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A General Equilibrium Analysis of the China-ASEAN Free Trade Agreement [1, 2]

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Abstract

We simulate the effects of the China-ASEAN free trade area (CAFTA) with a recently developed global trade, applied general equilibrium (AGE) framework. This AGE model is different from other comparative-static models in two important aspects: we explicitly model transnational supply chains and export processing zones in China.

The CAFTA was signed in November 2002. China and ASEAN began lowering barriers to trade in 2005. Under the CAFTA, China, Indonesia, Thailand, the Philippines, Malaysia, Singapore and Brunei removed almost all tariffs in January 1, 2010. Some agricultural products and parts for motor vehicles and heavy machinery will still face tariffs in 2010, but those will gradually be phased out. ASEAN's newest members — Cambodia, Laos, Vietnam and Myanmar — will gradually reduce tariffs in coming years and must eliminate them entirely by 2015.

Our analysis will focus at the sectoral and macro implications of CAFTA for China, selected ASEAN countries (i.e., Malaysia, the Philippines, Singapore, Thailand, Vietnam and Indonesia) and their trading partners (e.g., Japan, Korea, India, the European Union and the United States). Our data contains 26 countries or regions and 41 aggregate sectors. Producers operating in processing zones in China and Mexico are modeled as separate and different from producers in the rest of the economy.

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[2] This paper is not meant to represent in any way the views of the U.S. International Trade Commission or any of its individual Commissioners.

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A General Equilibrium Analysis of the China-ASEAN Free Trade Agreement

1 Introduction

Reductions in transportation and communication costs along with liberalization of trade, finance and political barriers have significantly affected global trade relationships. Economies have become more integrated, with a vast potential for trade to facilitate sustainable and inclusive growth and development. Two important aspects of the new global economic reality are the integration of China in the global economy and the proliferation of transnational supply chains. In this paper, an applied general equilibrium (AGE) framework that explicitly models transnational supply chains and export processing zones in China is used to simulate the effects of the China-ASEAN free trade agreement.

2 The China-ASEAN FTA

The CAFTA was signed in November 2002. China and ASEAN began lowering barriers to trade in 2005. Under the CAFTA, China, Indonesia, Thailand, the Philippines, Malaysia, Singapore and Brunei removed almost all tariffs in January 1, 2010. Some agricultural products and parts for motor vehicles and heavy machinery will still face tariffs in 2010, but those will gradually be phased out. ASEAN's newest members — Cambodia, Laos, Vietnam and Myanmar — will gradually reduce tariffs in coming years and must eliminate them entirely by 2015.

3 Review of the literature

Urata and Kiyota analyzed the impacts of Asian FTAS (including a China-ASEAN FTA) with the GTAP model.

Jiang and McKibbin used a suite of general equilibrium models to examine the impact of a free trade area of the Asia-Pacifi c, in conjunction with the possible development in the existing ASEAN-China FTA and a proposed East Asian FTA. The authors found that China gains from all of the three FTAs.

4.A Theory of AGE model

This AGE model is closely related to comparative-static AGE models already available for the analysis of international trade policies (for reviews see Shoven and Whalley, 1984 and 1992; Francois and Shiells;

Hertel, Ianchovichina, and McDonald). This model divides the global economy into several economies and regions. Each regional economy is specified with demand and production structures. Subject to transportation costs, each region engages in commodity trade with all other regions in the model. Commodity prices are determined by market clearing through interregional and international trade.

Each regional economy consists of producing sectors, a private household and a government. All economic agents are price-takers and their demands for commodities and primary factors are based on cost minimizing or utility maximizing behavior. Cost minimizing sectors produce a single commodity, using as inputs primary factor services and intermediate products. Intermediate (and final demand) users of commodities are assumed to differentiate a commodity by its region of origin (i.e., the *Armington specification* is applied).

On the demand side of the model, in each region, households maximize utility subject to a regional budget constraint. They purchase commodities and they save part of their income, which consists of returns to primary factors and net tax collections. In each region, aggregate investment in new capital goods is represented by the output of a "capital goods" sector. Globally, the sum of household savings is equal to the sum of investment expenditures.

Integrated into this treatment of production, demand, and trade, are U.S. and foreign policies which have regional impacts. These policies affect the equilibrium computed by the model and when they change they induce behavioral changes by producers and consumers in all regions.

