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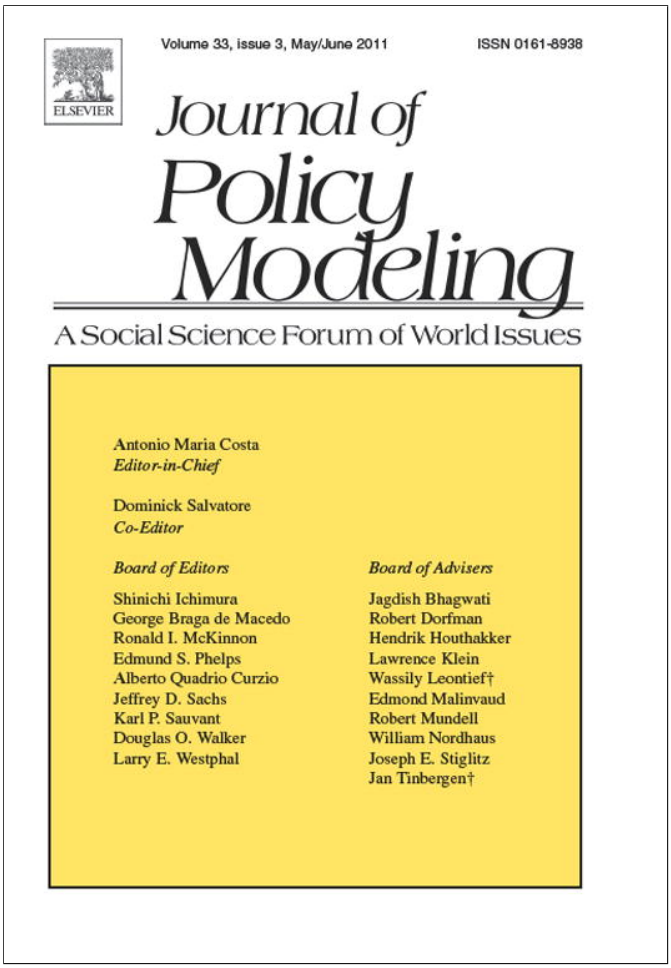

Volume 33, issue 3, May/June 2011 ISSN 0161-8938

ELSEVIER

Journal of Policy Modeling

A Social Science Forum of World Issues

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Journal of Policy Modeling
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The impact of the Doha trade proposals on farmers' incomes in China

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Received 1 February 2010; received in revised form 1 July 2010; accepted 1 August 2010
Available online 24 August 2010

Abstract

This paper analyzes the potential impacts of the Doha trade proposals (those of the USA, EU and G20) on agricultural production and incomes of China's farmers by region and income group. By linking a global trade model to a national policy model which itself is connected to a set of disaggregated household data, we are able to assess the effects of the proposed Doha trade liberalizations on households both at the national and regional levels. According to the results of the model, the impacts of a Doha Round agreement on households differ significantly from those of China's WTO accession. China's economy would benefit from the trade liberalization associated with the Doha Round. The overall impacts, however, are relatively minor. Although farmers will benefit at the national level, the gains among farmers vary largely by income group and province. Also, the impacts on households that produce different types of crops differ.
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Keywords: Doha trade liberalization; Poverty alleviation; General equilibrium model; Regional impacts

JEL classification: F13; C68; I32; R12

1. Introduction

It is well known that over the past several decades that China has experienced remarkable economic growth and impressive poverty reduction. The annual growth rate of gross domestic product

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doi:10.1016/j.jpolmod.2010.08.005

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(GDP) reached 9.8% between 1979 and 2006 (NBSC, 2007a,b). The incidence of rural poverty (based on China's official poverty line) fell from 31% in 1978 to 2.3% in 2006 (NBSC, 2007). Despite this remarkable record, China continues to confront great challenges in its development, including addressing concerns about those that remain in poverty.

While there are a number of potential drivers of these adverse economic trends, many have pointed to trade liberalization as one of the main reasons (Huang, Xu, Li, & Rozelle, 2005; Huang, Zhang, & Rozelle, 2007; Mao & Liu, 2005; Wang, 2002). Agriculture was at the center of debate over China's entry into the WTO. There was great concern inside China that its rural economy was highly vulnerable to trade reforms. Despite the sensitivities inside China, because of the importance of agriculture in the political economies of a number of the developed nations with whom China negotiated its accession to the WTO, there were high demands made of China's trade policy makers. Even now nine years after China's accession to the WTO, despite the conclusions of several studies that have shown that the effect of WTO accessions on China's agriculture (in general) has been modest (Anderson, Huang, & Ianchovichina, 2004; Huang, Li, & Rozelle, 2003; Huang, Rozelle, & Chang, 2004), there is still concern about the impacts that additional trade liberalization—such as, the new round of the Doha negotiations—might have on China's agricultural production and rural poverty.

