Welfare Gains to Small Asian Economies from a Global Free Trade

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Abstract

This paper reports on a 11 region 15 sector global trade model which includes China, Japan and Small Asia economies (SAE) as separate regions. Model results show that a global elimination of tariffs, export taxes and subsidies raises the volume of global trade. Gains from the global free trade are 1.3 percent of the global GDP, roughly about 325 billion dollars in 1995. In absolute terms Japan gains the most (91 billion dollars) followed by Europe (67 billion dollars) and the USA (54 billion dollars). SAE gains about 70 billion dollars from multilateral trade liberalisation. These gains are significantly higher than gains usually reported from unilateral liberalisation obtained from small open economy models. Gains from free trade as a share of GDP are much higher for emerging countries such as China than for other regions in the model.

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1. Background

The global trade model presented in this paper explicitly models small Asian economy (SAE) which is linked to other economies through trade and investment. The SAE is part of the wider world economy, where key regions and countries (such as the EU, UK, USA, Japan, China, Canada-Australia and New Zealand, Africa and other Rest of the World economies) are modelled as separate but linked economies with substantial detail in the representation of production and consumption. Considering a little over 35 percent of the SAE's international trade that occurs with the China and Japan, it is important to illustrate a model which explains the trading relations between the SAE and the China and Japan and between the EU and other trading blocks in the global economy. Here the SAE economy is modelled alongside other ten different regions in the global economy.

Model parameters are calibrated using information on international trade flows and production and consumption flows in each region reported in the GTAP4 data base for 1995. GTAP data base produced by the Global Trade Analysis Project of the Purdue University in Indiana in the USA, contains data on 50 sector input-output tables and national account series for 45 different regions in the global economy. We follow the GTAPinGAMS approach used by Rutherford (1998) in formulating the model equations and in designing a GAMS/MPSGE program for the global model.[1]

The GTAP4 data allows us to build a global model treating the SAE as a separate region trading with China, Japan, the EU, the USA, other trading blocks and the rest of the world. This global model enables policy makers to examine the specific impacts of international trade policies pursued at the European level, at a level of

[1] See http://nash.Colorado.edu/tomruth/gtapingams/html/gtapgams.html for GTAPinGAMS.

various other trading blocks, and at a global level. It also allows for trade policy evaluation on a bilateral as well as on a multilateral basis.

The global model consists of interdependent economies grouped in one of eleven trading blocks, namely, UK, Europe, USA, Canada-Australia and New Zealand, Japan, China, Asia, Central Europe, Former Soviet Union, oil exporting countries, and the rest of the world. Each of the trading regions in the global model has 15 production sectors, a representative household and a government, which collects taxes from factor incomes and domestically supplied or imported consumption goods and imports and redistributes this revenue through transfers. Goods are differentiated by location of production, i.e. the same good produced in the SAE is different from that produced in the USA.

A representative household in each trading region maximises utility subject to a budget constraint, and producers maximise profit subject to technology constraints. Households buy both domestic and foreign goods and producers produce for both domestic and foreign markets. Both the utility of households and production by firms are described by standard CES functions (concave, monotonic, homothetic and continuous). Equilibrium conditions in each region and at a global level imply that markets for goods and capital clear, competitive firms earn zero economic profit, the income and expenditure of a representative household are equal and trade is balanced. Labour market clears at the regional level in the model. The multi-regional equilibrium model is closed by allowing quantities, prices and income to adjust at global as well as regional level until all excess demand functions are zero and equilibrium conditions are satisfied.

The capital inflow or outflow, if any, is allowed to clear any imbalance in international trade. Capital will flow into and out of regions until real returns are

equalised across among all regions and sectors. The governments in each region are allowed to carry out their own fiscal and trade policies in order to enhance bilateral and multi-lateral trades. This model explicitly specifies interdependency in global markets. It is an appropriate framework for the evaluation of the effects of various trade and investment promoting measures being pursued by members of the trading community grouped in various trading blocks (See Hartel (1997), Perroni and Whalley (1996), Whalley and Hamilton (1996), Will and Winters (1996) for more discussion on global trade).

