AGRICULTURE TRADE LIBERALIZATION AND POVERTY IN CHINA: LINKED CGE MODEL ANALYSIS (DRAFT)

Xiaohe Liu (Principal Researcher)
Lan Fang (Researcher)
Hongye You (Research Assistant)

Institute of Agricultural Economics & Development (IAED)
Chinese Academy of Agricultural Sciences (CAAS)
12 Zhongguancun Nandajie
Beijing 100081, CHINA
E-mail: xliu17@hotmail.com

May 2007

Abstract

China's trade liberalization has progressed smoothly since the late 1980s. The gains and losses from agricultural trade liberalization are often unevenly distributed within a country, especially for China, which has nearly 100 *million rural people involved in agriculture experience poverty. In this study, we use a national CGE model of China linking to GTAP model to track the changes of household income and expenditure patterns due to the impacts of WTO membership on China's agriculture. Then we also compare several different scenarios to maintain a better trade policy for poverty elimination. The results from this study could be of great value for policy makers to identify courses of action for enhancing the positive income distributional outcomes and reducing any unfavorable effects from further changes in trade policy.*

Keywords: trade liberalization, poverty, agriculture, link CGE model

1. Main research questions and central research objectives

Since her accession to the WTO, China has undertaken substantial trade reforms in agriculture: tariff rates have been reduced, tariff structures simplified, and quantitative restrictions converted to tariffs. The average tariff rate on agricultural products was reduced from 23.2% in 2001 to 15.35% in 2005. Compared to the world's average agricultural products tariff rate, 62%, China has become a member of the group which has the lowest average agricultural tariff rate amongst all countries. However, China's average amount of natural resources per capita is much less than that of other countries, and the techniques in agricultural production are less advanced. As a result, China possesses no comparative advantage in most agricultural products. According to the review of the agricultural trade liberalization in recent years, there have been some impacts on Chinese farmers, who are categorized as being in the poorest group in China. Examples of the crops produced include soybean and tropical fruits. These sectors may be largely impacted during the trade liberalization and the consequential influence will obviously hurt the farmers. But until now, the impact of agricultural trade liberalization on the poor is still not quite clear and, therefore, is the subject of very intense debate.

Some questions to which answers are required include the following. Is the trade liberalization in agriculture within last five years favorable or harmful to the poor? What are the effects on different income levels of the poor? What alternative or accompanying policies may be used in order to ensure a more equitable distribution of the gains from freer trade? What are the channels through which these changes are most likely to affect the poor? These are examples of the quite challenging concerns that are the focuses of the ongoing debate on agricultural trade reforms.

In order to answer these questions, we use a national CGE model of China which has five types of rural households and five types of urban households. Moreover according to the national statistical data, we also make a link between labor and income of households. However, national model could not well deal with the international trade issues, especially for china which has large amount of imports and exports. To solve this problem, we link the

GTAP model to national model, so that we can analyze the effects on poverty of trade policy changes under WTO agreement on agriculture.

2. Scientific contribution of the research

Computable general equilibrium (CGE) models have long been used for poverty analysis. In traditional analysis, however, the Representative Household formulation is used to represent consumer behavior in the model. This formulation, although adequate for many purposes, limits our investigation of poverty and income distribution analysis.

Savard (2003) provides a discussion on poverty analysis and CGE models. From the point of view of that author, the models dealing with poverty and income distribution analysis can be classified into three major categories: models with single representative household (RH), models with multiple households (MH), and the micro-simulation approach that links a CGE model to an econometric household micro-simulation model.

The Representative Household model is used as the traditional method, and has been widely used in the literature. The main drawback of this model for income distribution and poverty analysis is that there are no intra-group income distribution changes available, as the households are all aggregated into one representative household. This, obviously, limits the scope of economic behavior in the model.

The second approach, namely the multiple-household model (MH), consists of the multiplication of the number of households. Increasing computation capacity allows us to process a large number of households in the model. In an extreme case, the total number of households in a household survey could be used. Cockburn (2001), for instance, studied the effects of trade liberalization on the poor in Nepal by using all 3373 households from the Nepalese Living Standards Survey in a national CGE model. Cororaton and Cockburn (2005) combined a CGE model with a micro simulation analysis of the effects of trade policy changes on poverty in Philippines, integrating all 24,979 households from the 1994 Family Income and Expenditure Survey. Rutherford et al. (2005) used all 55,000 households from Russian Household Budget Survey as ‘real’ households in their CGE model, analyzing the effects on poverty after Russia’s anticipated accession to the WTO. Annabi et al. (2005) use a

dynamic micro simulation CGE model of Senegal with 3278 observations. This approach then allows the model to take into account the full detail in household data, and avoids pre-judgment about aggregating households into categories. The major disadvantages of this type of approach are that data reconciliation could be difficult, and the size of the model could become a constraint.