A careful analysis of the trade impacts on poverty is particularly needed in the light of the ongoing Doha negotiations. Based on our knowledge, there is no study in China that analyzes the impacts of the recent proposals by the USA, the EU and the G20 on China's agriculture and rural poverty. More generally, there is also little if any work that has attempted to assess the effect of trade policy changes on specific agricultural commodities on a disaggregated regional level (i.e., the province level). Without this type of analysis, it is difficult to generate convincing results that can be used to measure the effect of proposed trade liberalization moves on households and to develop policies to try to offset the adverse effects.

The overall goal of this paper is to improve our understanding of how further trade liberalization will affect China's agricultural development. More specifically, in this paper we seek to examine the impacts of Doha Round negotiations on the production, prices and incomes of farmers, and particularly the income of the poor, in different regions of China. These results can then be used as a basis for designing policies to help offset the negative effects—especially those on the poor.

2. China's agricultural trade and Doha round negotiations

The structure of China's trade, in general, and agricultural trade, in particular, has changed dramatically over the past two decades. While the seven-fold increase in exports of food products during the period would be regarded as extraordinary in almost any other economy, it pales into insignificance relative to the 34-fold increase in non-agricultural exports. During this same time period, agricultural imports grew by a factor of 11—although the rate of rise varied among commodities. Imports of oilseeds grew by a factor of 96; fruits and vegetables by a factor of 84; and fish by a factor of 70, all from low initial levels. By contrast, imports of grains grew by a factor of two, far below the growth rate of exports. Imports of agricultural fibers, mainly cotton, grew by a factor of 6, also below the growth rate of overall agricultural exports, although these imports grew substantially after China's WTO accession. Interestingly, despite the relatively higher in total exports compared to total imports during the past 30 years, net agricultural trade has gradually changed from surplus to deficit over the past decade. However, the trade deficit in agriculture is still small: by 2005 the volume of agricultural net trade deficit was only 0.4% of China's total exports.

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Regardless of China's net trade position, since its accession to the WTO, the agricultural trade regime has become relatively open. For key products, such as rice, wheat and maize, the assessed tariffs have been low because the in-quota tariff rates have generally been the ones that have applied (see Huang, Yang, Li, Rozelle, and Martin (2009), Appendix Table 1, for a complete listing of these rates). For many other products, such as fish products, oilseeds, pork, poultry, sugar and dairy products, protection rates are relatively low and higher out-of-quota rates are not applicable.

The fact that China's agricultural tariff rates are relatively low is important for the decisions of leaders who are trying to decide whether to go along with. The potential to secure large market access gains is especially important economically for countries like China, whose own agricultural trade barriers are relatively low, but which face relatively high barriers in export markets. Huang et al. (2009) showed that while China's agricultural import tariffs are in some cases above world average tariff rates, in most cases they are below them. However, at the same time (and importantly for this paper) the tariffs on exports from China (that is, the rates imposed on China's food exporters) are above the world average rates. When taken together, in fact, the data show a pattern of tariffs (in many cases) being higher on exports from China than on the rest of the world's exports. This pattern of distortions may mean that China can best address this set of systematic inequalities through negotiations under the WTO.

2.1. Main proposals in the Doha round negotiations

Despite the heavy burden imposed on countries like China by other countries' barriers, the WTO negotiations under the Doha agenda will not reduce agricultural protection to zero. Rather, what is envisaged is reduction in tariff rates using a so-called tiered-formula approach that makes larger cuts in higher tariffs. The specific approach to be used has been the subject of great disagreement, with a wide range of proposals advanced as the negotiations have continued. One relatively early point of agreement, however, was that the all proposals for negotiation would use four "tiers." For the industrial countries, some of the key proposals have included those offered by the USA and the EU. The proposal that is supposed to reflect more of the developing countries point of view is the one developed by the G-20. Building on the G-20 proposal, Falconer (2007) subsequently suggested a range of possibilities for cuts in each tier. Each of these proposals is set out in Table 1.

As is evident from Table 1, the US proposal was by far the most ambitious, with a ceiling tariff after cutting of 75%, and cuts of 90% in tariffs above 60%. The G-20 proposal, which has been the basis for most of the discussion in recent years, involved a tariff cap of 100%, and cuts of 75% in tariffs above 75%. The most recent proposal, by Crawford Falconer, the chairman of the agricultural negotiations, removes the explicit cap on tariffs, and lowers the cuts in the highest tariffs, while raising the cuts in the lowest tariffs. Since the G-20 proposal captures the broad nature of the policy changes involved in the subsequent proposal, and because the Falconer proposal provides only ranges (and these ranges seem likely to change in the future), we focus primarily on the G-20 proposal in our analysis.

As is clear from Table 1, the proposed tiers for developing countries are wider than those for the industrial countries. This means that in the case of developing countries, the stiffest tariff cuts do not apply except for the higher rates of tariffs (when compared to the case of industrial countries). For example, under the G-20 formula, the largest cuts are in tariffs above 130% for developing countries, rather than those above 75% for the industrialized countries. In addition, the largest cuts only reach 40% for these tariffs (in the case of developing countries), rather than 75% as in the case of industrialized countries. The Falconer proposal also eliminates the tariff

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Table 1
Proposed tariff reductions of agricultural commodities (%).