2. The Structure of the Global Trade Model

Each region in the global model is endowed with primary factors of production, land, capital, skilled and unskilled labour and natural resources. These non-labour primary factors are either used in producing goods in the same region where these factors are located, or are permitted to move to other regions in response to factor price changes. Labour is mobile across sectors only at the regional level. Production in sector i in region r uses intermediate inputs, and labour and capital from its own region as well as from all other regions as following:

$$Y_{i,r} = \min\left(\frac{INT_{j,i,r}}{a_{i,j,r}}, \left(K_{i,r}^{\beta_r} L_{i,r}^{1-\beta_r} \right) \right) \qquad (1)$$

Here $Y_{i,r}$ is output of the sector i good in region r, $K_{i,r}$ is capital services originating in region r but used to produce the good i in region r, $L_{i,r}$ are labour services originating in region r but used to produce the sector i good in region r, $INT_{j,i,r}$ is an intermediate input originating in sector j of region r but used to produce the sector i good in region r, $a_{j,i,r}$ is a coefficient that gives the amount of the sector j intermediate input of region r used to produce the sector i good in region r, and β_r is the share of capital

income in sectoral output in region *r*. Land and natural resources are additional inputs in case of agriculture sector.

The output of good *i* for a particular region *r*, $Y_{i,r}$, is either supplied to the home region or exported to other regions. This is represented by a CET function:

$$Y_{i,r} = \left(\delta_{i,r} YD_{i,r}^{\eta_{i,r}} + (1-\delta_{i,r}) X_{i,r}^{\eta_{i,r}}\right)^{\frac{1}{\eta_{i,r}}} \quad (2)$$

where $YD_{i,r}$ is domestic sales of output of good *i* in region *r*, $X_{i,r}$ is exports of good *i* from a region *r*, $\delta_{i,r}$ is the share of domestic sales of gross output, $Y_{i,r}$, and $\eta_{i,r}$ is the elasticity of transformation between domestic sales and exports.

Total domestic supplies comes from domestic sales plus imports. Thus absorption of region, *r* is given by a CES aggregation of imports and domestic supplies is given by

$$A_{i,r} = \left(\mu_{i,r} YD_{i,r}^{\sigma_{i,r}} + (1-\mu_{i,r}) M_{i,r}^{\sigma_{i,r}}\right)^{\frac{1}{\sigma_{i,r}}} \quad (3)$$

where $A_{i,r}$, is Armington aggregation of domestic and imported goods, $\sigma_{i,r}$ is the elasticity of substitution between imported and domestic products, $\mu_{i,r}$ is the share of domestic production in the Armington product and $M_{i,r}$ is imports of good *i* to region *r*. The value of imports of goods into regions *r* are equal to value of exports of other region to that region plus transportation costs from the origin to the destination.

Transportation services are proportional to trade:

$$T_{i,r,s} = \tau_{i,r,s} M_{i,r,s} \quad (4)$$

Here $T_{i,r,s}$ transportation services, $\tau_{i,r,s}$ is transport cost per unit of traded goods $M_{i,r,s}$ amount of good *i* traded from region *r* to *s*.

These international transport services are produced using transport goods supplied by each region.

For simplicity, we represent the utility function in each region by a CES or Cobb-Douglas aggregation of final consumption goods supplied by each region. The total domestic demand is divided between household and government consumption. Household consumption is a Cobb-Douglas aggregation of sector *i* commodities over all *r* regions.

$$U_r = \prod_{i,r} C_{i,r}^{\gamma} \tag{5}$$

Households receive factor income from all regions and transfers from their own government. The income of the representative household in each region is

$$I_r = \sum_i w_r L_{i,r} + \sum_r r_r K_{i,r} + RV_r \tag{7}$$

where I_r is income, w_r is wage rate and r_r is the interest rate and RV_r is the transfer received by a representative household in region *r*.

Government consumption demand reflects a Cobb-Douglas aggregate of all sector *i* commodities over all *r* regions.

$$G_r = \prod_{i,r} GD_{i,r}^{\gamma} \tag{8}$$

$GD_{i,r}^{g}$ is the government consumption of good *i* in region *r*. The government in each region collects taxes from factors income, intermediate inputs, imports and domestic sales.

$$G_r = \tau_k r_r \overline{K}_r + \tau_w w_r \overline{L}_r + \tau_{i,r} P_{i,r} Y_{i,r} + \tau_{N,r} P_{i,r} INT_{j,i,r} \tag{9}$$

Here G_r is total government revenue, $\iota_{k,r}$ is tax rate on capital income, $\iota_{w,r}$ is tax rate on labour income, $\iota_{w,r}$ is tax rate in wage income, $\iota_{i,r}$ is tax rate on intermediate income, $\iota_{N,r}$ is tax rate on intermediate input.