The third approach, namely MS, draws on micro-simulation techniques. Here, a CGE model generates aggregate changes that are later communicated to a micro-simulation model based on a large database of unit records. The main advantages of this approach are: firstly, there is no need to scale micro economic data to match the aggregated macro data; secondly, we can accommodate more households in the MS mode. However, Savard (2003) pointed out that the drawbacks of the approach are coherence between models, since the causality usually runs from the CGE model to the micro-simulation model, with no feedback between them.

In recent years, there has been much research using CGE models to analyze trade liberalization. Previous studies mainly focused on the possible impacts at the national level (DRC, 1998; USITC, 1999; Wang, 1999; Martin et al., 1999; Walmsley et al., 2000; Lejour, 2000; Fan and Zheng, 2000), although some CGE studies do have considered the regional situation (Yang and Huang 1997; Fan and Zheng 2000; Diao et al. 2002, 2003; Jiang 2003). It is confirmed that the effects of trade liberalization at the national or regional level is positive. However, this does not imply that different types of household in China would benefit equally because that income is always unevenly distributed among sectors. Someone may seriously suffer due to the transaction of economic development and trade policies. Although there is a large literature in which CGE models have been used to measure the impact of trade reforms, very few attempts have been made to investigate the impact of agricultural trade liberalization on poverty, especially in China. Therefore, it is important to conduct this research.

In this paper, we intend to link GTAP model to a national model which integrate 10 types of households and 5 types of sectors. The model proposed in this project has three characteristics. Firstly, we use Version 6 database of GTAP model, and aggregate it into five sectors. Secondly, the technique which link GTAP model to national model developed by Mark Horridge (Mark Horridge Joaquim Bento de Souza Ferreira Filho 2003). Thirdly, the

national model of china is based on ORANI, we integrate 10 types of households and make a income matrix to measure the linkage between sectors and households.

3. Policy relevance

During the reform period, which started in 1978, China made huge progress to achieve its objectives: agricultural production rose sharply, rural industries absorbed a large part of farm labor, poverty fell dramatically, and the level and quality of food consumption improved significantly. The commune system was replaced by one where individual families hired land from the collectives, ensuring that almost all rural households had access to land and were, at minimum, food self-sufficient.

Currently, China has about 200 million farm households with an average land allocation of just 0.65 ha. Limited arable land and a large rural labor force mean that, in general, China tends to have a comparative advantage in the production of labor intensive crops, such as fruits and vegetables, and a disadvantage in the production of land intensive crops, such as grains and oilseeds.

One of the most striking features of China's development in the reform period has been a large and growing income disparity between the rural and urban populations. This is largely due to limited factor mobility, especially of labor and capital. Surplus farm labor and low labor productivity have resulted in low agricultural income and hidden unemployment in rural areas. The rural-urban gap in living standards is further accentuated by disparities in access to education, health care and other social services.

The level of policy support to agriculture, measured by %PSE, fluctuated from low levels through the 1990s, rising to 8% in 2003, but still well below the OECD's average of 30%. Support levels are highest for import-competing commodities such as sugar and milk, but also for exportable maize. Grain markets remain distorted, mostly due to state trading, which drives a wedge between domestic and world prices. The Total Support Estimate (TSE) is relatively high at 3.7% of GDP, reflecting a large expenditure on general services, in particular investments in agricultural infrastructure to improve productivity.

In line with the improving economic situation and sectoral performance, government

priorities have shifted from increasing production, especially of food grains, to rural income support and, more recently, to environmental concerns. In the medium term, the main challenges for China's policy makers include balancing the large income inequality between rural and urban populations; integrating small-scale farmers, who are dominant, into markets; stimulating internal reallocation of resources to create more efficient farm structures; reducing the negative impacts of increasing agricultural production on the environment; improving the competitiveness of agricultural and food products on domestic and international markets; and improving the governance of institutions in designing and implementing agricultural policies.

Meanwhile, with China's accession into the WTO, reduction of the agricultural tariff and abolition of some Non-Tariff-Barriers will benefit manufacturing sectors and hurt agricultural producers, and consequentially increase rural-urban disparity and thus influence the pattern of income distribution in different sectors and poverty incidence in different household groups.

It will be with great interest to give the Chinese government and international organization advice on how we can reduce inequality and poverty by means of China's agricultural trade liberalization, and finally reach the millennium development goals.

