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Keywords: Border barriers; Agricultural trade; GTAP
JEL classification: F13; F14; Q17

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Border Barriers in Agricultural Trade and the Impact of their Elimination: Evidence from East Asia

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Abstract: By means of a GTAP based-CGE model, we investigate the impact of the elimination of import tariffs and non-tariff policy barriers (NTPBs) on agricultural trade towards East Asian FTAs. To do that, we first measure the NTPBs by employing a widely-used method derived from the literature on border effects. Next, by adding into the GTAP database our estimates on the NTPBs, which the original GTAP database by its nature does not succeed in incorporating, we compute the impact of the entire elimination of policy barriers (the complete reduction of import tariffs and of NTPBs) on GDP.

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1. Introduction

A mix of various kinds of barriers masks the true magnitude of barriers that impede trade in agricultural goods. Although tariffs are the best known of the major barriers, there are more serious policy barriers such as import quotas (IQs), state trading enterprises (STEs), and sanitary and phytosanitary measures (SPS) as applied to agricultural trade. Similar barriers remain also in the trade of other sectors, particularly in developing countries, but the magnitude of the barriers, and the number of products involved, seem to be especially conspicuous in agricultural trade. In fact it is possible to say that the highest policy barriers of all are those that exist in agricultural trade. However, in practical terms it is difficult to demonstrate that the tariff barriers in agricultural trade are higher than in other types of trade. For instance, without taking barriers other than ad valorem tariffs into account, tariff peaks are higher in some manufacturing sectors (for example knitted apparel (HS61), woven apparel (HS62) and footwear (HS64)) than in agricultural goods in terms of tariff lines for Japan, Korea and China (Kimura and Ando, 2003). Consequently, direct measurements such as trade-weighted average MFN tariff rates are not useful in demonstrating the overall magnitude of agricultural trade barriers.

Without knowing the exact magnitude of trade barriers, we cannot investigate the impact of their elimination by means of simulation analyses. The Global Trade Analysis Project (GTAP) model is the most widely used tool for assessing the impact of trade liberalization. For example, Bach *et al*. (2000) show that tariff elimination in Asia could lead to a 17 percent rise in world welfare. Tongeren *et al*. (2001) and Fontagné *et al*. (2005) provide other examples of GTAP simulation analyses. The GTAP model provides a database not only of information on generally available variables such as exports and production values but also on various kinds of trade barriers such as import duties, import quotas, and export subsidies. In the database, however, non-tariff barriers, particularly technical barriers (for example administrative and document costs), are not well integrated. As a result, the database tends to either overestimate or underestimate the impact of trade liberalization. We need to incorporate data on more comprehensive trade barriers into our simulated model.

In measuring trade barriers that include qualitative and intangible barriers, the measurement of border effects is useful. Several attempts have been made to estimate border effects on international transactions in agricultural goods. Furtan and Melle (2004) estimated the border effects for a selected group of agricultural products and found that border effects between the U.S. and Canada and between Mexico and Canada have declined over the period 1992 to 1998. Olper and Raimondi (2005) attempted to measure and explain the level of border effects for manufactured food trade among the Quad countries (United States, European Union, Canada, and Japan). Their results showed that not only policy barriers (tariffs and so on) but also non-policy barriers (for example cultural proximity and differences in consumers' preferences) went far to explain the magnitude of border effects for manufactured food trade among the Quad countries.

The purpose of this paper is to simulate the impact of a complete elimination of policy barriers on agricultural trade. To this end, we first measure the border effects on international transactions in agricultural goods. Based on the results in Olper and Raimondi (2005), this paper defines border effects as the sum of policy barriers (for example tariffs) and non-policy barriers (preferential differences). In particular, we focus on the border effects in the East Asian countries. This focus on East Asia enables us to control preferential differences among sample countries to some extent because rice is the staple food of most of the East Asian countries. We further control the preferential differences by introducing some historical/cultural variables into our empirical framework. Next, we simulate the impact of the elimination of policy barriers on GDP by using a computable general equilibrium (CGE) model, namely the GTAP model. By incorporating into the database our estimates on policy barriers, which include not only technical barriers but also all the other trade impediments, we present revised results of the GTAP based-CGE simulation.