A competitive equilibrium in this global economy is such that, given the prices of commodities and factors, demands for good and supply of goods are equal at the

regional as well as the global level; factor market clears for each region and at the world level; consumers of each region maximise their utility subject to their income constraints; and the government budget and trade are balanced for each region.

In this global model a competitive equilibrium is given by prices of consumption goods, $P_{i,r}$; the prices of capital r_r; a wage rate for labour, w_r levels of gross output, $Y_{i,r}$; capital use, $K_{i,r}$; sectoral use of labour, $L_{i,r}$; and income I_r such that, given these prices and quantities

i) households in each region maximise utility subject to their budget constraints;

ii) firms in each region maximise profits subject to technology constraints;

iii) labour market clears at the regional level;

iv) the markets for goods and services and capital clear in each region and at the global level;

v) the government budget constraint is satisfied for each region, and

vi) the trade-balance condition is satisfied at the regional and global level.

More specifically, the market clearing condition for the goods market is given by

$$Y_{i,r} = \sum_{r} C_{i,r} + \sum_{rr,j} a_{i,j,r} INT_{i,j,r} \qquad (10)$$

The global capital market clearing condition implies

$$\sum_{r} \overline{K}_r = \sum_{i,r} K_{r,ri} \qquad (11)$$

and labour market clears at the regional level:

$$LS_r = \sum_{i} LS_{i,r} \qquad (12)$$

When there are *r.n* different markets in the economy, relative prices that clear *rn*-1 markets also clear the r*n*th market as well (Walras (1954)).

3. Data sources and calibration procedure in the Global Trade model

The global trade model presented above requires data on output, imports, exports, consumption and government demand, employment of labour and capital, intermediate inputs, and base year prices for each sector and region included in the model. It also needs tax and tariff rates for each product. We use GTAP4 to supply this information.

The GTAP4 data has been prepared by the Centre for Global Trade Analysis, Purdue University (McDougall (1998), Hertel (1997)). This data base consists of 50 GTAP sectors and 45 GTAP regions. We use the GTAP aggregation software of Rutherford (1998)[2] that maps data from the GLOBAL.HAR file of the GTAP4 data base to a GAMS readable data file, GTAP4001.gms. We also take basic features of Rutherford's (1998) regional model structure for implementing the global model.

We have aggregated the 45 GTAP regions into eleven model regions to represent the global market. These regions are UK, Europe, USA, Canada-Australia and New Zealand, Japan, China, SAE, Central Europe, Former Soviet Union, Major Oil Producers, and the Rest of the World. Countries included in each region are listed in Table 1. This regional classification is made according to the degree of SAE's trade linkage in the global economy. China, Japan, USA, Europe region, which consists of continental Europe, Scandinavian economies and other economies in the European Free Trade Area, are the major trading partners of the SAE. We treat the SAE as a separate region to make this model to represent the SAE perspective in the global

[2] See the detailed description of GTAP aggregation in http://nash.colorado.edu/tomruth/gtapingams.html/gtapgams.html.

trade issues. GTAP4 data set provides us the benchmark data set required for the calibration of the regional model.

Table 1
Regional concordance of Global Trade Model with GTAP regions

Model Regions	GTAP Regions
UK	United Kingdom, Channel Islands, Isle of Man
Europe (EUR)	Germany, Denmark, Sweden, Finland **Rest of EU** (Austria, Belgium, France, French Guiana, Gibraltar, Greece, Gaudeloupe, Holy See, Ireland, Italy, Luxembourg, Martinique, Monaco, Netherlands, Portugal, Reunion, Saint Pierre and Miquelon, San Marino, Spain) **European Free Trade Area** (Iceland, Leichtenstein, Norway, Svalbard and Jan Mayen Is, Switzerland)
Central and Eastern Europe (CEA)	Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovakia, Slovenia
USA	American Samoa, Gaum, Northern Mariana Islands, Puerto Rico, United States Vergin Islands, United States of America
Japan (JPN)	Japan
ACN	Canada, Australia, New Zealand
China	China, Hong Kong, Taiwan
SAE	Malaysia, Singapore, Thailand, Philippines, Vietnam, Korea, India, Sri Lanka, **Rest of Asia** (Bangladesh, Bhutan, Maldives, Nepal, Pakistan)
Former Soviet Union	Armenia, Azerbaijan, Belarus, Estonia, Georgia, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Moldova, Russian Federation, Tajikistan, Turkmenistan, Ukraine, Uzbekistan
Major Oil Producers (MOP)	Mexico, Indonesia, **Rest of the Middle East** (Bahrain, Iran, Iraq, Isreal, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, United Arab Emirates, Yemen, Yemen Democratic) **Rest of North Africa** (Algeria, Egypt, Libya, Tunisia)

Table 1 (cont..)