	EU proposal		G20 proposal		US proposal		Falconer	
	Tiers	Cut	Tiers	Cut	Tiers	Cut	Tiers	Cut
For industrial countries								
1	<30	35	<20	45	0 < 20	65	< 20	48–52
2	30–60	45	20–50	55	20–40	75	20–50	55–60
3	60–90	50	50–70	65	40–60	85	50–75	62–65
4	>90	60	>70	75	>60	90	>75	66–73
Cap	100	100	75	No Cap				
For developing countries								
1	<20	37–43	<30	25	<30	25(1–40)	<30	32–34.6
2	20–40	43–50	30–80	30	30–80	30	30–80	36.6–40
3	40–60	50–57	80–130	35	80–130	35	80–130	41.3–43.3
4	>60	57–60	>130	40	>130	40	>130	44–48.6
Cap	112	150	150	No Cap				

Source: Hanrahan and Schnepf (2005), Sharma (2007) and Falconer (2007).

cap. For developing countries, it raises the tariff cuts on both the lowest and the highest tariffs relative to the G-20 formula.

Since these tariff formulas are to be applied to bound, rather than applied tariffs, their ultimate effect on applied rates will depend upon the gap between bound and applied tariff rates. It will also depend upon the extent to which some countries are excluded from the formula cuts, and particular products are selected for more flexible treatment than is allowed under the formula. In this stage of our analysis, we focus on the impacts of formula cuts to provide a benchmark against which these questions of flexible treatment can be addressed in future research. Besides the market accession negotiations, export competition and domestic support are other two important aspects in the Doha trade negotiations. These will also be considered in the modeling.

3. Methodology and scenarios

To understand the impacts of different proposals for trade liberalization in the Doha Round WTO negotiations, we use two models, the Global Trade Analysis Project (GTAP) and the Chinese Agricultural Policy Simulation and Projection Model (CAPSiM). The national-level economic impacts of Doha are assessed with the GTAP model. The simulated price changes of international agricultural products are then fed into CAPSiM in order to analyze the impacts of a Doha agreement on China's agricultural production. A module embedded in CAPSiM then allows us to study the effects of trade policy changes on the incomes of farmers by region and by income group.

While a more complete description of the model can be found in Huang et al. (2009), in briefest terms our international trade model uses GTAP, a well known multi-country, multi-sector computable general equilibrium model which is often used for international agricultural trade analysis (Hertel, 1997). We cannot, however, rely solely on GTAP since China enters the analysis as a single region. In order to meet our goals of tracking the effects of trade liberalization to households (and on different regions of the country), we also have to be able to model the effect of trade policy changes on China's agricultural economy. To do this, we adopt CAPSiM, a model differs from GTAP in several ways. First, CAPSiM is a partial equilibrium model. Most of the

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elasticities used in CAPSiM are estimated econometrically by ourselves using state-of-the-art econometrics and with assumptions that make our estimated parameters consistent with theory. Both the demand and supply elasticities change over time since income elasticities depend on the level of income. In addition, cross-price elasticities of demand (supply) depend on the food budget shares. In CAPSiM, the crops are also more disaggregated. CAPSiM can analyze 19 crops and livestock and fishery commodities, including all of the main cereals (rice, wheat, maize and soybean), sweet potato, potato, soybean, other edible oil crops, cotton, vegetables, fruit, other crops, six livestock products, and one aggregate fishery sector. The 19 commodities account for more than 90% of China's agricultural output. Finally, recent versions of CAPSiM are designed to track changes in policies, including trade liberalization, on both national and regional (provincial) aggregates and households.[1] The description of the actual way that GTAP and CAPSiM are linked can be found in Huang et al. (2009).

3.1. Policy scenarios

In this study, four scenarios are considered in assessing the impacts of Doha on China's agriculture at the national, regional and household levels. The four scenarios include one baseline scenario and 3 alternative Doha policy scenarios. The Doha policy scenarios include USA proposal, the EU proposal and the G20 proposal. In the analysis we are going to assume that all of the parts of the Doha agreement are realized by 2015. As such, we estimate the impact of Doha by comparing the baseline results with those under Doha policy scenarios in 2015.

3.1.1. Baseline scenario

In the baseline scenario, there are several key assumptions. First, we assume that there is no Doha agreement. Instead, every country will continue operating under their existing policies. If there are major trade agreements that affect agriculture, they are not due to the Doha Round. Therefore, our scenario embodies the effects of important known policies related to international trade, such as the continued implementation of the Uruguay Round commitments, China's WTO accession promises (which continue to take effect through 2010), the phase-out the Multi-fiber Agreement (MFA—by January 2005) and the implementation of the Agreement of Free Trade Areas between China and ASEAN member countries.

3.1.2. Doha policy scenarios

Doha negotiations mainly focus on three so-called pillars (i.e., market access; export competition or subsidies; and domestic support). Although there is a consensus that it will include elimination of export subsidies, the proposed reductions in import tariff and domestic support vary significantly between the EU, G20 and USA proposals. The major proposed policy commitments that are parts of the EU, G20 and USA proposals are summarized in Table 1. In short, the policy shifts described in the table constitute the major inputs into the scenario formulations.