4. Methodology

(1) Reason for use of methodology

The GTAP model is designed for analysis related to international trade. For many situations or types of policy analysis, however, more detailed modeling of specific national economies may be required. As standard GTAP model only has one representative household, it is hard to take poverty research on it. National model usually set world price of commodity exogenous, which could not well deal with the international trade issues, especially for china which has large amount of imports and exports.

Therefore, only a national model or GTAP model is not the best tool for analyzing policy, which is related to international trade and poverty. To solve this problem, we link the GTAP model to national model, so that we can analyze the effects on poverty of trade policy changes under WTO agreement on agriculture.

2) Structure of the model

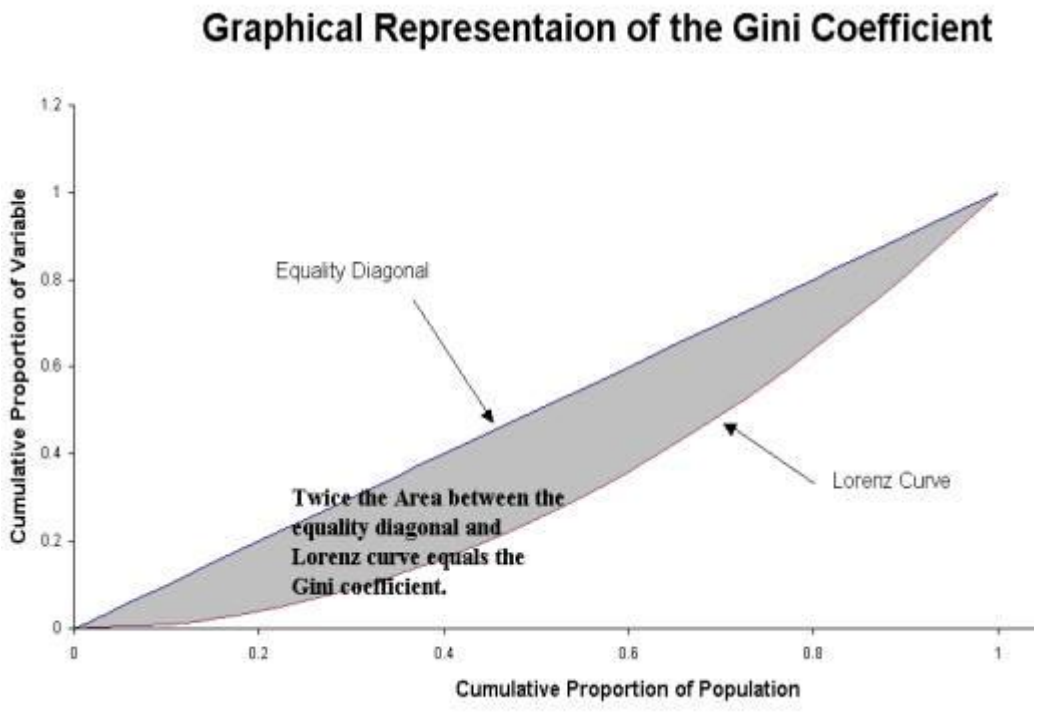
National model of China is based on ORANIG, which is a model developed by the Centre of Policy Studies, Monash University, Melbourne, Australia. We extended the household into five types of rural and five types of urban which grouped by their annual income. We also create an income matrix connected with income of different types households and different industries.

We aggregate GTAP database to make it coincide with national model. Then use the technique developed by Mark Horridge and Joaquim Bento de Souza Ferreira Filho in 2003, to link GTAP model with national model.

3) Poverty

Poverty is measured through Gini (Gini, 1912) index. The Gini Index was developed by Gini, 1912, and it is strictly linked to the representation of income inequality through the Lorenz Curve. In particular, it measures the ratio of the area between the Lorenz Curve and the equidistribution line to the area of maximum concentration. we aggregate that deficit between population shares and income shares in income across all values of p between 0 and 1, we would get half the well-known Gini index:

$$\text{Gini index} = 2\int_0^1 \big(\mathrm{p} - \mathrm{L(p)}\big)\mathrm{dp}$$



The Gini index implicitly assumes that all "share deficits" across p are equally important. It thus computes the average distance between cumulated population shares and cumulated income shares.

5. Base Year

Economic structure:

Household income and poverty:

6. Policy Experiments

Policy experiments are undertaken in the study:

Scenario1 (real reducation)：Actual tariff reduction that occurred between 2001 and 2005. This period was chosen because china entered the WTO in 2001.