Welfare and household demands. It is assumed that preferences are separable, which allows expressing total utility as a function of sub-utilities, which in turn have deeper sub-groupings within them. In this model, demanders of commodities are assumed to treat imports from different sources as imperfect substitutes. Thus, demands reflect cost minimization across sources of supply (the *Armington* specification, 1969a and 1969b).

At the top of the utility tree, regional welfare is derived from private household expenditures, government expenditures, and savings. In particular, each household maximizes utility subject to a regional income constraint. Currently, there is no economic mechanism that links federal government expenditures in U.S. regions.

It is assumed that the simulations do not change the distribution of regional income across private and government expenditures, and savings. This assumption is implemented by applying a Cobb-Douglas function to describe substitutions between the four components of welfare. Household demands for composite commodities are specified with Cobb-Douglas functions.

Sectoral demands. Producing sectors demand two types of inputs: primary factors and intermediate inputs. The primary factor composite is a CES aggregate of land (where appropriate), labor, and capital.[1] The elasticity of substitution between primary factors, σ_{VA}, is industry specific. There is no substitution between the primary factor composite and intermediate inputs (i.e., a Leontief technology is assumed). Producer demands for foreign, out-of-region, and within region varieties of commodities have the same structure as those for households.

Interregional and international trade. The main features of the model treatment of trade are the Armington assumptions discussed earlier. There are, however, two aspects of the model which affect the interregional and international linkages in the model. Both of these aspects are drawn from the GTAP model (Hertel). First, a global sector demands services from each regional transportation services sector, to provide a composite service which is used for shipping commodities across regions. In value terms, each region's relative contribution to the global transportation sector does not change due to the simulation performed. It is also assumed that shipping services are required in fixed proportions with the quantity of a particular commodity shipped along a particular route.

The second global sector intermediates between regional savings and regional investment. This global sector has a portfolio of regional net investments which are offered to regional households to satisfy their demand for savings. Regarding the regional composition of net investment, the model offers two alternative specifications. The first specification assumes that the regional composition of global

[1] Land is used only by the agricultural sectors in the model; the "capital goods" sector uses only intermediate products as inputs.

capital stock will not change due to the simulation performed. The second specification assumes that there is a negative relationship between the (expected) regional rate of return on capital and the amount of investment undertaken in a region.[2]

Primary factor mobility. Each region has a fixed endowment of land, labor, and capital stocks. Labor services and services from existing capital stock are assumed to be intersectorally perfectly mobile, but region specific. This implies that all sectors, in a region, face the same market price for labor services and the same market price for capital services. Regarding land, the model allows for changes in sectoral patterns of land use, but land rent differentials across sectors are sustained. This assumption is implemented with a system of land supply functions which are derived from a Constant Elasticity of Transformation (CET) function.

The model has 26 economies or aggregates of economies. China and Mexico, however, have export processing zones and these zones are modeled as separate economies. Thus the total number of economies in the model is 28 (table 1).

Labor and capital markets in China and Mexico are modeled in a different way than labor and capital markets in the rest of the regions in the model. It is assumed that labor and capital can move freely between the export processing zone and the rest of the economy.

4.B Data used in the AGE model

A world production or supply chain can be seen as distribution of value-added share among countries (regions) in a particular global industry. Within the supply chain or production network, each producer purchases inputs and then adds value, which then becomes part of the cost of the next stage of production. The sum of the value added by every stage in the chain equals the value of final goods produced by the chain. To precisely define such chains across many countries one need able to quantify the contribution of each country (region) to the total value-added generated in the process of production (supply) of final products. In this regard, an inter-country input-output (ICIO) table provided the best available and

[2] The latter specification is implemented for the simulation that is discussed at the end of the paper.

consistent information that allow us to model the value-added generation process among related countries at industry average level.[3] This type IO account traces inter-country transaction in intermediate inputs and final use separately, matches bilateral trade flow in major end use categories to input-output relations therefore includes more detailed source/destination, supply/use information than a Multi-Country Input-Output (MCIO) table, which is the core of most global CGE modeling database such as GTAP database. In short, the inter-country table not only provides the origin and destination of international trade flows in its covered industries, but also specifies every intermediate and/or final use for all such flows. For example, from the table we will not only know how many electronics produced in China was shipped into the United States, but also can distinguish how many of them used as intermediate inputs in which particular U.S. sector and how many of them used for U.S. private household consumption or capital formation. However, global inter-country IO tables are very rare because of the tremendous amount of data required to compile them, as well as differences in statistical classifications across countries. Available inter-country IO tables, such as the Asian international IO table compiled by the Institute of Development Economies (IDE) in Japan, cover only a select set of Asian economies and treat other countries (including EU) in the rest of the world as exogenous blocks. In addition, there is no processing trade information is taking into account in any available MCIO and ICIO dataset. Therefore, in order to implement the AGE model with explicitly specified transnational supply chains and export processing zones in developing countries such as China, a new database has to be developed first.