[1] In order to estimate the impact of national changes in price, supply and demand on households, CAPSiM's equilibrium solutions, including estimated levels of supply, demand and the level of food prices, are simulated at the national level given international prices. Domestic prices at the national level are transmitted to each region (province) and to the various households within each region. Given the prices transmitted to the local level, each group of households within each region change their production and consumption of each commodity based on the production and consumption elasticities which also differ among regions and household groups. The impacts of trade liberalization on agricultural income for each group of farmers are estimated given the changes in the household production and local prices as well as input changes.

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Table 2
The macro-impacts on China under EU, G20 and USA proposals in 2015.

	EU proposal	G20 proposal	USA proposal
EV (million USD)	3479	3361	3413
Real GDP growth (%)	0.05	0.05	0.05
GDP price index (%)	0.99	0.98	0.97
Total income (%)	1.08	1.07	1.06
Term of trade (%)	0.46	0.43	0.44
Total export (%)	3.89	3.92	4.01
Total import (%)	5.56	5.60	5.70
Trade balance (million USD)	2293	2286	2492
Agricultural income (%)	2.04	2.05	2.24
Agricultural export (%)	10.31	10.99	19.89
Agricultural import (%)	6.83	7.41	9.08

Source: GTAP simulation results.

In the process of modeling the proposed provisions, there are two key modeling issues that need to be addressed when one seeks to embed the proposals into the GTAP model. The first is what kind of import tariff lines (applied tariffs or bound tariffs) is used for calculating the tariff reduction. Although the gap between bound tariffs and current applied tariffs can be significant in the case of some countries (Laborde, 2007), as only the applied tariffs are available in GTAP database, the tariff cuts in our research are based on the applied tariffs.[2]

The second issue that we must address is what cuts in domestic support we should include in the reduction formulas. Specifically, we need to make assumptions of the level of amber box support in order to be able to make the cuts that are demanded by the different proposals. In order to make our analysis consistent with other careful trade analyses, the categories of Amber Box support and the subsidies in GTAP used in this study follow those used by Rae and Strutt (2003).

4. Potential impacts of the Doha round negotiations

Table 2 summarizes the impacts of the three policy scenarios on China's overall economy. The most interesting result is that regardless of which of the three scenarios that is simulated, a Doha agreement would improve China's economic welfare and stimulate domestic economic growth though the impacts would not be large. According to our analysis, if any of these three agreements were implemented, China's welfare would increase by about 3.4 billion US$. Real gross domestic production would rise by 0.05% when comparing the results of the scenario analyses to the baseline. At the same time, international trade would also expand, including both imports and exports. Since the export price rises higher than the import price, China's terms of trade would improve and China's imports will grow faster than its exports. Although China's imports grow faster than its exports, China's trade balance will still increase by about 2.3 billion.

While the overall impacts are minor, individuals associated with China's agricultural sectors would benefit from the adoption and extension of the proposed trade liberalization changes being discussed under the Doha negotiations. As shown in Table 2, the rise in income in agriculture is

[2] The gap between bound import tariff and current applied import tariff is usually called "binding overhang." Using applied tariffs, however, implies that the estimated impacts that are simulated in this study should be considered as upper bounds.

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about two times that of the national average. Similarly, the increases of agricultural exports and imports are also larger than those of the national average. Moreover, the growth of agricultural exports is higher than that of imports. This relatively higher rate of rise in exports implies that the agricultural sector as a whole will enjoy more trade benefits from Doha trade liberalization.

4.1. The impact on China's international prices, trade and domestic production

Compared to the overall economic impacts, Doha Round liberalization would have larger impacts on the international prices faced by China and international trade of agricultural commodities. Importantly, however, the trade and price impacts will vary significantly among commodities. Whether a sector will enjoy higher prices from greater access to global markets (or whether it will encounter more competition from the inflow of imports from the rest of world) largely depends on pre-Doha policy arrangements, trade status, domestic support policies and the post-liberalization reallocation of resources among domestic sectors. Our results also show that the impacts of Doha multilateral trade liberalization on China are quite different from the effects of unilateral liberalization of China's WTO accession.

Compared to the results under the baseline, if the Doha round were to take effect, China's imports of grains and soybean will fall, while its exports will increase and China will gain in net export of these crops in Doha Round.[3] The nature of impacts is the result of how China's trade responds to the changes in the international prices of these commodities due to trade policy changes. For the three scenarios simulated, compared to the baseline in 2015, our results show that the Doha Round will raise China's import price of grain by about 2% for rice, 3–4% for wheat, about 6% for maize and other coarse grains, and 1–2% for soybean. Rising import prices will lead to corresponding declines in the imports of these commodities. The largest declines in imports, about 25–27%, will occur in the case of wheat and maize. On the other hand, all export prices of grain and soybean will rise. The rise in these export prices will range from 6–7% for wheat, to 12–17% for rice, and to 15–19% for soybean. With the negative impacts on imports and positive impacts on exports of grain and soybean, China's trade balance (or net exports) of these commodities would rise by about 500 thousand tons for rice, more than 400 thousand tons for wheat and about 500–700 thousand tons for soybean and maize. The Doha development agenda tends to improve China's food security.

