach is that the adjustment cost parameter can be varied for different sectors to capture the degree to which capital is sector specific.

The goal of each firm is to choose inputs of labor, energy, materials and sector specific resources to maximize intertemporal net-of-tax profits. For analytical tractability, this problem is assumed to be deterministic (in other words, the firm is assumed to believe its estimates of future variables with subjective certainty) subject to constraints on capital accumulation and cost function. Solving the optimization problem facing this representative firm, gives the set of derived demands for factors of production. These factors (L, E, and M are hired to the point where the marginal productivity of these factors equals their prices relative to the output price of the sector. We can also use these factor demand equations together with the production function to rewrite the model in terms of cost functions. In this case the price of the output at each level of the tier structure will be a function of the price of variable inputs and the quantities of

[15] This does not require that both sectors purchase the same amount of oil, or even that they purchase oil at all; only that they both feel the same way about the origins of oil they buy.

available fixed factors (such as capital).

The price of labor is determined by assuming that labor is mobile between sectors in each region, but is immobile between regions. Thus, wages will be equal across sectors[16]. The wage is assumed to adjust according to an overlapping contracts model where nominal wages are set based on current and expected inflation and on labor demand relative to labor supply. In the long run, labor supply is given by the exogenous rate of population growth, but in the short run, the hours worked can fluctuate depending on the demand for labor. For a given nominal wage, the demand for labor will determine short run unemployment in each industry. This will vary across industries depending on the composition of demand for each sectors good.

The solution of the optimization problem also gives that the rate of gross investment in sector h is a function of "Tobin's q" for that sector. Following the MSG2 model, it is assumed that investment in each sector is a weighted average of forward looking investment and investment out of current profits.

So far, we have described the demand for investment by each sector. Investment goods are assumed to be supplied by a firm facing an optimization problem similar to those of the twelve industries described above (and not repeated here). Like other industries, the investment sector demands labor and capital services as well as intermediate inputs. The investment column in the input-output table is used to parameterize the investment sector's production function. As with the discussion above, there is a shadow "q" associated with investment in the investment goods sector.

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[16] In future developments of the model we propose to introduce an adjustment cost model of labor mobility.

b. Households

Households consume a basket of composite goods and services in every period and also demand labor and capital services. Household capital services consist of the service flows of consumer durables plus residential housing. Households receive income by providing labor services to firms and the government, and from holding financial assets. In addition, they also receive transfers from the government.

The behavior of a representative household can be thought of as a sequence of decisions. Households first decide on aggregate consumption for each period. Once this is determined expenditure is allocated across goods and services based on preferences and relative prices. We use a nested constant elasticity of substitution utility function, so income elasticities will be unity and price elasticities can differ from unity.[17] Aggregate household consumption is nested as shown in Figure 3. Total private consumption is allocated between capital, labor, a basket of energy goods and a basket of non-energy goods. Materials are a sub-aggregate of intermediate goods.

Aggregate consumption is chosen to maximize an intertemporal utility function subject to the constraint that the present value of consumption be equal to human wealth plus initial financial assets. Human wealth in real terms is defined as the expected present value of future stream of after tax labor income of households. Financial wealth is the sum of real money balance, real government bonds in the hand of the public, net holding of claims against foreign residents and the value of capital in each sector. The solution to this maximization problem is

[17] In the preliminary version of the model presented here, the elasticities of substitution are assumed to be unity. We are in the process of estimating the elasticities econometrically using a long time series of input-output data.

the familiar result that aggregate consumption is equal to a constant proportion of private wealth, where private wealth is defined as financial wealth plus human wealth. However, based on the evidence cited by Campbell and Mankiw (1987) and Hayashi (1982)) we follow the approach in the MSG2 model and assume that only a portion of consumption is determined by these intertemporally-optimizing consumers and that the remainder is determined by after tax current income. This can be interpreted as liquidity constrained behavior or a permanent income model in which household expectations regarding income are backward-looking. Either way we assume that total consumption is a weighted average of the forward looking consumption and backward-looking consumption.

Once the level of overall consumption has been determined, spending is allocated among goods and services. Households demand each of the model's 12 commodities and also demand labor and capital services. Household capital services consist of the service flows of consumer durables plus residential housing. The result is a system of household demand equations which depend on the level of aggregate consumption and the price of the individual goods relative to the price of the consumption basket.

The solution for the consumption of capital services is a little more complex. Here we assume that consumers invest in household capital in order to generate a desired flow of capital services subject to the accumulation equation for capital and a cost of adjustment model. Solving this problem yields results similar to those discussed for firms above. However, since no variable factors are used in producing capital services, the first order conditions for the problem give investment as a function of the shadow price of capital. The demand for capital services arising in the household consumption problem determines the price of capital services given the

supply of services. The stock of household capital at each point in time is determined by the initial stock of capital, the rate of depreciation and the rate of gross investment in the stock of capital. In the same way that investment by firms is determined, the investment by households depends on the Tobin's q associated with the stock of household capital.

c. Government

We take each region's real government spending on goods and services to be exogenous and assume that it is allocated among final goods, services and labor in fixed proportions, which we set to 1987 values. Total government outlays include purchases of goods and services plus interest payments on government debt, investment tax credits and transfers to households. Government revenue comes from sales, corporate and personal income taxes, and by issuing government debt. We assume that agents will not hold government bonds unless they expect the bonds to be paid off eventually. This transversality condition implies that the current level of debt will be equal to the present value of future budget surpluses.[18]

The implication of these constraints is that a government running a budget deficit today must run an appropriate budget surplus as some point in the future. Otherwise, the government would be unable to pay interest on the debt and agents will not be willing to hold it. To ensure that the constraint holds at all points in time we assume that the government levies a lump sum