It is worth noting that this paper conforms with a branch of the literature on border effect (home bias) estimation, of which McCallum's contribution (1995) was a pioneer work. The literature has followed three main approaches. The first of these has been an attempt to achieve technical sophistication in methods of estimation, Feenstra (2002) and Anderson and van Wincoop (2003) being examples. The second has aimed at disaggregating the elements of border barriers by introducing various kinds of explanatory variables. For instance, Frankel and Rose (2002), Rose (2000), Rose and van Wincoop (2001), Sousa and Lochard (2005), and Taglioni (2002) have added a common currency dummy variable, while Chen (2000) and Head and Mayer (2000), have introduced technical barriers and non-tariff barriers, and Sousa and Disdier (2002) have incorporated an indicator of weakness concerning the legal framework. Proxy variables for information costs have been introduced by Combes et al. (2005) and by Olper and Raimondi (2006). The third approach, to which our paper belongs, has been to employ estimates of border effects as an explanatory variable and to examine in detail the impact of their reduction on selected economic variables. For instance, Poncet (2003) has examined impacts of this kind on industrial distribution in China, while

Hayakawa (2007) has quantified the contribution of border effects to the growth of the intermediate goods trade in East Asia. In this paper, we will simulate the contribution of border effects to growth of a macro economic variable, namely GDP, by employing the GTAP model.

The rest of this paper is organized as follows. In section 2, we explain our empirical methodology of measuring border barriers, and section 3 presents the results of the measurements and performs the GTAP based-CGE analysis. We present our conclusions in section 4.

2. Empirical Methodology

This paper measures the level of agricultural protection by employing the log odds ratio method following Head and Mayer (2000). The method enables us to resolve the problem that data for agricultural price indices are unavailable.

As usual in the GTAP model, the Armington assumption is imposed in the agricultural sector. Supposing agricultural finished goods distinguished by country of origin and a CES type (sub-) utility function, utility maximization by the representative consumer gives the following expression for the demand in country *i* for the good produced in country *j*, $c_{i,j}$.

$$c_{i,j} = a_{i,j}^{\sigma-1} t_{i,j}^{1-\sigma} p_j^{-\sigma} P_i^{\sigma-1} E_i ,$$

where *a*, *t*, σ, *p*, *P*, and *E* denote preferential weight parameter, trade costs formulated by iceberg, the elasticity of substitution between goods, the producer price, the price index, and the total expenditure, respectively. From this equation, we obtain a ratio of inter-national import values to intra-national import values $X_{i,j}$, as follows:

$$X_{i,j} \equiv p_j c_{i,j} \big/ p_i c_{i,i} = \left(a_{i,j} / a_{i,i}\right)^{\sigma-1} \left(t_{i,j} \big/ t_{i,i}\right)^{1-\sigma} \left(p_j \big/ p_i\right)^{1-\sigma} . \qquad (1)$$

This formulation relates the decisions of the consumers in country *i* on how to allocate expenditure between finished goods produced in country *j* and the goods produced domestically. We use the method of ordinary least squares (OLS). To avoid the dummy trap in importer dummy variables, we drop the Singapore dummy variable because of its relative insignificance as a policy barrier.

We specify preferential parameter, producer price, and trade costs as follows. The differences in preferential parameters, which reflect non-policy barriers, are assumed to be a function of two kinds of cultural element. First, we introduce a linguistic dummy variable *language*, which is a binary variable taking unity if a language is spoken by at least 9% of the population in both countries and zero otherwise. Second, *colony* is a binary variable which takes the value of one if countries had ever had a colonial relationship and zero otherwise. In addition, as argued in the introductory section, our focus on samples derived from the East Asian countries also contributes to controlling other preferential differences. The producer price is simply assumed to be a log-linear function of wage rates (*wage*). In the empirical part, GDP per capita is used as a proxy for wage rates. We assume that trade costs consist of tariffs, transport costs incurred by geographical distance, and other policy barriers that impede the import of foreign goods. The other policy barriers are quantified by examining a coefficient for an importer dummy variable.

Consequently, the equation to be estimated is given by:

$$\ln X_{i,j} = \beta_0 + \gamma' \mu + \beta_1 \left(\ln wage_j - \ln wage_i\right) + \beta_2 \left(\ln d_{i,j} - \ln d_{i,i}\right) + \beta_3 \ln(1 + tariffs_{i,j})$$

$$+ \beta_4 language_{i,j} + \beta_5 colony_{i,j} + \varepsilon_{i,j} \,. \qquad (2)$$

$d_{i,j}$ is geographical distance between countries *i* and *j* and is measured by greater circle between their respective capital cities. $d_{i,i}$ is intra-national distance and is calculated as 0.67 times a radius of surface area in country *i*. μ and $\varepsilon_{i,j}$ are a vector of importer dummy variables and a normally distributed random error, respectively. From the theoretical point of view, a log of the other policy barriers in each country is represented by the respective dummy coefficient divided by (1-σ).