The projected changes in grain and soybean prices are not surprising given the current production and trade policies as well as policy reforms in the future. Grain sector is heavily protected and supported by many developed countries. The world average of applied import tariffs on rice, wheat and coarse grains are 8.7%, 4.3% and 8.2%, respectively, the highest among all commodities except sugar. While the protection of soybean in the rest of world is relatively less than grain, its protection is also high. However, China's import tariffs on grain and soybean has become very small after its WTO accession. Moreover, China has never applied its above quota tariff on imported grains. On soybean, the single tariff rate (3%) policy has been implemented since the early 2000s. As a consequence, the tariff cut on imports of these commodities will be limited for China. Moreover, China's export of rice and maize still face the high tariff rates in place in other countries. Therefore, Doha multilateral trade liberalization implies that the ratio of international to domestic prices of grains and soybean will increase, which will facilitate China's exports and lower China's imports.

[3] Due to space restriction we do not provide the full results in table form for the impacts on trade flows and prices. For more detail, see Huang et al. (2009).

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In contrast, the situations will be different for the cases of sugar and cotton. Moreover, the findings also differ between these two commodities. Although China's agriculture has been largely liberalized, sugar is still relatively heavily protected by the nation's border policies. The average import tariff on sugar in 2006 was about 12.7%, which is higher than the worlds' average tariff, 9.3%. Although Doha trade liberalization will raise the world price of sugar, China's sugar import price is expected to fall by 2.9–5.7% (under the different scenarios). This fall will occur because the tariff reduction in China is scheduled to be more than the increase in the world price of sugar. Consequently, compared with the baseline in 2015, China's imports of sugar will rise by about 15–20%. Although China's export of sugar will also increase, exports will be minimal and China's net import will increase by about 400–500 thousand tons because of much higher volume of imports in the baseline scenario.

Both the import and export of vegetables and fruit will expand in China, however, the positive impact on China's horticulture exports under the Doha Round will be more than its impacts on import's increase; this shift, of course, means that China's trade surplus in the vegetable and fruit sub-sectors will rise. China has a strong comparative advantage in the production of horticulture since this is one of China's more labor-intensive cropping sub-sector. Moreover, China's vegetables and fruit have great potential to expand if the Doha Round (or future rounds of trade liberalization) talks can reduce the high import tariffs levied by other countries on China's horticultural exports.

The impacts of the Doha Round on the domestic production inside China are fully consistent with the impacts of the Doha Round on trade in a number of ways. First, the production of many grains (e.g., rice, wheat, maize, potato and other coarse grains) will increase. Second, while the results for grain may not be surprising (due to the high levels of liberalization during the WTO accession negotiations), our results suggest that the production of other land-intensive commodities, such as soybean, oil crops and cotton, will also increase. In fact, the growth rates of soybean and cotton are the highest among all the crops. The production of soybeans will increase by 1.9%, 2.0% and 1.8% respectively in the EU, G20 and US proposals (Table 3). At the same time, the output of cotton will rise by about 1.7% in all three proposals (Table 3). Third, one of the most consistent results is that horticultural farmers should gain from trade liberalization. According to our model, the output of labor-intensive vegetables and fruit will increase. This is especially true in the more liberal US proposal. In fact, this is mostly true since the tariffs of vegetables and fruit decrease sharply in US proposal, if that proposal were to be realized, China would be able to further exploit its comparative advantage in labor-intensive vegetables and fruit. Finally (and importantly), our results indicate China's production of many animal products (i.e., beef, mutton, pork, poultry and eggs) will fall under the Doha trade scenarios.

4.2. The impacts on farmer income and poverty in China and its regions

Our results reveal that Doha trade liberalization has effects beyond supply, demand and trade (and prices and national food security); additional trade reform will also help, in general, China's farmers increase their income. The contribution to income growth, however, according to the findings, will be limited. As shown in Table 4, the per capita income of farmers, on average (for the nation), will rise by 1.07% (or about 22 yuan), 1.12% (about 23 yuan) and 1.17% (about 24 yuan), respectively, in the EU, G20 and US proposals. The results also indicate that the gains of farmers will increase under the more liberalized proposals.

Perhaps the more important result of this paper—given our interest in designing policies to help China maximize the benefits and minimize the cost of trade reform—is that, while the gains

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Table 3
The impacts on production in China under different scenarios in 2015.