Our research in this direction is on two parallel tracks. To support our global value chain analysis and AGE modeling of processing trade efforts, we first constructed a single year global IO table based on version 7 GTAP database and processing trade information from China and Mexico. The initial allocation of bilateral trade flows in the GTAP database into intermediate and final uses is based on UN BEC (Broad Economic Categories) method. We use China's expanded I/O table with a separate account for processing

[3] There are product-level approach to estimate the financial value embedded in an product and quantify how it is distributed across the many participants in the supply chain from design and branding to component manufacturing to assembly to distribution and sales (Jason Dedrick, Kenneth L. Kraemer, Greg Linden, 2008).

exports from (Koopman, Wang and Wei, 2008) and obtained 2003 Mexico IO table with separate domestic and Maquiladora account from Mexico statistical agency, Instituto Nacional de Estadística, Geografía e Informática (INEGI). We integrate China and Mexico's IO table with version 7 GTAP database by a quadratic mathematical programming model to minimize the deviation between the resulted new data set from original GTAP data. The new database covers 26 countries and 41 sectors (the model specification and detailed country and sector classification are listed in Appendix A) and was used to calibrate our AGE model.

In parallel with the modeling and analytical research, we also in an efforts to develop a time series global ICIO database, which integrating individual country's IO tables from OECD with detailed bilateral trade statistics by a three-stage optimization procedure. It currently covers all OECD countries and important non-OECD economies such as Brazil, China and India from 1995 to 2007 and is classified at 2-digit ISIC (48 industries). Its data structure is similar to the database we build up from version 7 GTAP and will become the major data source of our AGE model in the future.   We will describe the methodology and data sources of this database under development in a separate paper.

5 Specification of simulations

There are six economies in the model that belong to ASEAN: Indonesia, Malaysia, the Philippines, Singapore, Thailand and Vietnam. We simulate a China-ASEAN Free Trade Agreement by removing tariffs among the six ASEAN economies and between China and the ASEAN economies.

6.A Simulated macro effects

Table 2 shows welfare and trade effects from the China-ASEAN FTA simulation. The effects for China and Mexico in table 2 are the sum of the effects for the two China and Mexico regions in the model. Vietnam is the country that experiences that largest percentage effects in welfare and trade.

The aggregate exports effect for China is a 0.79 percent in the value of exports (table 2). This effect can be decomposed in a 1.89 percent increase in exports from the export processing zones in China and a 0.13 percent increase in exports from the rest of China.

6.B Simulated sectoral effects

Table 3 shows export effects for China's manufacturing sectors. The table shows exports before the China-ASEAN FTA simulation and the effect of the simulation on export volumes. The percentage effects on sectoral exports from the processing zones in China are different from those from the rest of China because their destinations are different. For example, about 73 percent of electronic equipment exports from China's export processing zones are shipped to the European Union, the United States and to Japan. Because these three economies are not removing their tariffs in this simulation, exports of electronic equipment from China's processing zones decline.

7 Future work

Future work which will be presented at the Thirteenth Annual Conference on Global Economic Analysis will analyze selected implications of the FTA in greater detail, compare them to simulations with other AGE models which do not model transnational supply chains and export processing zones in China and identify areas of improvement.

8 Summary and conclusions

In this paper we simulated the effects of the China-ASEAN free trade area with a recently developed global trade, AGE framework. This AGE model is different from other comparative-static models in two important aspects: we explicitly model transnational supply chains and export processing zones in China.