We refer to a total of eight East Asian countries (China, Indonesia, Japan, Malaysia, Republic of Korea, the Philippines, Singapore, and Thailand) with reference to the year 2000.[1] The data on inter-national agricultural import values and intra-national consumption values have been obtained from the Asian International Input-Output Table published by the Institute of Developing Economics (IDE)[2]. We use the aggregated final private consumption values/imports in agricultural products (agricultural, livestock, forestry, and fishery of finished goods), as defined in the Asian International Input-Output Table. The other data sources are as follows. Data on GDP per capita have been obtained from the World Development Indicator. The source of geographical distance, language, and colonial variables is the CEPII database[3]. The data

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1 We incorporate Taiwan into our sample only as an exporter because its estimate of border barriers suffers from idiosyncratic shock: the Foot-and-Mouth Disease Epidemic that affected pigs in the island in 1997. Indeed, in Taiwan, cereal imports, which have been the largest portion of the agricultural imports, underwent a remarkable decrease after the epidemic because cereals are the main ingredient for hog raising-feed.

2 http://www.ide.go.jp/English/Publish/Books/Sds/090.html

3 http://www.cepii.fr/anglaisgraph/bdd/distances.htm

on bilateral import tariffs in 2000 are constructed by linear interpolation of the tariffs in 1997 (obtained from GTAP 5) and 2001 (obtained from GTAP 6). The basic statistics are set out in Table 1.

== Table 1 ==

3. Empirical Results

We first measure border effects for trade in agricultural goods in East Asia by estimating an equation (2). Table 2 reports the results in the estimation of the equation (2).

== Table 2 ==

In order to illustrate the magnitude of the overall border barriers including non-policy barriers, we first regress the equation without tariffs and cultural variables. The results are reported in Eq (I). All coefficients have the expected signs and are statistically significant. Countries are less likely to import from distant and high-wage countries. The insignificance in a constant term may indicate that border barriers in Singapore are zero. Coefficients for all importer dummy variables are estimated as negatively significant. That is, in East Asian countries other than Singapore, border barriers significantly discourage trade in agricultural commodities. China emerges as the country with the highest levels of protection while Malaysia exhibits the lowest.

Second, we extract various kinds of border barriers from the above-obtained estimates. The results of the equation with tariffs, reported in Eq (II), are qualitatively similar to the results of Eq (I). In this equation, coefficients for importer dummy variables reflect the magnitude of non-tariff policy barriers plus trade impediments by preferential disparities. The decrease of their magnitude indicates that tariffs occupy a certain proportion of border barriers though the coefficient for tariffs is insignificant. The results of the equation with both tariffs and cultural variables are shown in Eq (III). It can be seen that a colonial history increases significantly agricultural trade though the language dummy variable is not significant. In the results of this equation, the importer dummy coefficients show non-tariff policy barriers (NTPBs). The absolute magnitude of the importer dummy coefficients is slightly different from that in Eq (II), implying that non-policy barriers also play a part in border effects.

We next conduct a simulation analysis of trade liberalization by employing the standard GTAP model.[4] The data has been obtained from the GTAP database (Version 6) which for 2001 contains 87 countries/regions and 57 sectors.[5] The database provides production and consumption structures described in the social accounting matrix for each region. We add into the GTAP database the above-obtained estimates of the NTPBs. The estimates of the NTPBs are expressed in the *ad valorem* tariff equivalent, which is calculated by the coefficient for each importer dummy variable divided by 1-σ, i.e., (exp(dummy coef./(1-σ))-1). In conformity with Hertel et al. (2003), we choose 3 for σ.[6] The resulting tariff equivalents of NTPBs are reported in Table 3. We further set the tariff equivalent in Singapore at zero percent. Such tariff equivalents in East Asian countries are added to import tariffs in the original GTAP database for 2001, though in fact they are ones for 2000. To facilitate computation, we arrange the database into eleven regions and three sectors. The eleven regions are Japan, Korea, China, Indonesia, Malaysia, the Philippines, Singapore, Thailand, USA, EU, and the rest of the world (hereafter ROW). Sectors are shown as Agriculture, Manufacturing, and others. The regional and sectoral composition of our model is reported in Appendixes 1 and 2, respectively.