[18] Strictly speaking, public debt must be less than or equal to the present value of future budget surpluses. For tractability we assume that the government is initially fully leveraged so that this constraint holds with equality.

tax in each period equal to the value of interest payments on the outstanding debt.[19] In effect, therefore, any increase in government debt is financed by consols, and future taxes are raised enough to accommodate the increased interest costs. Thus, any increase in the debt will be matched by an equal present value increase in future budget surpluses. Other fiscal closure rules are possible, such as requiring the ratio of government debt to GDP to be unchanged in the long run. These closures have interesting implications but are beyond the scope of this paper.

d. Financial Markets and the Balance of Payments

The sixteen regions in the model are linked by flows of goods and assets. Flows of goods are determined by the import demands described above. These demands can be summarized in a set of bilateral trade matrices which give the flows of each good between exporting and importing countries. There is one 16 by 16 trade matrix for each of the six goods.

Trade imbalances are financed by flows of assets between countries (except where capital controls are in place). We assume asset markets are perfectly integrated across the OECD regions. With free mobility of capital, expected returns on loans denominated in the currencies of the various regions must be equalized period to period according to an uncovered interest parity condition. While we allow for exogenous risk premium in the calibration of the model there is no allowance for endogenous risk premia on the assets of alternative currencies. For the experiments in this paper we assume open capital markets in each of the APEC countries. This therefore assumes a good deal of financial liberalization as part of the trade reforms.

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[19] In the model the tax is actually levied on the difference between interest payments on the debt and what interest payments would have been if the debt had remained at its base case level. The remainder, interest payments on the base case debt, is financed by ordinary taxes.

Determining initial net asset positions and hence base-case international capital flows is non-trivial. We assume that capital flows are composed of portfolio investment, direct investment and other capital flows. These alternative forms of capital flows are perfectly substitutable ex ante, adjusting to the expected rates of return across economies and across sectors. Within an economy, the expected return to each type of asset (i.e. bonds of all maturities, equity for each sector etc) are arbitraged, taking into account the costs of adjusting physical capital stock and allowing for exogenous risk premia. Because physical capital is costly to adjust, any inflow of financial capital that is invested in physical capital (i.e. direct investment) will also be costly to shift once it is in place. The decision to invest in physical assets is based on expected rates of return. However, if there is an unanticipated shock then ex-post returns could vary significantly. Total net capital flows for each economy in which there are open capital markets are equal to the current account position of that country. The global net flows of private capital are constrained to zero.

We treat the OPEC region differently to the regions which have full internal structures. We assume that OPEC chooses its foreign lending in order to maintain a desired ratio of income to wealth.

e Data, Parameterization and Model Solution

The data used in the AP-GCUBED model comes from a number of sources. Unlike the GCUBED model we have not yet estimated the CES production elasticities of substitution. We currently assume the production function are Cobb-Douglas.

The input-output tables for the Asia-Pacific economies are from the Institute of

Developing Economies. The Australian table is from the Australian Bureau of Statistics. In lieu of obtaining input-output tables for the aggregate ROECD region, we currently create the tables for this region based on the U.S. table and adjusted for actual final demand components from aggregate ROECD macroeconomic data. In effect, we are assuming that all countries modeled share the same production technology but differ in their endowments of primary factors and patterns of final demands. This assumption is a temporary necessity while we complete construction of the AP-GCUBED database.

Trade shares are based on the United Nations SITC (Standard Industry Trade Classification) data for 1987 with sectors aggregated from 4 digit levels to map as closely as possible to the SIC (Standard Industry Classification) used in the U.S. input/output data[20]. This data is from the International Economic Databank at the ANU.

The parameters on shares of optimizing versus backward looking behavior are taken from the MSG2 model. These are based on a range of empirical estimates as well as a tracking exercise used to calibrate the MSG2 model to the experience of the 1980s.

AP-GCUBED is solved using the same software as the MSG2 model The model has approximately 7,400 equations in its current form with 140 jumping or forward looking variables, and 263 state variables.

3. Results for Trade Liberalization

[20] A full mapping of SITC and SIC codes is contained in a technical appendix available from the authors by request.

In this section we use the model described above to simulate three scenarios. The first scenario is non discriminatory reduction in trade barriers by APEC economies (MFN liberalization). It is assumed that each industrialized economy in APEC cuts protection on goods beginning in 1995. The cuts in each period are gradually phased in such that our measures of protection are equal to zero by 2010. For developing economies we assume the same linear reduction but with a terminal date of 2020. The size of cuts depends on the initial levels of tariffs. These are shown in table 3 and are based on the WTO/World Bank database. This table shows that there are significant differences in the level of protection across countries as well as across sectors within a country. This asymmetry in the cuts suggests that relative price changes within economies will be important in the adjustment process and therefore a sectoral disaggregation is important for analyzing APEC trade policy.

The second policy is the same as the first except that the cuts are made on a preferential basis (APEC free trade area). Thus the tariff rates remain unchanged for trade with non APEC members but are reduced the same as in scenario 1 for APEC members only. The third scenario is where only ASEAN members cut their level of protection in a non preferential way (Asean Free Trade Area).

Table 3: Initial Tariff Rates

	Agriculture	Energy	Mining	Durable Manufacturing	Non Durable Manufacturing
United States	6.7	0.5	0.0	8.5	26.2
Japan	148.8	1.1	0.6	4.9	59.4
Australia	1.9	0.7	0.7	13.9	15.2
Indonesia	11.0	1.5	2.4	16.4	11.4
Malaysia	104.0	2.5	3.5	13.7	57.4
Philippines	104.0	5.8	10.2	24.1	63.3
Singapore	9.9	2.1	0.0	0.2	9.6
Thailand	107.6	6.9	10.9	33.4	70.5
China	16.7	14.0	18.7	45.1	43.5
Taiwan	12.6	14.3	23.5	39.3	42.1
Korea	105.0	2.8	4.4	16.0	41.0
Hong Kong	0.0	0.0	0.0	0.0	0.0

Source: Centre for International Economics aggregations based on WTO/World Bank data.