Regional concordance of Global Trade Model with GTAP regions

Rest of the World	Morocco, Western Sahara, Turkey, Venezuela, Columbia, Argentina, Brazil, Chile, Uruguay **Rest of Andean Pact** (Bolivia, Ecuador, Peru) **Central America and Caribbean** (Anguila, Antigua and Barbuda, Aruba, Bahamas, Barbados, Belize, British Virgin Islands, Cayman Islands, Costa Rica, Cuba, Dominica, Dominican Republic, El Salvador, Grenada, Guatemala, Haiti, Honduras, Jamaica, Montserrat, Netherlands Antilles, Nicaragua, Panama, Saint Christopher and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago, Turks and Caicos Isl.) **Rest of the South America** (Guyana, Paraguay, Surinam) **South Africa Customs Union** (Botswana, Lesotho, Namibia, South Africa, Swaziland) **Rest of South Africa** (Angola, Malawi, Mauritius, Mozambique, Tanzania, Zambia, Zimbabwe) **Rest of sub-Saharan Africa** (Benin, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo, Cote d'Ivoire, Djibouti, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Liberia, Madagascar, Mali, Mauritania, Mayotte, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, Sudan, Togo, Uganda, Zaire) **Rest of the World** (Afghanistan, Albania, Andorra, Bermuda, Bosnia and Herzegovina, British Indian Ocean Territories, Brunei, Cambodia, Christmas Island, Cocos (Keeling) Islands, Cook Islands, Croatia, Cyprus, Falkland Islands, Faroe Islands, Fiji, French Polynesia, Greenland, Johnston Island Kiribati, Laos, Macao, Macedonia- former Yugoslav Republic, Malta, Marshall Islands, Federation State of Micronesia, Mongolia, Myanmar, Nauru, New Caledonia, Niue, North Korea, Pacific Islands, Palau, Papua New Guinea, Pitcairn Islands, Saint Helena, Solomon Islands, Tokelau, Tonga, Tuvalu, Vanuatu, Wake Island, Wallis and Futura Isl., Western Samoa, Yugoslavia)

We aggregate 50 GTAP sectors into fifteen global model sectors in Table 2 consistent with the classification in the small open economy model of the SAE. These sectors are agriculture, extraction, other mining, food and drink, other manufacturing, chemical, metal, engineering, utilities, construction, trade and transportation, private services, public services and housing.

GTAP draws on various national and international data sources in creating the global trade database. It takes macroeconomic data on GDP and GDP components and population data from the Bank Economic and Social Database (BESD) of the

International Economics Department of the World Bank. A large number of the input output tables were inherited from the Australian Industry Commission's SALTER project (McDougall (1998)). Input output tables for 12 European countries relies on the Central Statistical Offices of those countries, and Eurostat data base which contains input-output tables harmonised in accordance with the European System of Integrated National Accounts (ESA). The SAE data in GTAP is drawn from the input-output table of 1995 and business and agricultural statistics published by the Central Statistics Offices of the SAE economies.

Bilateral trade flows are based on the United Nation's COMTRADE database. GTAP's information on tariffs was drawn from UNCTAD's Trade Control Measures Database (TCMD) as well as from the WTO Integrated Database (IDB). TCMD is the most comprehensive database covering tariffs that is currently available. It covers all OECD member countries as well as a number of non-OECD countries. At the global level there are still many countries/regions which do not have input-output tables or other data sources. GTAP applies the proper regional average technique to fill data gaps in the absence of original data sources[3].

Table 2

[3] See Whalley and Yeung (1983), Whalley (1985) more discussion on micro consistent data set required for regional trade models

Concordance of sectors in the Global Trade Model with GTAP sectors

Model Sectors	Commodities
Agriculture	Paddy, wheat, grains, non-grain crops, wool, other livestock, fisheries, forestry
Extraction	Coal, Oil, Gas
Other mining	Other minerals, non-metallic mineral products,
Food and drink	Processed rice, meat products, milk products, other food products, beverage and tobacco,
Other Manufacturing	Textiles, wearing apparel, leather etc., lumber, pulp, paper, etc.
Chemical	Chemicals, rubbers, and plastic
Metal	Primary ferrous metals
Engineering	Fabricated metal products, machinery and equipment
Utilities	Electricity, gas and water
Construction	Construction
Trade and Transportation	Whole sale and retail trade, hotel and restaurants, railways highways subways transport, freight transport, inland and ocean transport, air transport, storage and warehousing, communication
Private services	Monetary and financial services, real estates, accounting, data processing, engineering and technical services, advertising, radio and TV broadcasting, amusement, repairs domestic services, photographic, personal services, business services
Public services	Public administration, health ,education, veterinary, welfare and religious organisations, social and related community services, International and extra-territorial bodies
Housing	Dwellings