Scenario2 (agricultural protection)：Agricultural sectors tariff reduction is half of the real one which occurred between 2001 and 2005. Reduction tariff of manufacture and services sector

Tariff cut (%)	Scenario1	Scenario2
Plan Production	11.61	5.80
Forestry	0.00	0.00
Live Stock	3.17	1.58
Fishing	0.90	0.45
Manufacture and Services	4.75	4.57

7. Simulation results

Macro effects: The tariff reduction leads to decline in the local price of imported products. As a result, consumer prices decrease by about 4 percent. The tariff reduction effectively reduces the price of imported intermediate inputs. This makes China-made products relatively cheaper in the international market: Export price index decrease by about 4 percent, lead to

about 29 percent increase in export volume index. The results of two scenarios are similar with each other.

Macro effects

Tariff cut (%)	Scenario1	Scenario2
Aggregate employment %	3.79	0.49
GDP price index, expenditure side %	-5.63	-5.55
Economy-wide wage rate %	-4.09	-4.00
Consumer prices %	-4.09	-4.00
Export price index %	-4.12	-4.06
Import volume index, CIF prices %	25.73	27.44
Real GDP from expenditure side %	2.81	1.26
Export volume index %	29.46	28.94

Effects on Sectors: The tariff reduction leads to decline in all of imports prices, domestic prices and output prices. From the table below, we could find that Plan Production has the largest disparity between the changes of imports prices and output prices. As a result, consumers substitute domestic commodity of Plan Production with cheaper imports one. According to the table (Effects on volumes), imports of plan production increased more than 100%, and total domestic output decline 2.9% in scenario one. And the rest of sectors have a positive change on domestic output. However, in scenarios 2 huge imports of plan production would not happened and all the sectors increase more or less in domestic output.

Effects on prices

Sector (percentage change)	Scenario1			Scenario2		
	Pm	**Pd**	**Px**	**Pm**	**Pd**	**Px**
Plan Production	-8.75	-4.59	-4.59	-4.39	-3.96	-3.96
Forestry	0.03	-2.02	-2.02	-0.01	-3.04	-3.04

Live Stock	-2.9	-3.63	-3.63	-1.53	-3.75	-3.75
Fishing	-0.71	-1.93	-1.93	-0.44	-3.46	-3.46
Manufacture and Services	-4.33	-4.12	-4.12	-4.33	-4.06	-4.06

Pm: import prices, Pd: domestic prices, Px: output prices,

Effects on volumes

Sector (percentage change)	Scenario1			Scenario2		
	m	**e**	**x**	**m**	**e**	**x**
Plan Production	106.18	24.45	-2.93	7.83	19.24	0.5
Forestry	-3.17	8.98	2.66	-7.29	13.72	1.25
Live Stock	-5.67	15.51	2.28	-19.54	15.5	1.02
Fishing	-2.75	3.8	0.99	-7.89	6.48	0.26
Manufacture and Services	24.41	29.69	2.48	28.37	29.23	0.16

m: imports, e: exports , x: total output

Factor: Factor price decline with every sectors, and quantity of primary factor increase except Plan Production. With both of factor quantity and price decline, the factor income decreases in Plan Production. Moreover, hundreds of millions rural labors works on Plan Production. The decline of this sector will influence the life of rural households. We will analysis households income and consumption.

Effects on Factor Market

Sector (percentage change)	Scenario1			Scenario2		
	xlab	**xprim**	**pprim**	**xlab**	**xprim**	**pprim**
Plan Production	-4.97	-2.93	-4.72	0.85	0.5	-3.9
Forestry	3.52	2.66	-1.39	1.65	1.25	-2.76
Live Stock	4.13	2.28	-3.01	1.85	1.02	-3.51

Fishing	2.05	0.99	-0.69	0.53	0.26	-3.14
Manufacture and Services	5.08	2.48	-4.04	0.32	0.16	-4

xlab: quantity of employment, xprim: quantity of primary factor, pprim: price of primary factor

Household Income: In senario1, the consumptions of different types of households increase except the ruralhh1-poorest group in the nation. And urban households get more percentage change than rural households. In rural households, the consumption of households with less income gets less percentage change; while in urban highest and lowest income household get less percentage change. However, in scenario2, rural households get more percentage change than urban households. And both in rural and urban households, the highest get less. In the poverty analysis, we use Gini coefficient to measure the inequality. According to Gini coefficient, in base year china has the least Gini coefficient, and Scenario1 course the income a little more inequality than in Scenario2. After all, the impact of tariff cut on real income is not obvious.

