Trade Costs and the Gains from Trade in Crop Agriculture

Jeffrey J. Reimer
Assistant Professor
Department of Agricultural and Resource Economics
213 Ballard Hall, Oregon State University, Corvallis, OR, 97331
jeff.reimer@oregonstate.edu

Man Li
Graduate Research Assistant
Department of Agricultural and Resource Economics
213 Ballard Hall, Oregon State University, Corvallis, OR, 97331
lim@onid.orst.edu

Poster prepared for presentation at the Agricultural & Applied Economics Association 2010 AAEA,CAES, & WAEA Joint Annual Meeting, Denver, Colorado, July 25-27, 2010.

Trade Costs and the Gains from Trade in Crop Agriculture

Jeff Reimer and Man Li
Department of Agricultural and Resource Economics, Oregon State University









Introduction

World crop markets are often thin and characterized by volatile prices. One reason is that crop yields are highly variable over time and space. International trade can alleviate this problem to some extent but is hindered by restrictive border policies. For example, global average bound tariffs in agriculture are roughly double those in other sectors. Non-tariff barriers are pervasive. Furthermore, in 2007-2008 at least 10 grain exporting countries restricted their exports so as to keep prices low for consumers at home; the inability of other countries to import this grain caused a great deal of suffering.

Not only are world crop markets highly insulated, prospects for further trade liberalization are uncertain. Since countries are often quite hesitant to make concessions in exchange for trade liberalization in other countries, it may help to illuminate basic facts about the world crop sector, and get new perspectives on the size and distribution of the gains from trade, by country.

In this study we develop a new global simulation model of crop agriculture to address these questions. The model is partial-equilibrium and designed around the salient features of world crop markets: yield variability and high trade costs, the latter of which are caused by policy as well as geography. The resulting framework provides econometric evidence about trade costs, and – since it is a simulation model – can be used to examine the types of questions that heretofore have been the domain of spatial equilibrium and computable general equilibrium models.

A new model for crops trade

The simulation model we propose for crop agriculture is based on the class of Ricardian trade models developed by Eaton and Kortum (*Econometrica*, 2002). Unlike the textbook Ricardian model, in which two countries each specialize in one of two goods, the goods sector is modeled as a continuum, with multiple countries specializing in sections of this continuum according to comparative advantage.

In our adaptation, specialization is determined by random productivity, land endowments, and the bilateral costs of trade. Productivity is determined through a random draw from country-specific crop yield distributions. Each country has a chance of being a low cost supplier depending on whether it has a bumper crop or crop failure in a given year.

A country's ability to trade is hampered by bilateral trade costs, however, which are estimated from a structural gravity model that is predicted by the model.

Comparison to other models

The framework provides an alternative to computable general equilibrium (CGE) models. As with them, the model can be used to simulate the effects of trade policy changes or other types of shocks once it is parameterized. The characterization of the global trading equilibrium differs in important ways from CGE models, however. For example, countries specialize in a subset of homogeneous crops as determined by their productivity distributions and the costs of trading with foreign markets. By contrast, most CGE models invoke specialization through differentiation by country. Relative to that approach, this model has greater flexibility in the extent to which trade patterns adjust in response to shocks to the system.

In this way the framework is more like a spatial equilibrium model, which allocates trade flows on the basis of lowest possible transportation cost. Unlike spatial equilibrium models, however, bilateral trade is predicted by a gravity model, which is generally superior at replicating actual trade flows.

Our gravity model is different from most in the literature, in turn, in that it is derived from the trade model used for the simulation analysis. It incorporates structural parameters from the yield distributions that govern specialization. Furthermore, gravity studies tend to focus only on what gets traded. We allow the size of the sector to be endogenous and account for the amount of trade relative to overall consumption, that is, the extent of "home bias" in consumption.

Parameterization of model

Data to estimate model parameters are primarily from the Food and Agricultural Organization (FAO) and the Global Trade Analysis Project (GTAP). The model corresponds to the following crops: paddy rice, wheat, oil seeds, and cereal grains not elsewhere classified.

Nearly every model parameter is econometrically estimated. Bilateral trade costs are calculated as an ad valorem tax equivalent and are estimated using the structural gravity equation predicted by the model. Parameters of the crop yield distributions are estimated by three alternative approaches. Approach I is a Generalized Method of Moments technique applied directly to the crop yield distributions. Approach II proceeds in similar fashion but involves Maximum Likelihood Estimation. Approach III starts with a different equation within the model and makes use of Ordinary Least Squares. The choice of technique affects the overall parameterization of the model since certain remaining parameters are a function of the parameters of the crop yield distributions. A comparison of the three parameterizations to external criteria provides evidence in favor of Approaches I and III. We base our subsequent simulation results on both approaches.