Results for each scenario are presented in Table 4 through 8 for full liberalization, Table 9 through 13 for preferential liberalization and Table 14 through 18 for ASEAN liberalization. Some comparative results are also presented in figures 4 and 5.

The results in each table are the percentage deviation of a range of variables from what otherwise would have occurred along the baseline projection of the model without any trade

liberalization. This assumes that the GATT/WTO negotiations do not lead to any changes in rates of protection along the baseline path which is obviously a crucial simplification. Indeed the results of scenario 1 of this paper could equally be interpreted as a WTO induced liberalization rather than APEC liberalization.

The variables presented are: real gross domestic product (GDP); real consumption; real investment; real exports; and the current account expressed as percent of baseline GDP deviation. In figure 4 and 5 we present the results for a single year, 2020, for GDP and consumption across each of the three scenarios. This gives a comparison of the distribution of gains in production and consumption at a point in time. This is not the long run result that compares with static studies but the point at the end of the liberalization process.

It is important to stress that macroeconomic policy is assumed not to respond to undesirable fluctuations in short run economic activity. Monetary policy is assumed to be targeting a stock of nominal money balances in each economy. Fiscal policy is defined as a set of fixed tax rates and government spending constant in real terms. With higher output, tax revenues rise implying a move towards fiscal surplus in each economy. Although not examined in this paper, some of the longer term gains in real activity would be reduced if the endogenous rise in government saving was offset by greater government spending.

Now consider the results presented in Table 4 through 19. Table 4 contains result for real GDP. For example this shows that real GDP in Japan by 2020 is projected to be 0.1 percent higher than otherwise would have been the case. This is a measure of the production implications of the APEC trade reforms. It is not a measure of welfare because income relates to the ownership of factors of production and not where a they are use in production. As part of the

simulation capital flows from Japan to the other Asian economies raising income for owners of capital in Japan but not necessarily raising production in Japan, since the production will occur where the capital has located. Thus real consumption presented in table 5 is a better measure of welfare since it is more closely related to income.

Several points emerge from tables 4 and 5 which are supplemented by the other tables for scenario 1. By 2020, production in all economies is higher as a result of APEC. The size of the change varies across countries but it is linked to the degree of trade reform. Those countries that undertake the most trade liberalization realize the largest gains in terms of GDP and consumption. Secondly the consumption gains are larger than the production gains because of the fall in the price that consumers pay for products. Thirdly although the longer run gains are positive (consistent with other studies) in the very short run there are negative effects in some economies. This occurs because in the short run factors of production are relocated in response to the policy announcements. However, this cannot be done instantly and therefore there is short run dislocation of production in some economies. Our assumption of macroeconomic policies are crucial here because it is assumed that the macroeconomic policies are not adjusted in response to the fluctuations in economic activity. With an adjustment of macroeconomic policies, some of the short run negative effects could be offset.

Apart from the domestic reallocation of factors of production, the policy announcement causes a change in expected rates of return within different sectors within economies. This leads to movements of domestic factors of production and a rapid movement of international financial capital. The financial flows lead to changes in physical investment which over time raises the capital stock in a number of sectors. In particular financial capital flows from the countries that

are not undertaking large reforms, in particular the United States, into the other economies that are undertaking large reforms. This leads to a depreciation of the US dollar in real and nominal terms which improves the US trade balance and the current account. Indeed the improvement in the current account is the mirror image of the capital outflow. This capital outflow from the United States which also occurs from Japan and Australia is a capital inflow for the rapid liberalizing developing countries in the APEC group.

The extent of gains from APEC depends on the size of the liberalization, the linkage between sectors within economies, the extent to which goods from certain sectors are demanded by other economies whose income rise, the reaction of macroeconomic policies and a range of other channels which are captures through empirical relationships in the model.

Preferential liberalization is presented next in table 9 through 13. In this case only tariff s on goods from other APEC members are reduced over time. The adjustment story is very similar to the previous simulation except the magnitude of results are reduced. This partly reflects the smaller fall in consumer prices as well as the smaller fall in the price of imported capital goods that come from Europe and other non APEC economies. Thus incomes and capital investment rise by less in the preferential APEC case.

Finally results for liberalization in ASEAN economies are presented in tables 14 through 18. In the ASEAN economies, the gains are still substantial although less than for full APEC liberalization. This implies that ASEAN economies gain from other liberalization in other economies but most of the gains are from their own actions. It is also clear than GDP of non ASEAN economies is only very slightly affected by ASEAN liberalization. There is more effect on non ASEAN consumption because again of the higher returns to foreign capital that is

repatriated to non ASEAN economies and used for consumption. Again there are positive effects on real exports of all economies but this does not necessarily lead to significantly higher output in these economies because exports are a relatively small share of GDP.

A comparison of the three scenarios for GDP and consumption in the year 2020 are shown in figures 4 and 5. It is clear from these figures that full APEC liberalization is better for each country shown that the other alternatives. It is also clear that the consumption gains are larger and more evenly spread that the production gains. This is not surprising given that the production reallocations follow the improvements in resource allocation in different sectors in different economies, whereas the consumption gains accrue to the owners of factors of production wherever they are located.

5. Conclusion

We have presented a framework for analyzing macroeconomic and sectoral linkages within the Asia-Pacific region and the global economy. We still have a good deal of work ahead in adapting the model to replicate the particular institutional and market features of the individual countries in the region, but we feel that the results to date form a useful benchmark from which to proceed.