Real income (2001)Per Capita	Base year (dollar)	Scenario1 (%)	Scenario2 (%)	Scenario1 (change dollar)	Scenario2 (change dollar)
ruralhh1	103.27	-0.45	0.57	-0.46	0.59
ruralhh2	186.45	0.09	0.6	0.17	1.12
ruralhh3	260.74	0.47	0.58	1.23	1.51
ruralhh4	365.11	0.78	0.56	2.85	2.04
ruralhh5	710.32	1.59	0.51	11.29	3.62
urbanhh1	802.33	2.74	0.34	21.98	2.73
urbanhh2	595.98	2.77	0.34	16.51	2.03
urbanhh3	767.02	2.79	0.35	21.40	2.68
urbanhh4	983.64	2.8	0.35	27.54	3.44
urbanhh5	3071.06	2.58	0.32	79.23	9.83
Gini coefficient	0.4982	0.5017	0.5001	-	-

Households grouped by different income level. Rurahh1 is the group which has the least income in rural, Ruralhh5 is the group which has the highest income in rural, the same as urbanhh

8. Conclusion

The tariff reduction leads to a decline in local import prices, inducing consumers to substitute cheaper imported agricultural products for their domestic counterparts. Similarly,

the tariff reduction brings about cheaper intermediate inputs as it drives the domestic cost of production down, benefiting the outward-oriented-import-dependent industrial sector as output and exports increases. Agricultural output decline while industry and services output expand. It affects the income of rural households which engaged in agriculture production. According to the analysis of household income, real tariff cut (scenario 1) could increase income of most households. But it also bring about a little inequality in income.

7. Short list of key references

Annabi, Nabil, Cissé, Fatou, Cockburn, John and Decaluwe, Bernard, 'Trade Liberalisation, Growth and Poverty in Senegal: A Dynamic Microsimulation CGE Model Analysis', CIRPEE Working Paper No. 05-12, May 2005.

Cockburn, J., 'Trade liberalisation and Poverty in Nepal: A Computable General Equilibrium Micro Analysis', Discussion paper 01-18, Centre de Recherche en Économie et Finance Appliquées (Université Laval), October 2001.

Caesar B. Cororaton, John Cockburn, Erwin Corong, Doha Scenarios, 'Trade Reforms, and Poverty in the Philippines: A CGE Analysis', MPIA Working Paper, 2005-03.

Diao, X., Fan, S. and Zhang, X. (2002) 'How China's WTO Accession Affects Rural Economy in the Less-developed Regions: A Multi-region, General Equilibrium Analysis', *TMD Discussion Paper No. 87*, International Food Policy Research Institute, Washington DC.

Diao, X., Somwaru, A. and Tuan, F. (2003) 'Regional and National Perspectives of China's Integration into the WTO: A CGE Inquiry with Emphasis on the Agricultural Sector', *Review of Urban & Regional Development Studies*, 15: 84-105.

Jiang, T. (2003) 'The Impact of China's WTO Accession on Its Regional Economies', *Australian Agribusiness Review*, 11.

Lejour, A. (2000) ‘China and the WTO: The Impact on China and the World Economy’, mimeo, Netherlands Bureau for Economic Policy Analysis, and paper presented at the third annual conference of Global Economic Analysis, Melbourne.

Mark Horridge, Joaquim Bento de Souza Ferreira Filho,(2003) ‘LINKING GTAP TO NATIONAL MODELS: SOME HIGLIGHTS AND A PRACTICAL APPROACH’, Presented at the 6th Annual Conference on Global Economic Analysis, The Hague, The Netherlands

Peter B. Dixon and Maureen T. Rimmer (2002) ‘Dynamic General Equilibrium Modelling for Forecasting and Policy’, North-Holland.

Rutherford, Thomas F., Shepotylo, Oleksandr and Tarr, David, ‘Poverty Effects of Russia's WTO Accession: Modeling 'Real' Households and Endogenous Productivity Effects’, World Bank Policy Research Working Paper No. 3473, January 2005.

Savard, L. (2003) ‘Poverty and Income Distribution in a CGE-household Sequential Model’, International Development Research Centre – IDRC processed, 32p..

Wang, Z. and Zhai, F. (1998) ‘Tariff Reduction, Tax Replacement, and Implications for Income Distribution in China’, *Journal of Comparative Economics*, 26: 358-87.

Yang, Y. and Huang, Y. (1997) ‘The Impact of Trade Liberalization on Income Distribution in China’, *Economics Division China Economy Working Paper 87/1*, Research School of Pacific and Asian Studies, ANU.

Zheng, Yuxin and Fan, Mingtai (1999) ‘A Chinese CGE Model and Its Application to Policy Analysis’, Social Sciences Documentation Publishing House, Beijing.