Crop markets are thin

With the model fully parameterized, we consider six counterfactual simulations. The first two are not meant to emulate actual policy scenarios but to illustrate basic points about the world trading system. We compare global trade volumes that are *observed* with those that would occur under hypothetical *zero trade cost* and *autarkic* (infinite trade cost) equilibria. When compared against these extremes, the international crops market is surprisingly close to the extreme of autarky. For example, observed trade volumes are only one-fifteenth of that which would occur under zero trade costs.

Another way to interpret this result is that there is far less trade than one might expect given how much countries differ in terms of their: (a) crop prices, (b) land endowments and rental rates, and (c) crop yields. The severity of barriers to international trade costs – whether caused by policy or geography – is also revealed by the sensitivity of trade flows to them. A mere 1% reduction in aggregate trade costs would increase world trade volumes by approximately 2.5%.

In the third and fourth simulations we distinguish trade costs that are in principle reducible, such as tariffs, from those that are difficult to reduce, such as transportation costs. The two simulations differ in terms of whether land is fixed within the crop sector. We find that a modest degree of liberalization – such that each country has a level of openness similar to the current U.S. level – leads to big welfare gains in most countries, mainly because crop prices for consumers can fall a great deal. Selected results are below:

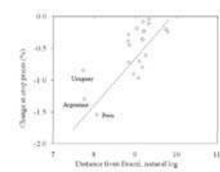
Table 4. Counterfactuals 3 and 4: Liberalized Import Policy

	Land is fixed by agricultural sector			Land is mobile across agricultural sectors		
Country	Net welfare	Crop prices	Land rental rates	Net welfare	Crop prices	Cropland area
Argentina	13.4	57.7	78.3	1.1	-4.7	306.7
Australia	5.0	-24.4	-6.2	7.0	-26.4	-33.3
Brazil	3.0	14.2	26.6	4.7	-18.7	16.3
Bulgaria	17.9	-56.9	-0.4	25.3	-64.0	-63.0
China	4.6	-39.3	-29.3	10.7	-37.0	-68.7
Ethiopia	4.4	-27.6	-4.0	10.2	-35.8	-43.9
France	7.8	-25.2	5.0	12.0	-40.2	-32.6
Greece	77.4	-93.7	-24.7	107.6	-96.3	-80.7
Hungary	45.0	-59.8	69.4	26.9	-66.0	106.5
Italy	32.0	-75.7	-20.6	52.3	-85.1	-65.1
Japan	14.4	-49.9	-37.0	29.0	-68.4	-95.3
Mexico	25.3	-74.7	-47.1	51.5	-84.8	-96.8
Morocco	13.3	-38.3	8.0	18.4	-55.5	-16.4
Peru	38.6	-88.6	-74.0	77.6	-92.6	-99.7
Romania	40.0	-60.1	57.3	26.1	-65.0	322.6
Russia	22.5	-46.1	30.9	19.6	-55.5	72.7
South Africa	8.2	-41.2	-20.1	20.4	-56.9	-78.7
Spain	25.5	-64.0	1.0	30.9	-70.5	-9.2
Turkey	21.2	-38.6	-1.3	28.1	-67.4	-5.3
Ukraine	9.8	-33.4	-1.3	15.4	-47.8	-24.7
USA	5.9	70.0	72.9	0.0	0.0	175.1
Uruguay	43.2	-87.7	-53.1	79.4	-92.9	-96.5
Zimbabwe	38.4	-87.6	-59.1	68.3	-90.5	-98.4

Note: Values are percentage changes. In both counterfactuals, import trade costs for each country are lowered to the level of the country that is most open in this regard (the U.S.). Approach I parameters are used. World trade increases 775% and 1,102% in the left and right scenarios, respectively. Crop prices refer to those faced by buyers.

Transportation costs matter

The fifth and sixth counterfactual simulations examine how changes in supply in one country affect the welfare of other countries. Distance in particular can greatly reduce the extent by which an event in one country is transmitted to others. The following scatterplot shows what happens if there would be an expansion of supply in Brazil, due, say, to an expansion of cropped area onto former rainforest. The effect to which prices fall in other countries is correlated strongly with their physical distance to Brazil:



Systematic differences between rich and poor countries

Many of the results differ systematically by countries' level of economic development, as proxied for by per capita income. Countries with high average productivity are more likely to be found on the high end of the global income distribution. Countries with high import trade costs, by contrast, are more likely (though not always) found on the low end of the global income distribution.

The insulation associated with high import trade costs may shield countries somewhat from adverse changes in other countries. However, it also means they may gain less when other countries are able to increase their supply. Regardless of these tendencies, it appears that all countries are very far from reaping the potential gains from trade in international crop markets. The framework offers a means for future researchers to determine the gains from trade from new policy directions.

For further information

Please contact jeff.reimer@oregonstate.edu phone 541-737-1415

OSU Oregon State University