Flows of trade from one region to other regions reflect the comparative advantage enjoyed by an exporting region over importing regions and the production and consumption structure among trading regions. We present the structure of total volume of trade from one region to another in percentage terms in Table 3. Figures in this table show the volume of trade, in percentage terms, originating from a region on each row to other regions listed in columns. About 18 percent of trade flows of SAEs occurs among themselves. Another 20 percent SAE trade occurs with USA, followed by 15 percent with Japan and 14 percent with the UK. The intra-regional trade is very important in the European region where 58 percent of trade takes place among the

member countries themselves. Also note that SAE region is the most integrated after the European region with other regions as reflected in its dominance of trade link with other regions in the global economy. United States, China, and Asia follow Europe in the degree of trade integration.

Table 3
Bilateral trade composition for 1995 (in percentage terms)
(From a region in the column to various regions in the row)

	USA	JPN	EUR	UK	ACN	CHN	FSU	CEA	SAE	MOP	ROW
USA	0.0	27.1	7.4	13.9	55.7	22.7	8.0	4.2	19.5	28.9	19.3
JPN	11.8	0.0	2.6	3.1	12.4	15.3	9.4	4.9	15.2	16.5	7.8
EUR	22.6	14.1	58.0	55.0	7.2	16.8	40.6	53.2	14.0	20.5	30.6
UK	5.6	3.3	8.1	0.0	2.4	2.9	3.2	3.3	3.6	2.3	4.9
CAN	19.2	4.7	1.5	3.6	3.5	3.9	0.9	0.8	3.2	2.3	2.0
CHN	7.0	16.9	2.6	2.8	4.9	16.7	6.9	3.4	12.6	3.6	3.7
FSU	1.0	0.5	1.8	1.4	0.3	0.7	4.3	5.2	1.2	0.4	1.5
CEA	0.7	0.4	3.2	1.8	0.2	0.7	9.1	11.5	0.7	0.6	1.3
SAE	11.6	23.4	4.1	6.2	7.1	11.8	7.7	2.7	18.2	13.8	6.3
MOP	11.2	5.3	4.8	5.9	3.0	3.6	2.7	3.8	5.9	4.2	4.8
ROW	9.3	4.3	5.8	6.3	3.2	5.0	7.2	7.0	5.9	6.7	17.8
TOTAL %	100	100	100	100	100	100	100	100	100	100	100

Source: GTAP data base version 4, 1998.

Volume of the global trade in value terms are given in Table 4 below, which shows that the value of global trade stood around 5.6 trillion US dollars in 1995. This implies the openness of the global economy of around 22 percent in that year. Row sum in this table shows imports and column sum represents exports. In this benchmark data USA, UK, CEA, SAE and ROW regions had deficit in trade accounts whereas Japan, Europe, ACN, China, FSU and MOP regions had surpluses in the trade account. Intra-regional trade in Europe alone had more than 2 trillion US dollars.

Also note that the North-North trade volume is significantly larger than South-South or South-North trade. Rich countries in the North trade more among themselves than with developing countries in the South. The reason for the small share of South-South trade compared to North-South trade lies in predominance of imports of

machinery and high-tech manufactured products by developing countries from the rich industrialised countries in the North. The South regions supplies the North only with cheap primary products. For instance, the USA, Japan and European regions were the major trading partners for the SAE and ROW regions. SAE exported more to Europe, USA and the ACN regions than to the ROW or to Asia itself.