Using this new dynamic framework several insights emerge. The first is that a policy such as APEC trade liberalization announced in advance of implementation can have significant effects on international capital flows and through this mechanism affects real exchange rates and trade flows. Allowing for the adjustment international capital flows shows that some common perceptions in industrial economies of the effect of opening up to trade with developing

economies need to be re-evaluated.. Rather than experiencing a flood of low cost goods from developing countries, the adjustment of financial capital into these developing economies in anticipation of significant return to liberalization, can lead to a real exchange rate appreciation in these economies which results in a trade balance surplus for the countries providing the capital and trade deficit in the countries attracting the capital. This phenomena was apparent in Mexico after 1989 in response to NAFTA[21]. Thus for example, the US and Japanese current accounts improve as a result of a weaker dollar and yen as capital flows out of these economies. Trade volumes nonetheless rise as a result of the trade liberalization even though there are very different net balance effects. The more efficient allocation of resources leads to some dispersion in production in different regions but more uniform income gains.

In the longer run as found in other studies, incomes throughout the world rise as a result of trade liberalization. In the short run however there are offsetting factors at work. The process of reallocating factors of production in economies in response to the change in price signals can lead to short run underutilization of resources. Whether this effect dominates depends on the extent of rigidities in economies and the extent of factor reallocation required. To the extent that there are short run adjustment problem, there is room for adjustment of macroeconomic policies. We have not focussed on that in this paper but the reader should refer to McKibbin and Wong (1996) for an analysis of fiscal and monetary policy using this model.

The other lesson from this paper is that to the extent that the Bogor Declaration (or trade liberalization in general) is taken as credible, international financial markets may well begin adjusting in advance of the actual implementation of the policies. Policy makers will need to be

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[21] See Manchester and McKibbin (1995).

aware of these adjustments which could imply large changes in current account balances and real exchange rates. To the extent that the financial capital flows into economies undertaking large policy reforms, the accumulation of physical capital that results from this process can help smooth the adjustment to a new long run equilibrium and indeed this can bring forward some of the gains of the APEC process. To the extent that countries place barriers in the way of these international flows of capital, the gains are postponed.

This study illustrates that the major gainers from the reduction of barriers to trade are the consumers in the countries that reduce the barriers. There are positive spillovers from liberalization but most of the gains depend on the extent to which a country reduces trade barriers.

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Table 4: Real GDP Consequences of Full APEC Liberalization
(% deviation from baseline)

	1995	2000	2005	2010	2020
United States	-0.0	-0.0	0.1	0.2	0.3
Japan	-0.0	0.1	0.2	0.2	0.1
Australia	-0.1	0.1	0.4	0.7	0.8
Indonesia	0.0	0.1	0.7	1.6	3.5
Malaysia	-0.0	0.4	0.6	0.8	1.1
Philippines	-0.0	0.1	0.4	0.8	1.4
Singapore	0.2	0.6	0.8	0.9	0.7
Thailand	-0.0	0.1	0.6	1.1	2.3
China	-0.3	0.0	0.2	0.4	0.9
Taiwan	-0.0	0.5	1.0	1.4	1.1
Korea	0.0	0.3	0.7	1.0	1.0
Hong Kong	0.1	0.2	0.4	0.5	0.5

Source: Simulations from AP-Gcubed Model

Table 5: Real Consumption Consequences of Full APEC Liberalization
(% deviation from baseline)

	1995	2000	2005	2010	2020
United States	-0.3	-0.1	0.6	1.3	1.7
Japan	-0.1	0.4	1.0	1.6	1.4
Australia	-0.5	0.0	1.0	2.1	2.0
Indonesia	0.2	0.8	2.2	3.8	6.6
Malaysia	-0.5	1.9	4.1	6.2	9.1
Philippines	-0.5	0.2	1.5	2.9	5.7
Singapore	6.0	12.2	14.2	13.8	6.9
Thailand	-0.8	0.5	2.6	4.6	8.3
China	-1.9	-0.6	0.8	2.1	4.4
Taiwan	-0.5	2.8	5.8	8.4	6.4
Korea	-0.1	1.6	3.6	5.4	4.4
Hong Kong	1.7	3.2	3.8	3.8	3.2

Source: Simulations from AP-Gcubed Model

Table 6: Real Investment Consequences of Full APEC Liberalization
(% deviation from baseline)

	1995	2000	2005	2010	2020
United States	-3.1	-0.1	1.8	3.9	3.4
Japan	-0.2	0.3	0.6	1.0	0.8
Australia	-2.5	0.7	3.3	6.0	5.3
Indonesia	0.3	2.3	4.8	6.9	10.7
Malaysia	0.2	1.2	1.9	2.5	4.0
Philippines	-1.0	0.6	1.8	2.9	6.1
Singapore	2.9	1.8	1.7	1.5	1.2
Thailand	-0.6	0.6	1.7	2.6	4.5
China	-2.6	-1.1	-0.4	0.2	2.8
Taiwan	0.6	2.5	4.4	6.1	5.2
Korea	0.3	1.0	1.7	2.4	1.9
Hong Kong	1.7	1.5	1.7	1.9	2.1

Source: Simulations from AP-Gcubed Model

Table 7: Real Export Consequences of Full APEC Liberalization
(% deviation from baseline)

	1995	2000	2005	2010	2020
United States	2.1	5.3	9.2	13.0	13.3
Japan	0.3	3.2	6.8	10.5	11.1
Australia	1.1	4.6	8.9	13.2	14.6
Indonesia	-0.4	0.5	2.1	4.1	7.3
Malaysia	0.0	2.3	5.3	8.4	12.2
Philippines	1.1	5.7	11.5	17.3	22.1
Singapore	-1.7	-0.3	2.0	4.7	7.4
Thailand	0.9	3.2	6.2	9.7	14.3
China	4.0	7.7	12.4	17.3	23.2
Taiwan	-0.0	3.4	8.0	13.0	14.4
Korea	-0.2	2.8	6.6	10.6	11.6
Hong Kong	-0.6	1.8	5.0	8.6	11.5