	Baseline (thousand ton)	Impacts under difference scenarios					
		EU proposal		G20 proposal		USA proposal	
		(Thousand ton)	%	(Thousand ton)	%	(Thousand ton)	%
Milled rice	123,130	82	0.07	149	0.12	248	0.20
Wheat	98,643	79	0.08	88	0.09	84	0.09
Maize	181,251	88	0.05	32	0.02	−54	−0.03
Sweet potato	22,596	−48	−0.21	−53	−0.23	−58	−0.26
Potato	19,084	44	0.23	46	0.24	53	0.28
Other grain	15,735	248	1.58	248	1.58	228	1.45
Soybean	20,396	382	1.87	408	2.00	366	1.79
Cotton	9144	153	1.67	156	1.71	155	1.70
Oil crop	9658	26	0.27	36	0.37	20	0.21
Sugar crop	11,909	−289	−2.43	−318	−2.67	−370	−3.11
Vegetable	464,688	128	0.03	384	0.08	1490	0.32
Fruit	153,826	86	0.06	172	0.11	569	0.37
Pork	58,465	−204	−0.35	−220	−0.38	−240	−0.41
Beef	5905	−82	−1.39	−85	−1.44	−90	−1.52
Mutton	3481	−40	−1.15	−41	−1.18	−45	−1.29
Poultry	19,292	−30	−0.16	−42	−0.22	−55	−0.29
Egg	23,707	−88	−0.37	−90	−0.38	−93	−0.39
Milk	45,709	51	0.11	25	0.05	5	0.01
Fish	33,815	65	0.19	69	0.20	66	0.20

Source: CAPSiM simulation results.

are positive (albeit small), on average, they vary by income groups, topography and by minority status. Although per capita incomes in all income groups will be improved, the benefits increase gradually from the lowest to the highest income groups. As the shown in Table 4, the per capita income of those farmers under poverty will increase by 1.00% (or 8.3 yuan), 1.06% (8.7 yuan)

Table 4
The impacts on per capita agricultural income in rural area by income groups under EU, G20 and USA proposals in 2015.

	Absolute change (yuan)			Relative change (%)		
	EU proposal	G20 proposal	USA proposal	EU proposal	G20 proposal	USA proposal
National average	22.06	23.05	24.02	1.07	1.12	1.17
Under poverty	8.29	8.72	9.21	1.00	1.06	1.11
Income group 1	15.41	16.06	17.19	1.11	1.16	1.24
Income group 2	23.45	24.19	25.47	1.28	1.32	1.39
Income group 3	38.45	39.76	41.30	1.62	1.68	1.74
Income group 4	54.15	55.73	56.51	1.77	1.82	1.85
Income group 5	69.55	71.38	71.62	1.64	1.68	1.68
Farmers: Han	22.30	23.32	24.37	1.08	1.13	1.18
Farmers: Minority	8.40	7.48	3.71	0.44	0.39	0.20

Source: CAPSiM simulation results.
Note: The group under poverty includes all households with per capita income of less than 872 yuan in 2001, which accounted for about 10% of rural population. Per capita income of groups 2, 3, 4, 5 and 6 were in the ranges of 872–1300, 1300–1700, 1700–2300, 2300–3300 and above 3300 yuan, respectively. The groups 2, 3, 4, 5 and 6 accounted for about 15%, 15%, 20%, 20% and 20% of rural population in 2001.

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and 1.11% (9.2 yuan) in the EU, G20 and US proposals (row 2). Correspondingly, the increase in per capita agricultural income of those farmers in the top income group (i.e., income group 5) will rise by 1.64% (or 69.6 yuan), 1.68% (71.4 yuan) and 1.68% (71.6 yuan). This rate is higher than that of the group farmers that earn incomes under the poverty line. In this way, we cannot say the trade liberalization is progressive.

Interestingly, our results also allow us to show that ethnicity matters. The per capita income of Han farmers is shown to rise more than that of those that live in minority villages. The average per capita income of Han farmers will rise by 1.08% (22.3 yuan), 1.13% (23.2 yuan) and 1.18% (24.4 yuan) in the EU, G20 and USA proposal. Correspondingly, the income growth of minority farmers is much lower.

One of the most important parts of our analysis is our investigation into the sources of different gains (losses) among groups. Among all of the differences, the most important is the differences among the groups in terms of their farming structure. In other words, richer Han farmers living in plains village benefit more because of the nature of the crops that they are producing. In order to clearly show the difference in farming structure among the groups, we classify agricultural commodities into three groups based on our analysis of production and trade. The first group is composed by those commodities that are discovered by our analysis to produce benefits for farmers. The set of goods include rice, wheat, soybean, cotton, oil crops, vegetables, fruit and fish. We call these *benefiting commodities*. The second group includes those that when produced under the Doha round proposals will lead farmers to incur a loss (relative to the baseline). These activities include sweet potato, sugar, beef, mutton, pork and poultry. We call these *non-benefiting commodities*. The rest agricultural commodities are not affected significantly. These activities include maize, milk, potato and some minor crops (e.g., other grain). We call these *neutral commodities.* Through the comparison of farming structures—benefiting versus non-benefiting—we seek to explain the reason why different groups enjoy/suffer different impacts.

The farming structures of different groups help explain the nature of their benefits. As shown in column 1 of Table 5, the different income groups that gained the most from the Doha round also produced more benefiting commodities. Specifically, farmers that were under the poverty line only had 53% of their output from benefiting commodities. In contrast, those in the top decile had 67% of their output in benefiting commodities. Although the share of the non-benefiting commodities to total production was almost the same (there is a difference in products that are neutral), the difference between the propensity of higher income groups to produce relatively more benefiting commodities explains a great deal of our results among income groups.