Table 4
Volume of bilateral trade for 1995 (in billion of US $s)
(Imports across the column and exports down the column)

	USA	JPN	EUR	UK	ACN	CHN	FSU	CEA	SAE	MOP	ROW	Global
USA		131	159	38	154	94	7	4	96	93	64	842
JPN	83		56	9	34	64	8	5	75	53	26	413
EUR	159	68	1244	152	20	69	36	57	69	66	101	2041
UK	39	16	174		7	12	3	4	17	7	16	295
CAN	134	23	33	10	10	16	1	1	16	7	7	257
CHN	49	82	56	8	14	69	6	4	62	12	12	373
FSU	7	3	39	4	1	3	4	6	6	1	5	78
CEA	5	2	69	5	1	3	8	12	3	2	4	114
SAE	82	113	87	17	20	49	7	3	89	45	21	533
MOP	78	26	103	16	8	15	2	4	29	14	16	312
ROW	65	21	125	17	9	21	6	7	29	22	59	381
Global	701	484	2145	276	277	414	89	107	491	322	331	5638

Source: GTAP data base version 4, 1998.

The North-North and South-North trade pattern observed above in aggregate trade flows is also apparent at the sectoral level. For instance, 71 percent of total exports of European agricultural products are sold within the European region, while intra-regional trade for agricultural products is 19 percent in the SAE region. About 54 percent of CEA's agricultural products are exported to Europe compared to 15 percent intra-regional flows.

The composition of regional exports and imports are presented in Table 5 and Table 6. The row sum in Table 5 and 6 show the percentage of sectoral imports and exports in the global economy. Most global trade occurs in the engineering sector which comprised about 34 percent of global trade followed by other manufacturing, chemical and transport sectors. This global trade trend applied also to the SAE

economy. The columns for individual regions in table 5 and 6 represent sectoral share of imports and exports in each region respectively. These regional aggregations on trade flows by goods and regions are obtained by aggregating the bilateral flows of GTAP countries. More details on their derivation and various consistency conditions properly checked for reconciling bilateral trade flows, are presented in detail in McDougall (Chapter 3 and 16).

Subsidies and tariff rates are the most important means of protecting domestic industries against foreign competition. The GTAP reports trade-weighted average tariff rates from tariff lines of 6000 to 10,000 commodities. GTAP concordance procedure converts non-tariff distortions into tariff equivalent distortions for the effective tariff rates for year 1995 for the agriculture, energy, manufacturing and transport sectors. Similarly producer subsidy equivalent (PSE) calculations are made to arrive at effective export taxes/ subsidies for all eight model sectors (McDougalll (1993)).

Agriculture is the most heavily protected sector among all sectors, followed by manufacturing. For instance, agricultural products from the USA were subject to a 165 percent tariff rate in Japan, 59 percent in Asia, and 34 percent in China. Food and drink sector also is subject to heavy import duties among regions.

Agriculture receives the highest rate of export subsidy or is subject to the highest export tax rates among these various sectors. Export subsidies on agricultural products from SAE range from 1 percent for exports to the UK to 37 percent for exports to major oil producers.

Table 5
Sectoral composition of imports by regions for 1995
(gross of tariff in billions of US $s)

	USA	JPN	EUR	UK	CAN	CHN	FSU	CEA	SAE	MOP	ROW	Global (%)
AGR	2.1	9.5	4.1	3.4	2.1	4.3	4.1	3.6	4.2	5.0	4.0	4.2
EXT	7.0	11.6	4.7	3.1	3.1	2.3	1.9	7.1	7.4	2.4	6.7	5.5
OMI	2.1	3.3	2.8	2.6	1.9	2.3	1.7	3.0	2.8	3.5	2.1	2.6
FDR	2.7	9.7	6.1	6.4	3.4	3.7	15.6	5.4	4.1	6.8	6.9	5.6
OMA	16.6	13.9	14.6	15.0	12.6	17.5	14.6	16.8	8.9	13.1	13.5	14.3
CHM	7.0	5.7	12.0	10.3	10.3	11.7	7.9	13.2	10.1	10.2	12.6	10.3
MTL	5.4	4.6	7.5	5.9	5.6	7.7	3.2	7.2	8.0	7.6	5.8	6.7
ENG	42.8	17.7	30.3	35.6	44.2	38.2	25.3	30.8	41.5	34.8	33.7	34.2
UTI	0.1	0.0	0.2	0.2	0.0	0.1	0.2	0.1	0.0	0.0	0.1	0.1
CON	0.0	0.0	0.3	0.0	0.0	0.8	0.8	1.5	0.0	1.5	0.8	0.4
TRN	6.5	18.2	7.8	10.5	10.4	5.6	12.0	8.6	5.7	9.2	9.8	8.6
PRS	5.9	5.7	6.8	2.5	5.6	3.5	11.5	2.7	4.5	3.7	2.3	5.3
PUB	1.8	0.1	2.7	4.3	0.8	2.2	1.1	0.1	2.7	2.2	1.7	2.1
Global (%)	100	100	100	100	100	100	100	100	100	100	100	100
Total Value	904.2	474.3	2167	316.1	275.9	438.1	85.05	126.3	627.2	347.7	448	6210

Source: GTAP data base version 4, 1998.