Source: Simulations from AP-Gcubed Model

Table 8: Current Account Consequences of Full APEC Liberalization
(% of baseline GDP from baseline)

	1995	2000	2005	2010	2020
United States	0.2	0.3	0.3	0.2	0.3
Japan	0.1	0.1	-0.0	-0.1	-0.1
Australia	0.4	0.2	-0.0	-0.3	-0.3
Indonesia	-0.1	-0.4	-0.8	-1.2	-2.2
Malaysia	0.2	-0.1	-0.3	-0.6	-1.6
Philippines	0.3	0.4	0.5	0.5	0.2
Singapore	-2.7	-4.3	-5.0	-4.8	-3.4
Thailand	0.5	0.2	-0.3	-0.8	-2.1
China	1.3	1.0	0.7	0.3	-1.2
Taiwan	0.2	-0.6	-1.5	-2.3	-2.1
Korea	0.0	-0.3	-0.7	-1.0	-0.9
Hong Kong	-1.2	-2.0	-2.5	-2.6	-2.2

Source: Simulations from AP-Gcubed Model

Table 9: Real GDP Consequences of Preferential APEC Liberalization
(% deviation from baseline)

	1995	2000	2005	2010	2020
United States	-0.0	0.0	0.1	0.1	0.2
Japan	0.0	0.1	0.1	0.2	0.1
Australia	-0.0	0.1	0.3	0.5	0.6
Indonesia	0.1	0.2	0.7	1.3	2.7
Malaysia	-0.0	0.4	0.6	0.7	0.9
Philippines	0.0	0.2	0.5	0.8	1.2
Singapore	0.3	0.5	0.7	0.8	0.6
Thailand	0.0	0.2	0.5	0.9	1.8
China	-0.2	0.1	0.2	0.4	0.7
Taiwan	0.1	0.4	0.8	1.1	0.9
Korea	0.0	0.3	0.6	0.8	0.8
Hong Kong	0.1	0.2	0.3	0.4	0.4

Source: Simulations from AP-Gcubed Model

Table 10: Real Consumption Consequences of Preferential APEC Liberalization
(% deviation from baseline)

	1995	2000	2005	2010	2020
United States	-0.0	0.1	0.4	0.8	1.1
Japan	0.1	0.4	0.7	1.0	0.9
Australia	-0.1	0.2	0.8	1.3	1.3
Indonesia	0.5	0.9	1.9	3.0	4.8
Malaysia	-0.1	1.8	3.5	4.9	7.1
Philippines	-0.0	0.6	1.5	2.4	4.4
Singapore	6.8	11.1	12.3	11.6	6.0
Thailand	-0.2	0.8	2.2	3.5	5.9
China	-1.0	-0.1	0.7	1.5	2.9
Taiwan	0.1	2.4	4.5	6.3	5.0
Korea	0.2	1.5	2.8	4.1	3.4
Hong Kong	1.8	3.1	3.5	3.3	2.6

Source: Simulations from AP-Gcubed Model

Table 11: Real Investment Consequences of Preferential APEC Liberalization
(% deviation from baseline)

	1995	2000	2005	2010	2020
United States	-0.9	0.4	1.3	2.4	2.2
Japan	0.4	0.5	0.6	0.7	0.5
Australia	-0.7	1.1	2.6	4.1	3.8
Indonesia	1.0	2.3	4.0	5.4	7.8
Malaysia	0.6	1.2	1.8	2.1	3.4
Philippines	0.2	1.1	1.9	2.5	4.7
Singapore	2.9	1.7	1.6	1.4	1.1
Thailand	-0.0	0.7	1.4	2.1	3.4
China	-1.3	-0.5	-0.1	0.2	1.7
Taiwan	1.4	2.5	3.8	5.1	4.4
Korea	0.5	1.0	1.4	1.8	1.5
Hong Kong	1.9	1.6	1.7	1.7	1.8

Source: Simulations from AP-Gcubed Model

Table 12: Real Export Consequences of Preferential APEC Liberalization
(% deviation from baseline)

	1995	2000	2005	2010	2020
United States	0.4	2.3	4.6	6.7	6.7
Japan	-0.6	2.0	5.2	8.5	9.0
Australia	0.3	3.1	6.5	9.9	11.0
Indonesia	-0.5	0.4	1.9	3.9	6.2
Malaysia	-0.2	1.8	4.4	7.2	10.2
Philippines	0.2	4.3	9.4	14.7	18.1
Singapore	-1.6	-0.1	2.0	4.5	6.9
Thailand	0.2	2.0	4.5	7.3	10.6
China	2.1	5.2	9.1	13.1	17.1
Taiwan	-0.3	2.5	6.3	10.4	11.4
Korea	-0.4	2.1	5.3	8.7	9.4
Hong Kong	-0.8	1.4	4.4	7.7	10.1

Source: Simulations from AP-Gcubed Model

Table 13: Current Account Consequences of Preferential APEC Liberalization
(% of baseline GDP from baseline)

	1995	2000	2005	2010	2020
United States	0.1	0.1	0.2	0.2	0.3
Japan	-0.1	-0.1	-0.1	-0.1	-0.0
Australia	0.1	0.0	-0.0	-0.2	-0.1
Indonesia	-0.3	-0.5	-0.7	-1.0	-1.6
Malaysia	-0.1	-0.2	-0.3	-0.4	-1.2
Philippines	0.0	0.1	0.2	0.3	0.1
Singapore	-2.8	-3.9	-4.3	-4.1	-2.9
Thailand	0.1	-0.1	-0.5	-0.8	-1.6
China	0.6	0.5	0.3	0.1	-0.8
Taiwan	-0.1	-0.7	-1.2	-1.6	-1.5
Korea	-0.2	-0.4	-0.6	-0.7	-0.6
Hong Kong	-1.2	-1.9	-2.3	-2.2	-1.8