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Table 1. Regions and sectors in the AGE model

Regions		Sectors	
1	China	1	Crops
2	China - export processing zones	2	Liv estock
3	Hong Kong	3	Forestry
4	Taiwan	4	Fishing
5	Japan	5	Coal
6	Korea	6	Oil and gas
7	Indonesia	7	Minerals nec
8	Philippines	8	Meat and dairy products
9	Malaysia	9	Other foods
10	Singapore	10	Beverages and tobacco products
11	Thailand	11	Textiles
12	Vietnam	12	Wearing apparel
13	India	13	Leather products
14	Australia, New Zealand	14	Wood products
15	Canada	15	Paper products, publishing
16	United States	16	Petroleum, coal products
17	Mexico	17	Chemical, rubber, plastic products
18	Mexico - export processing zones	18	Mineral products nec
19	Brazil	19	Ferrous metals
20	European Union - 12	20	Metals nec
21	European Union - 15	21	Metal products
22	Russia Federation	22	Motor vehicles and parts
23	South Africa	23	Transport equipment nec
24	Rest of high income countries	24	Electronic equipment
25	Rest of South America	25	Machinery and equipment nec
26	Rest of Asia	26	Manufactures nec
27	Rest of East Asia	27	Electricity
28	Rest of the world	28	Gas manufacture, distribution
		29	Water
		30	Construction
		31	Trade
		32	Transport nec
		33	Water transport
		34	Air transport
		35	Communication
		36	Financial services nec
		37	Insurance
		38	Business services nec
		39	Recreational and other services
		40	Public Admin., Defense, Educ., Health
		41	Dwellings

Table 2. China-ASEAN Free Trade Agreement: Simulated welfare and trade effects

Region	change in welfare, $ mil.	percent change in welfare	percent change in exports	percent change in imports
China	1,357	0.09	0.79	1.90
Hong Kong	1	0.00	-8.05	0.02
Taiwan	-272	-0.10	-1.23	-0.17
Japan	-1,321	-0.03	-4.13	-0.37
Korea	-586	-0.10	-8.42	-0.15
Indonesia	397	0.17	3.31	4.32
Philippines	159	0.21	1.50	3.66
Malaysia	774	0.76	0.50	3.88
Singapore	798	0.84	-9.50	0.58
Thailand	814	0.67	1.46	9.01
Vietnam	399	1.07	17.86	26.28
India	-354	-0.06	-1.96	-0.21
Australia, New Zealand	-184	-0.03	-1.54	-0.21
Canada	12	0.00	-1.42	-0.07
United States	-1,041	-0.01	-3.29	-0.19
Mexico	10	0.00	-0.31	-0.08
Brazil	-106	-0.02	-0.88	-0.17
European Union - 12	-65	-0.01	-5.50	-0.03
European Union - 15	-2,825	-0.03	-7.11	-0.20
Russia Federation	147	0.03	-2.87	-0.03
South Africa	-34	-0.02	-0.30	-0.11
Rest of high income countries	85	0.02	-3.85	-0.03
Rest of South America	-172	-0.09	-1.36	-0.39
Rest of Asia	-152	-0.02	-2.82	-0.16
Rest of East Asia	-75	-0.18	-2.08	-0.71
Rest of the world	96	0.01	-2.93	-0.07

Table 3. China-ASEAN Free Trade Agreement: Simulated exports of manufactures from China

Sector	Exports before China-ASEAN FTA, $ million		Percentage effect of China-ASEAN FTA on volume of exports	
	China - export processing zones	Rest of China	China - export processing zones	Rest of China
Meat and dairy products	607	3,341	36.77	4.35
Other foods	5,654	9,035	0.57	3.56
Beverages and tobacco products	114	801	50.94	39.39
Textiles	23,919	34,087	18.46	10.45
Wearing apparel	23,391	35,730	-1.01	-2.87
Leather products	18,921	15,255	5.2	-1.88
Wood products	8,954	11,487	-0.79	0.06
Paper products, publishing	3,161	2,197	1.8	3.17
Petroleum, coal products	1,867	7,209	6.35	6.18
Chemical, rubber, plastic products	25,655	39,238	1.75	2.39
Mineral products nec	2,287	11,728	4.23	4.14
Ferrous metals	2,617	10,978	6.43	2.85
Metals nec	5,266	8,108	3.85	0.26
Metal products	8,275	20,108	1.9	1.88
Motor vehicles and parts	9,416	17,619	1.36	7.24
Transport equipment nec	9,268	12,021	3.08	8.94
Electronic equipment	183,980	38,349	-0.06	0.23
Machinery and equipment nec	66,310	72,285	0.53	0.02
Manufactures nec	23,717	15,911	-1.91	-0.21