Table 6
Sectoral composition of exports by regions for 1995
(gross of export taxes in billions of US $s)

	USA	JPN	EUR	UK	CAN	CHN	FSU	CEA	SAE	MOP	ROW	Global (%)
AGR	5.1	0.1	2.5	1.3	6.5	1.4	6.1	2.9	3.0	3.3	12.2	3.4
EXT	1.2	0.4	2.1	4.5	8.8	0.9	19.2	3.3	2.8	39.0	12.2	5.3
OMI	1.2	1.2	2.4	2.8	3.6	1.7	2.8	3.0	2.3	3.4	6.5	2.5
FDR	3.8	0.4	6.6	5.1	6.8	2.5	3.8	4.7	5.9	2.1	9.9	5.2
OMA	8.1	6.1	12.5	8.5	14.7	31.8	6.8	19.5	17.8	11.1	13.9	13.2
CHM	9.6	7.5	12.6	12.1	6.8	7.2	11.0	9.3	6.3	6.5	6.1	9.7
MTL	3.6	5.8	7.1	5.8	7.8	6.0	25.4	13.2	3.6	3.7	8.9	6.5
ENG	39.7	63.7	32.9	33.7	28.7	30.1	3.8	19.2	37.2	16.3	7.4	33.2
UTI	0.0	0.0	0.3	0.0	0.3	0.1	0.3	0.3	0.0	0.0	0.0	0.1
CON	0.0	0.0	0.6	0.0	0.0	0.2	0.4	4.9	0.3	0.0	0.0	0.4
TRN	14.0	11.4	11.2	15.7	10.9	14.3	13.1	15.9	15.8	10.6	16.1	12.8
PRS	10.4	3.4	6.9	6.1	3.2	2.7	5.3	2.7	3.0	1.4	3.1	5.5
PUB	3.3	0.1	2.3	4.3	1.8	0.9	1.9	1.2	2.1	2.4	3.7	2.3
Global(%)	100	100	100	100	100	100	100	100	100	100	100	100
Total Value	736	503	2224	291	287	422	93	112	518	334	349	5867

Source: GTAP data base version 4, 1998.

4. Welfare impacts of tariff reforms in the global trade model

We use our global trade model to compute welfare gains to various trading blocks from global free trade for a selected values of substitution elasticity among factors of production (σ), elasticity of substitution between domestic supplies and imports in consumption (σ^m) and transformation elasticity for domestic supplies and exports (σ^d). The results are displayed in Table 7,8.

The elimination of tariffs increases global trade. Almost all trading communities/regions in the model experience welfare gains from liberalisation. Altogether these gains add up to around 323 billion dollars for 1995. Gains from free trade at the global level is about 1.3 percent of the global GDP. This gain varies significantly from one region to another. The SEA gains 1.85 percent of the GDP. Japan gains most by global free trade, which was equivalent to 91 billions dollars (1.93 percent of the Japanese GDP). Europe gains 67 billion but only 0.95 percent of European GDP. UK gains 11 billion dollars. As a percent of GDP China gains the most, about 3.8 percent of GDP. This is not surprising considering the export-led growth process that is undergoing in the Chinese economy over last two decades. Major oil producing countries loose from global trade liberalisation. These welfare figures are very similar to those found in the literature (Whalley (1985), Harrison-Rutherford-Tarr (1997), Ghosh and Whalley (1997), Bhattarai and Whalley (1998)).

Table 7
Hicksian EV by region from global trade liberalization
(Benchmark 1995, for $\sigma = 0.75$; $\sigma^d = 4$; and $\sigma^m = 6$)

Trading blocks or model regions	Welfare gains from free trade as a percent of GDP	Welfare gains in billion of 1995 US dollars
USA	0.825	54
Japan (JPN)	1.932	91
Europe (EUR)	0.949	67
UK	1.054	11
Australia-Canada and New Zealand (CAN)	3.035	27
China (CHN)	3.723	34
Former Soviet Union (FSU)	0.149	1
Central and East Asia (CEA)	2.143	6
Small Asian Economies (SAE)	1.849	20
OPEC Countries (MOP)	-0.346	-3
Rest of the World (ROW)	0.886	17
Global gain	1.300	323

We conduct a sensitivity analysis around key elasticity parameters in the production and utility functions to check the robustness of the results presented above. We make a ten step grid of three key substitution elasticities: substitution elasticity among factors of production (σ), elasticity of substitution between domestic supplies and imports in consumption (σ^m) and transformation elasticity for domestic supplies and exports (σ^d). Welfare gains as a percentage of base year GDP from global free trade are presented in Table 8, which shows welfare improving with increase in the elasticity in all regions except in Former Soviet Union (FSU) Region and major oil producers (MOP) region. Every regions may experience gains from global trade in case of higher values of elasticities.