Source: Simulations from AP-Gcubed Model

Table 14: Real GDP Consequences of ASEAN Liberalization
(% deviation from baseline)

	1995	2000	2005	2010	2020
United States	0.0	0.0	0.0	0.0	0.0
Japan	0.0	0.0	0.0	0.0	0.0
Australia	-0.0	0.0	0.0	0.0	-0.0
Indonesia	-0.0	0.1	0.6	1.3	3.0
Malaysia	-0.0	0.2	0.4	0.5	0.8
Philippines	-0.1	-0.2	-0.0	0.2	0.8
Singapore	0.1	0.3	0.3	0.4	0.3
Thailand	-0.1	-0.0	0.3	0.8	1.9
China	-0.0	0.0	0.0	0.0	0.0
Taiwan	-0.0	0.0	0.0	0.0	0.0
Korea	-0.0	0.0	0.0	0.0	0.0
Hong Kong	-0.0	0.0	0.0	0.0	0.0

Source: Simulations from AP-Gcubed Model

Table 15: Real Consumption Consequences of ASEAN Liberalization
(% deviation from baseline)

	1995	2000	2005	2010	2020
United States	0.0	0.0	0.0	0.0	0.1
Japan	0.0	0.0	0.0	0.0	0.0
Australia	0.0	0.0	0.0	0.0	0.0
Indonesia	-0.1	0.3	1.5	2.9	5.4
Malaysia	-1.1	0.8	2.7	4.4	7.2
Philippines	-1.1	-0.7	0.5	1.8	4.9
Singapore	2.0	5.4	6.6	6.7	3.7
Thailand	-1.4	-0.4	1.7	3.8	7.7
China	0.0	0.0	0.1	0.1	0.1
Taiwan	0.1	0.1	0.1	0.2	0.1
Korea	0.0	0.0	0.0	0.1	0.1
Hong Kong	0.0	0.2	0.3	0.3	0.3

Source: Simulations from AP-Gcubed Model

Table 16: Real Investment Consequences of ASEAN Liberalization
(% deviation from baseline)

	1995	2000	2005	2010	2020
United States	0.0	0.0	0.0	0.0	0.1
Japan	0.0	0.0	0.0	0.0	-0.0
Australia	-0.0	-0.0	-0.0	-0.1	-0.1
Indonesia	-0.5	1.5	3.6	5.7	9.6
Malaysia	-1.0	0.1	0.8	1.5	3.0
Philippines	-2.8	-1.2	0.1	1.5	4.8
Singapore	1.0	0.6	0.5	0.4	0.3
Thailand	-1.2	0.0	1.0	2.0	4.0
China	0.0	0.0	-0.0	-0.0	-0.0
Taiwan	0.1	0.1	0.1	0.0	0.0
Korea	0.0	0.0	0.0	-0.0	-0.0
Hong Kong	0.0	0.0	0.0	0.0	0.0

Source: Simulations from AP-Gcubed Model

Table 17: Real Export Consequences of ASEAN Liberalization
(% deviation from baseline)

	1995	2000	2005	2010	2020
United States	-0.0	0.1	0.2	0.3	0.4
Japan	-0.0	0.1	0.2	0.4	0.6
Australia	0.1	0.3	0.6	0.8	1.2
Indonesia	0.3	0.6	1.3	2.3	5.0
Malaysia	0.8	2.1	3.8	5.7	9.4
Philippines	2.6	4.4	6.6	8.7	12.3
Singapore	-0.4	-0.0	0.7	1.7	3.0
Thailand	1.9	3.1	4.8	6.6	10.6
China	-0.0	0.2	0.4	0.6	0.8
Taiwan	0.0	0.1	0.2	0.4	0.7
Korea	0.0	0.1	0.2	0.3	0.5
Hong Kong	0.1	0.2	0.4	0.7	1.1

Source: Simulations from AP-Gcubed Model

Table 18: Current Account Consequences of ASEAN Liberalization
(% of baseline GDP from baseline)

	1995	2000	2005	2010	2020
United States	-0.0	0.0	0.0	0.0	0.1
Japan	-0.0	-0.0	0.0	0.0	0.0
Australia	0.0	0.0	0.0	0.0	0.0
Indonesia	0.1	-0.2	-0.6	-1.1	-2.0
Malaysia	0.6	0.2	-0.2	-0.6	-1.5
Philippines	1.0	1.2	1.3	1.2	0.7
Singapore	-0.9	-1.8	-2.2	-2.3	-1.6
Thailand	0.9	0.7	0.2	-0.4	-1.7
China	-0.0	-0.0	-0.0	-0.0	0.0
Taiwan	-0.1	-0.1	-0.1	-0.1	-0.2
Korea	-0.0	-0.0	-0.0	-0.0	-0.0
Hong Kong	-0.0	-0.1	-0.1	-0.2	-0.2