Although we show that at the national level households in all income groupings gain from trade liberalization, this result does not hold for every province (Table 6). At the national (aggregated) level, the overall impact on farmer's per capita income is small. The main reason is that there are offsetting effects among provinces. But from Table 6 it can be seen that the impacts differ significantly across provinces even for the farmers in the same income categories.

Because trade impacts are more commodity-specific, and because farmers in different income groups in different provinces grow different sets of commodities, we can see that there actually are much sharper regional and income class-specific impacts. It also means that such impacts may have implications for equity. In the case of China, while nearly all farmers in all provinces, except Guangxi and Yunnan, can be seen to benefit from trade reform, liberalization generally hurts producers in Guangxi and Yunnan provinces. The reason, of course, is clear when we consider that farmers in Guangxi and Yunnan provinces are primarily producing sugar, which is the commodity most hurt by Doha trade liberalization.

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Table 5
Shares of output values for competitive and non-competitive agricultural products for different groups of farmers under baseline in 2015.

	Share of competitive agricultural products (those that benefited from Doha)	Share of non-competitive agricultural products (those that lost from Doha)	Share of neutral agricultural products (those that did not gain nor lose from Doha)
	(1)	(2)	(3)
National average	62	11	27
Under poverty	53	10	37
Income group 1	58	12	30
Income group 2	60	13	27
Income group 3	61	12	27
Income group 4	63	11	26
Income group 5	67	11	22
Farmers in plain area	61	8	31
Farmers in hill area	68	15	17
Farmers in mountain area	57	18	25
Farmers: Han	63	12	25
Farmers: Minority	46	24	30

Note: Based on the analysis of the impacts on trade and production, the potential benefit agricultural products under column 1 include rice, wheat, soybean, cotton, oil crops, vegetables, fruits and fish; the potential lost products under column 2 include sugar, beef, mutton, pork and poultry; the neutral products include maize, milk, potato and some minor crops (e.g. other grains).

Interestingly, not all the poor will gain or lose in terms of production with trade liberalization. Our analysis shows that the poor (and more significantly for richer farmers) in the poor provinces (in the western and northern provinces) gain more from trade liberalization, while the poor in the eastern and southern provinces gain relatively less or are hurt (Table 6). Therefore, according to these results, Doha trade reform will contribute to poverty alleviation in some parts of China. However, at the same time it may lead to greater poverty and worsening income distribution problems in other regions.

It also is worthy to note that farmer incomes in some regions may become worse under the more liberalized proposals. As shown in Table 6, farmer per capita incomes, on average (at the national level), will increase under the more liberalized proposals. However, it is not always true when looking at the differences among farmers in different provinces. Our results show that per capita incomes in Guangxi and Yunnan fall gradually from 13.6 yuan and 3.1 yuan under the EU proposal, to 16.6 yuan and 4.7yuan under the G20 proposal, to 24.5 and 8.4 under the US proposal. Therefore, one implication of this finding is that the national government needs to put effort into designing a way to compensate farmers that suffer relatively more pain (in certain types of villages in certain provinces) than those in others (that gain).

5. Summary, policy discussion and concluding remarks

One of the main contributions of this research is our approach. In the paper we create a series of linkages between a global general equilibrium trade model and our regional partial equilibrium models to explore the possible effects of Doha trade negotiations on China's agriculture. We also link the domestic market effects to households, examining how farmer income in different regions and income groups is affected by trade liberalization. Unfortunately, because we do not have the

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Table 6
Impacts on per capita agricultural income of different farmers by province under EU, G20 and USA proposals in 2015 (yuan/person).