== Table 3 ==

By using this database in a GTAP based-CGE model, we have investigated the impact of the elimination of import tariffs and NTPBs in agricultural goods on the East Asian Free Trade Agreement (FTA). The standard scenario (Scenario 1) assumes the complete removal of import tariffs in agricultural goods among the above-listed eight East Asian countries. The second scenario (Scenario 2) captures the impact of an entire elimination of policy barriers (the complete reduction to zero of both import tariffs and NTPBs). As calculated in this paper, our estimates of the NTPBs take account of the barriers that the original GTAP database does not succeed in incorporating, for example

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[4] The production side of the standard GTAP model assumes constant returns to scale technology and perfect competition. Demand for primary factors and intermediate inputs are represented by a nested constant elasticity of substitution (CES) function. On the demand side, total income is allocated using fixed value shares among three kinds of final demand: government, private household and savings expenditure, which are derived from an aggregate utility function of Cobb-Douglas type. Capital accumulation is endogenously determined in that investment funds are allocated across regions through a hypothetical global sector called global bank, equating the change in the expected rates of return across regions. Transport margins are derived from supply and demand in another hypothetical global sector called global transportation sector. Labor is assumed to be mobile across industries but not across countries. For the more detailed GTAP model, see Hertel (1997).

[5] For the GTAP database, see Dimaranan and McDougal (2002) and Dimaranan (2006).

[6] We can also use the elasticity implied by our estimate of the relative wage coefficient, 1.593 (=1-(-0.593)), but the preceding simulation results are qualitatively unchanged.

technical barriers and trade facilitation measures. We compare the simulation results of the complete elimination of such barriers with those of the elimination of only import tariffs in the original database.

Table 4 presents simulation results for GDP.[7] The column "Change" indicates the percentage change in GDP from pre-simulation to post-simulation. In scenario 1, the changes lie in the range between 0.0% and 0.4%, except for the change in Indonesia (-0.25%). Malaysia and Korea are the only two countries that register relatively large percentage changes from pre-simulation to post-simulation under Scenario 1. On the other hand, under scenario 2, all of the East Asian countries exhibit positive changes, of between 0% and 8%, with Japan, which shows a negative change of -1.88%, as the exception. In all of the countries, the magnitude of the changes under scenario 2 is much larger than that under scenario 1, because of the complete elimination of high NTPBs. In the Philippines in particular, the growth of GDP is much more conspicuous under scenario 2. To summarize, this simulation exercise indicates that the elimination of NTPBs exerts a strong impact on macroeconomic variables. There is a substantial disparity in the magnitude of the NTPBs among the selected countries, compared with that in the case of import tariffs. Therefore, depending on the FTA partners, the simulation of the entire removal of policy barriers presents a considerably different picture from that where only tariffs are eliminated.

== Table 4 ==

4. Concluding Remarks

By using a GTAP based-CGE model, this paper has investigated the impact of the elimination of import tariffs and non-tariff policy barriers (NTPBs) on agricultural trade among the member countries of a notional East Asian FTA. We first estimated the NTPBs by employing a widely-used method obtained from the border effects-literature and we proceeded to compute the impact of the entire removal of policy barriers on GDP by incorporating the estimates for them in the GTAP database. As a result, in the GTAP based-CGE simulation we found remarkable differences between the effect of the abolition of import tariffs and the effect of the entire elimination of all import barriers. In this sense, the simulation results of the previous analyses may underestimate the effect of FTA formation if it plays a significant role in reducing not only import tariffs but also non-tariff policy barriers. In order to obtain more highly detailed simulation

[7] The results for the other economic variables such as imports and exports are available from the authors upon request.

results of FTA formation, we need more sophisticated integration of the border effects and the database in the CGE model.

Appendix 1. Aggregation of Regions

Regions	Original regions
China	China
Japan	Japan
Korea	Korea
Taiwan	Taiwan
Indonesia	Indonesia
Malaysia	Malaysia
Philippines	Philippines
Singapore	Singapore
Thailand	Thailand
United States	United States
EU	Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom
ROW	Albania, Argentina, Australia, Austria, Bangladesh, Botswana, Brazil, Bulgaria, Canada, Central America, Chile, Colombia, Croatia, Cyprus, Czech Republic, Estonia, Hong Kong, Hungary, India, Latvia, Lithuania, Madagascar, Malawi, Malta, Mexico, Morocco, Mozambique, New Zealand, Peru, Poland, Rest of Andean Pact, Rest of East Asia, Rest of EFTA, Rest of Europe, Rest of Former Soviet Union, Rest of FTAA, Rest of Middle East, Rest of North Africa, Rest of North America, Rest of Oceania, Rest of SADC, Rest of South African CU, Rest of South America, Rest of South Asia, Rest of Southeast Asia, Rest of Sub-Saharan Africa, Rest of the Caribbean, Romania, Russian Federation, Slovakia, Slovenia, South Africa, Sri Lanka, Switzerland, Tanzania, Tunisia, Turkey, Uganda, Uruguay, Venezuela, Vietnam, Zambia, Zimbabwe