Source: Simulations from AP-Gcubed Model

Figure 2: Production Nesting

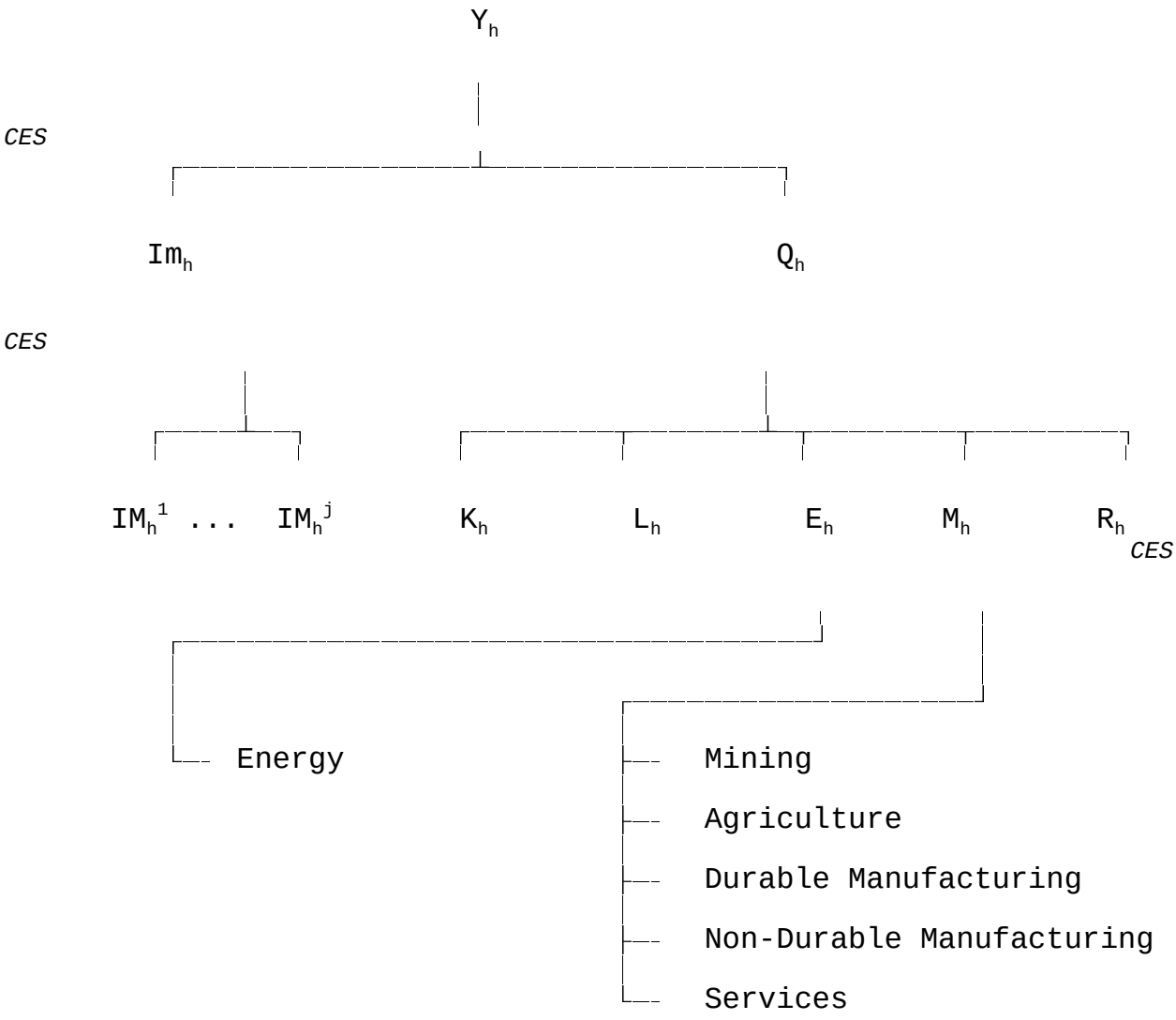

Figure 3: Consumption Nesting

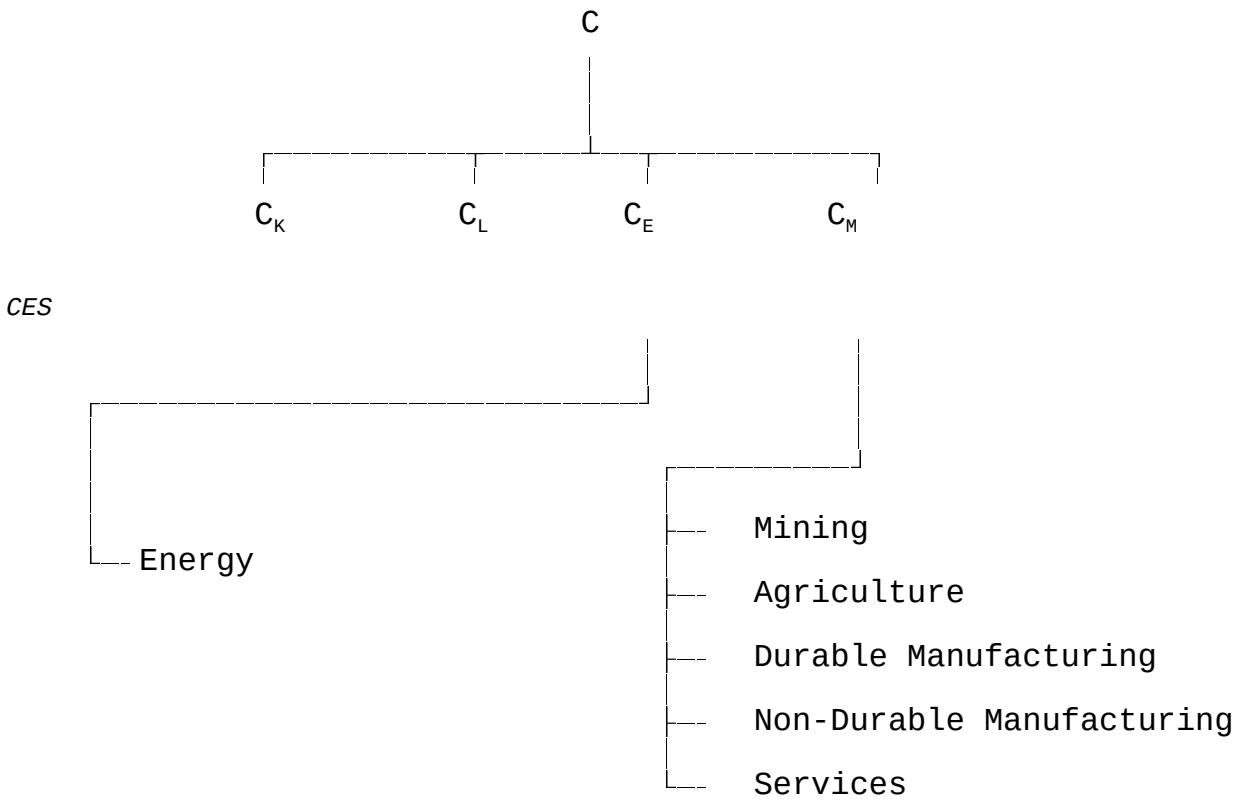

Figure 1: Stylized Interindustry Accounting Matrix for country k.

	1	2	3	6	C	I	G	X	M	tot
1	N_{k1}^{1k}			N_{k6}^{1k}	C_k^1	I_k^1	G_k^1	X_k^1	IM_k^1	Y_{k1}
2										
3										