Table 8

Sensitivity of welfare to production and substitution elasticities in the global model

(Welfare gain % of GDP from moving to the global free trade in 1995)

Substitution elasticities in production, imports and exports										
Scenario	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
σ	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00
σ^d	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50
σ^m	3.25	3.50	3.75	4.00	4.25	4.50	4.75	5.00	5.25	5.50
Welfare gains % of GDP from moving to the global free trade in 1995 (by region and by the range of values for the elasticity of substituion)										
Scenario	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
USA	0.693	0.715	0.737	0.759	0.781	0.801	0.82	0.838	0.855	0.871
JPN	1.049	1.179	1.317	1.464	1.618	1.779	1.944	2.112	2.282	2.451
EUR	0.824	0.854	0.883	0.911	0.939	0.967	0.996	1.026	1.059	1.093
UK	0.623	0.679	0.737	0.796	0.858	0.921	0.987	1.054	1.124	1.195
ACN	1.437	1.54	1.647	1.761	1.887	2.031	2.195	2.388	2.616	2.894
CHN	1.598	1.786	1.978	2.176	2.382	2.598	2.826	3.069	3.329	3.611
FSU	-0.595	-0.548	-0.498	-0.445	-0.388	-0.328	-0.263	-0.191	-0.111	-0.021
CEA	1.177	1.208	1.247	1.295	1.351	1.421	1.506	1.614	1.748	1.917
SAE	0.164	0.344	0.526	0.712	0.9	1.093	1.291	1.494	1.704	1.92
MOP	-1.331	-1.209	-1.09	-0.973	-0.853	-0.729	-0.599	-0.463	-0.322	-0.175
ROW	-0.088	-0.008	0.075	0.161	0.251	0.344	0.442	0.544	0.652	0.765

5. Conclusion

This paper reports on a 11 region 15 sector global trade model including the Small Asian economies (SAE) as a separate region. The SAE is modelled as part of the wider world economy, where key regions and countries (such as the UK, the EU, USA, Japan, China, Canada-Australia and New Zealand, Africa and other Rest of the World economies) are treated as separate but linked economies with substantial detail in the representation of production and consumption. A representative household in each trading region maximises utility subject to a budget constraint, and producers maximise profit subject to technology constraints even in the global model. Households buy both domestic and foreign goods and producers produce for both domestic and foreign markets. Both the utility of households and production by firms are described by standard CES functions (concave, monotonic, homothetic and continuous). Equilibrium conditions in each region and at the global level imply that markets for goods, labour and capital clear, competitive firms earn zero economic profit, the income and expenditure of a representative household are equal, trade is balanced and all government revenue is transferred to a household. Model parameters are calibrated using information on international trade flows and production and consumption flows in each region reported in the GTAP4 data base for 1995.

This model shows that an elimination of tariffs increases the volume of trade at the global level. Almost all trading communities/regions in our model experience gains from liberalisation. Gains from free trade at the global level are 1.3 percent of the global GDP, roughly about 325 billion dollars in 1995. In absolute Japan gains most followed by Europe and the USA. SAE gains about 70 billion from the multilateral trade liberalisation. The gain occurring to the China is much larger as a

share of GDP than any other region included in the model. OPEC economies loose from global scale liberalisation. This is mainly due to the removal of subsidies on their imports from developed countries and a significant amount of distortions prevalent in the domestic markets of these economies.

We carry out sensitivity analysis around major model parameters in the production and consumption functions of the model. The results show that the welfare gains reported are sensitive to values of substitution elasticities. It is possible to show much larger gains with higher values of production and trade elasticities.

In general, gains from multilateral liberalisation under a global economic framework reported here are higher than gains from unilateral liberalisation reported using a small open economy model. These two modelling frameworks are complementary to each other and show significant welfare gains to the UK economy from the removal of tariffs on international trade.

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