Appendix 2. Aggregation of Sectors

Sectors	Original Classifications	Sectors	Original Classifications
Agriculture	Paddy rice	Manufacturing	Coal
	Wheat		Oil
	Cereal grains nec		Gas
	Vegetables, fruit, nuts		Minerals nec
	Oil seeds		Textiles
	Sugar cane, sugar beet		Wearing apparel
	Plant-based fibers		Leather products
	Crops nec		Wood products
	Cattle, sheep, goats, horses		Paper products, publishing
	Animal products nec		Petroleum, coal products
	Raw milk		Chemical, rubber, plastic prods
	Wool, silk-worm cocoons		Mineral products nec
	Fishing		Ferrous metals
	Processed rice		Metals nec
	Meat: cattle, sheep, goats, horse		Metal products
	Meat products nec		Motor vehicles and parts
	Vegetable oils and fats		Transport equipment nec
	Dairy products		Electronic equipment
	Sugar		Machinery and equipment nec
	Food products nec		Manufactures nec
	Beverages and tobacco products	Others	Electricity
	Forestry		Gas manufacture, distribution
			Water
			Construction
			Trade
			Transport nec
			Sea transport
			Air transport
			Communication
			Financial services nec
			Insurance
			Business services nec
			Recreation and other services
			PubAdmin/Defence/Health/Educat
			Dwellings

Note: “nec” means not elsewhere classified.

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Table 1. Basic Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
relaive imports	64	-7.08	2.66	-12.31	0.29
relative distance	64	7.83	0.67	5.76	8.66
relative wage	64	0.16	2.16	-3.96	3.96
tariffs	64	0.15	0.21	0.00	1.21
language	64	0.30	0.46	0	1
colony	64	0.05	0.21	0	1

Table 2. Border Effects in East Asian Economies

Equation	(1)	(2)	(3)
relative distance	-0.515**	-0.589**	-0.412
	[0.256]	[0.259]	[0.279]
relative wage	-0.487***	-0.542***	-0.593***
	[0.118]	[0.124]	[0.126]
tariffs		-1.340	-0.992
		[0.971]	[1.000]
language			0.271
			[0.439]
colony			1.598*
			[0.937]
Indonesia	-4.033***	-3.721***	-3.462***
	[0.809]	[0.833]	[0.855]
Malaysia	-2.692***	-2.280***	-2.191***
	[0.702]	[0.758]	[0.754]
Philippines	-3.886***	-3.538***	-3.281***
	[0.783]	[0.817]	[0.839]
Thailand	-5.018***	-4.497***	-4.274***
	[0.739]	[0.824]	[0.860]
China	-5.958***	-5.567***	-5.370***
	[0.795]	[0.838]	[0.844]
Korea	-4.448***	-3.993***	-4.146***
	[0.674]	[0.745]	[0.761]
Japan	-4.168***	-3.999***	-4.347***
	[0.675]	[0.681]	[0.771]
constant	0.806	1.270	-0.376
	[2.017]	[2.029]	[2.294]
Obs.	64	64	64
R-squared	0.7875	0.7948	0.8063

Notes: ***, ** and * shows 1%, 5% and 10% significant, respectively. In parentheses is a standard error.

Table 3. The Tariff Equivalent of the Non-tariff Policy Barriers in 2000

	NTPBs
Indonesia	465%
Malaysia	199%
Philippines	416%
Thailand	747%
China	1366%
Korea	695%
Japan	779%

Source: Authors' estimation

Table 4. Estimated Impacts of East Asia FTA on Growth in Real GDP, by country

(US million dollars)

		Scenario 1		Scenario 2	
	simulation	simulation	(Change, %)	simulation	(Change, %)
Indonesia	142,373	142,018	-0.25	145,564	2.24
Malaysia	87,626	88,002	0.43	88,775	1.31
Philippines	71,428	71,508	0.11	71,533	0.15
Singapore	83,972	83,972	0.00	84,860	1.06
Thailand	109,340	109,593	0.23	117,816	7.75
China	1,147,816	1,148,092	0.02	1,160,058	1.07
Korea	429,880	431,497	0.38	446,128	3.78
Japan	4,262,353	4,263,720	0.03	4,182,347	-1.88
USA	10,068,241	10,068,253	0.00	10,082,543	0.14
EU	7,914,260	7,914,279	0.00	7,930,033	0.20
ROW	6,702,469	6,702,442	0.00	6,715,751	0.20

Source: Authors' estimation