6	N_{k1}^{6k}			N_{k6}^{6k}	C_k^6	I_k^6	G_k^6	X_k^6	IM_k^6	Y_k^6
R	R_{k1}				---	---	---	---	---	
K	K_{k1}			K_{k6}	K^C	K^I	---	---	---	
L	L_{k1}			L_{k6}	L^C	L^I	L^G	---	---	
Y										

Fig 4: Real GDP in 2020

(percentage deviation from baseline)

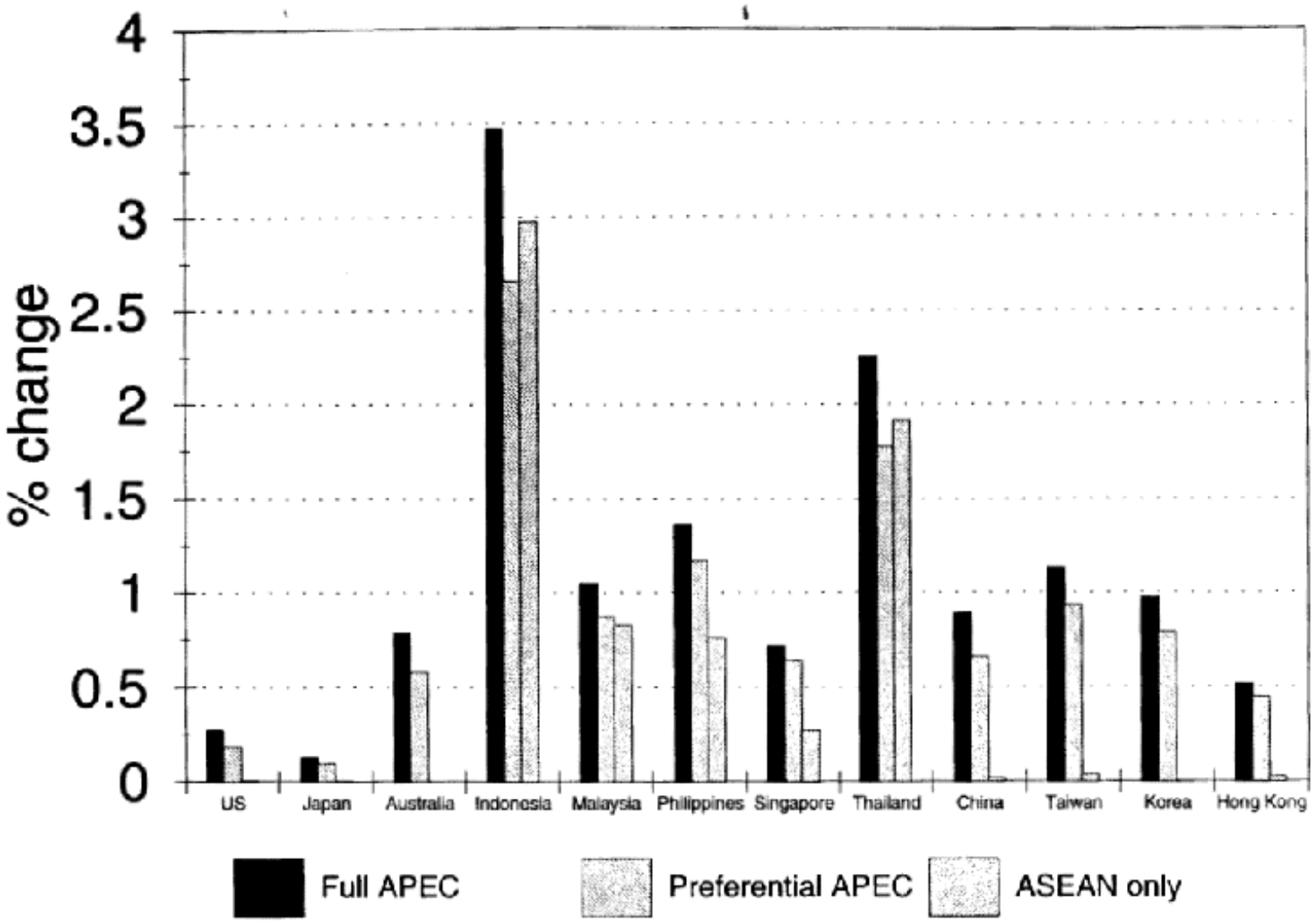

Fig 5 : Real Consumption in 2020

(percentage change from baseline)