	Average farmers			Farmers under poverty in 2001			The richest (top 20%) of farmers in 2001		
	EU	G20	USA	EU	G20	USA	EU	G20	USA
Beijing	17.9	19.7	25.9	0.0	0.0	0.0	30.8	30.6	29.4
Tianjin	22.4	22.9	25.4	3.4	3.3	2.8	74.4	70.9	60.0
Hebei	30.7	31.9	33.8	8.5	8.7	8.6	81.2	78.5	67.9
Shanxi	15.4	16.2	18.1	7.7	7.8	7.9	37.5	35.9	31.0
Inner Mongolia	27.8	27.9	19.5	11.6	11.4	9.3	172.5	166.2	152.7
Liaoning	36.6	37.4	38.3	12.4	12.4	12.1	198.3	193.0	169.6
Jilin	80.4	80.7	77.2	15.6	15.5	14.6	374.2	365.0	326.1
Heilongjiang	65.5	67.3	60.9	13.1	12.8	11.4	144.1	136.6	126.6
Shanghai	19.1	20.9	24.0	5.3	5.7	5.7	14.0	14.5	17.5
Jiangsu	32.0	34.2	35.9	10.0	10.5	11.2	35.7	34.9	33.0
Zhejiang	23.4	25.9	33.7	0.5	0.5	0.7	26.3	29.1	40.0
Anhui	28.9	30.9	30.7	14.1	14.8	14.6	41.0	39.7	37.1
Fujian	22.3	24.3	31.0	2.3	2.5	3.2	46.1	50.1	65.3
Jiangxi	23.8	25.6	27.8	10.0	10.7	12.0	45.8	48.7	57.9
Shangdong	37.1	38.7	41.0	25.7	26.1	25.7	86.1	84.2	75.8
Henan	39.4	41.1	40.7	16.9	17.5	17.8	80.8	77.6	67.3
Hubei	44.6	48.0	50.4	13.3	14.0	14.5	82.3	85.6	93.5
Hunan	21.9	23.6	27.0	8.5	9.3	11.3	18.0	18.1	21.1
Guangdong	21.4	22.5	25.4	4.8	5.0	5.1	43.8	46.9	58.3
Guangxi	−13.6	−16.6	−24.5	−24.5	−26.7	−33.0	44.2	47.5	55.3
Hainan	22.8	24.6	28.9	9.3	9.9	11.4	45.2	49.3	68.0
Chongqing	20.0	21.5	26.1	9.3	10.0	12.3	48.6	47.9	45.8
Sichuan	17.4	18.6	22.1	8.9	9.4	11.1	45.3	45.0	44.4
Guizhou	12.0	12.5	13.6	6.5	6.5	6.9	76.1	74.4	67.5
Yunnan	−3.1	−4.7	−8.4	−16.7	−17.7	−20.0	24.7	28.0	34.9
Tibei	38.5	38.5	33.9	32.9	32.9	29.5	34.7	30.0	18.6
Shaanxi	15.1	15.9	17.8	8.6	9.0	10.1	49.2	48.3	48.3
Gansu	36.0	36.8	36.4	11.4	11.7	11.4	199.1	200.2	188.5
Qinghai	9.4	9.5	6.4	12.1	13.2	13.2	−8.7	−10.9	−15.8
Ningxia	16.1	15.6	15.0	4.5	4.5	4.1	85.9	81.2	66.7
Xinjiang	74.9	75.8	70.6	48.3	49.4	47.5	224.1	234.9	254.2

Source: CAPSiM simulation results.

data to do so, the research does not account for the parts of the Doha proposals that are focused on special and sensitive products.

In using this framework, the impacts of the Doha trade liberalization scenarios have been shown to have a number of regular characteristics. First, the production of grains will increase. This means that, ceteris paribus, under trade liberalization, self-sufficiency in grains actually will improve. Second, the output of soybeans and cotton also will rise. In fact, although these are land-intensive commodities, their growth rates are the highest among all the crops. Third, the projected fall in China's production of sugar under Doha Round compared with the production under baseline scenario is the greatest challenge to China's producers. Fourth, trade liberalization, as might be expected, will promote China's production of vegetables and fruit. This result is most obvious in the US proposal. When other nations liberalize their horticultural sectors, China gains and it is able to further exploit its comparative advantage in labor-intensive products. When examining

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the effects on farm household income and the income in the regions in which different sets of households live and produce, it can be seen that the nation's leaders should be aware that further liberation will also have different effects on income and poverty. Those farmers producing crops in which China's production, prices and export will rise (or imports will fall) will benefit from increased trade liberalization. The opposite will also be true. The main determinant of whether production, prices and trade will move in a beneficial way is the relative levels of protection between China and rest of the world prior to the proposed Doha trade liberalizations.

So what do these results mean for policy? Perhaps the most basic lesson from this paper is that since China will benefit—in several ways—from further trade reform, its leaders may want to take a more active role in pushing forward the Doha Round negotiations, reducing high tariffs imposed on China's products in the rest of world. Moreover, our findings have important implications not only to China's position in Doha negotiation, but also for its domestic grain security. Importantly, China's food security improves under the Doha proposals.

However, it is true, as also shown in the paper that not all farmers in all regions benefit. As a consequence of these differential impact issues, policy makers might also want to consider several actions. First, officials need to try to encourage farmers in poorer areas to shift their production decisions (where appropriate) to more competitive and benefiting products that will gain from Doha Round. Second, China may need to implement regional policy to facilitate crop production structural change in major sugar production areas (sugarcane in South China and sugarbeet in Xingjiang and Helongjing). Third, officials may also need to take other non-trade actions to increase the livelihood of farmers in these areas. In many areas, farmers do not have an advantage in any farming activity. In such areas rural education, better communications and other policies that might facilitate their shift into the non-farm sector may be the most beneficial policy. Fourth, there is a role for government for improving agricultural productivity through more research, R&D extension and agricultural infrastructure investment, particularly in poor areas. Last, but not least, there is also a role of government to make effort in compensate farmers that suffer relatively more lose or less gains than those in others.

Acknowledgements

We would like to thank the financial support from World Bank, the Chinese Academy of Sciences (KSCX-YW-09; KSCX2-YW-N-039), National Natural Sciences Foundation of China (70873116) and EU CATSEI project (044255).

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