**A Japan-China-Korea Free Trade Agreement and Its Potential Impact**

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日中韓自由貿易協定とその潜在的影響

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1. Introduction

   The three major countries of East Asia, Japan, China, and South Korea, have each concluded a free trade agreement (FTA) with the Association of South East Asian Nations (ASEAN), but none of the FTAs between these countries has been ratified (Kanamori, 2010). In the trilateral summit held in May 2010, the Japan Business Federation (Nippon Keidanren) requested the political leaders of the three nations to begin Japan-China-Korea FTA negotiations (Japan Business Federation, 2010).

   This study aims to examine the potential impact caused by the Japan-China-Korea FTA using the GTAP model and the OECD Nitrogen Balance Database. Several studies have been conducted to evaluate the impact of FTAs among Japan, China and Korea, including the trilateral joint research carried out to assess this issue (DRC et al., 2007). Yamamoto et al. (2009) measured the possible economic and environmental impact under a Japan-Korea FTA. However, few previous studies have focused on the potential impact on agriculture resulting from Japan-China-Korea FTAs.

2. Methods

   In this study, we used methods similar to those of Rae and Strutt (2005, 2007), Yamamoto et al. (2009), Sawauchi (2009) and Tsuge et al. (2011). The potential impact of nitrogen pollution from agriculture resulting from agricultural trade liberalization under the Japan-China-Korea FTA was estimated using the GTAP model (Hertel, 1997) and the OECD Nitrogen Balance Database (OECD, 2001). Our results under the Japan-China-Korea FTA are compared with those under the Japan-Korea FTA.

   2.1 GTAP model analysis

   The GTAP model is a computable general equilibrium (CGE) model for trade analysis developed by the Global Trade Analysis Project. The latest GTAP database is Version 7, and its reference year corresponds to the global economy in 2004. However, since the latest available OECD nitrogen balance data is the year 1997, we use the GTAP database Version 5.4 from 1997. In this study, the scenario assumes the complete removal of all import tariffs between Japan, Korea and China.

   2.2 Nitrogen balance analysis

   Due to the limitations of data availability, we use nitrogen surplus as an indicator of environmental load focusing on the balance of nutrients in agricultural production. As shown in Fig. 1, nitrogen surplus is the difference between the total quantity of nitrogen inputs entering the soil and the quantity of nitrogen outputs leaving the soil annually (OECD, 2001).
In the OECD Nitrogen Balance Database, nitrogen input and output are calculated by multiplying the amount of activities such as livestock numbers or crop outputs by nitrogen coefficients. It is assumed that these coefficients will remain constant when trade is liberalized. This assumption enables us to calculate the post-FTA levels of nitrogen input and output in each component by multiplying the initial nitrogen input and output by the corresponding sectoral change rate from the GTAP results (Rae and Strutt 2005, 2007). We calculated nitrogen balance only between Japan and Korea because China is not included in the OECD Nitrogen Balance Database. Nitrogen input and output are estimated mainly based on Rae and Strutt (2007), but we calculated fertilizer input, nitrogen fixation by leguminous crops, and uptake by forage production using different methods.

3. Results
3.1 GTAP results
As shown in Table 1, the real GDP in Japan, Korea and China would increase by 0.01%, 0.46% and 0.08%, respectively. Total farm outputs in Japan would decrease by 4.26%, whereas total farm outputs in Korea and China would increase by 1.99% and 2.61%, respectively. These results suggest that under full trade liberalization, Japan is likely to experience a loss in total farm outputs. The results also suggest that the impact of full trade liberalization is more notable at the total farm output level than at the real GDP level in all three countries.

Table 1. Impact of real GDP and total farm output (%)

<table>
<thead>
<tr>
<th>Japan-China-Korea FTA</th>
<th>Japan-China-Korea FTA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Japan</td>
</tr>
<tr>
<td>Real GDP</td>
<td>0.01</td>
</tr>
<tr>
<td>Total farm output</td>
<td>−4.26</td>
</tr>
</tbody>
</table>

Notes:
1) All projections are percentage deviations from the initial period.
2) Output means a monetary value of gross output.
3) We recalculated the potential impact caused by the Japan-Korea FTA analyzed in Yamamoto et al. (2009).

Table 2. Changes in farm sectoral outputs (%)

<table>
<thead>
<tr>
<th>Japan-China-Korea FTA</th>
<th>Japan-China-Korea FTA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Japan</td>
</tr>
<tr>
<td>Rice</td>
<td>−12.78</td>
</tr>
<tr>
<td>Wheat</td>
<td>−4.98</td>
</tr>
<tr>
<td>Cereal grains</td>
<td>−2.36</td>
</tr>
<tr>
<td>Other crops</td>
<td>−1.59</td>
</tr>
<tr>
<td>Milk</td>
<td>−0.99</td>
</tr>
<tr>
<td>Cattle and sheep</td>
<td>−3.54</td>
</tr>
<tr>
<td>Other livestock</td>
<td>0.33</td>
</tr>
</tbody>
</table>

Notes:
1) All projections are percentage deviations from the initial period.
2) Output means a monetary value of gross output.
3) We recalculated the potential impact caused by the Japan-Korea FTA analyzed in Yamamoto et al. (2009).
higher than in rice output (4.56%). In China, the increased rate of rice output (6.48%) is higher than in milk output (1.70%) and cattle and sheep output (3.91%).

In a comparison between the Japan-Korea-China FTA and the Japan-Korea FTA (see Tables 1 and 2), the changes in real GDP in Japan would be extremely small in both cases. In contrast, a decreased level of total farm output in Japan under the Japan-China-Korea FTA would be much greater than under the Japan-Korea FTA because the Japan-China-Korea FTA might lead to a great decrease in Japan’s cereal production, especially rice.

### 3.2 Nitrogen balance results

Table 3 shows the impact of the Japan-China-Korea FTA on nitrogen balance. Japan’s nitrogen balance would decrease by only 1.2% from the initial level of nitrogen surplus. Our results show decreased levels of both total nitrogen outputs (−3.7%) and total nitrogen inputs (−2.4%).

Korea’s nitrogen balance would increase by 7.1% from the initial level of nitrogen surplus. Our results show a decreased level of total nitrogen outputs (−0.5%) but an increased level of total nitrogen inputs (4.5%). The increased input from livestock manure (12.0%) is the main reason for Korea’s increase in total nitrogen surplus. This arises mainly due to the large increase in output from the livestock sector in Korea.

The total nitrogen balance of Japan and Korea would increase by 2.4% from the initial level of nitrogen surplus. Our results show a decreased level of nitrogen outputs (−2.7%) and an increased level of nitrogen inputs (0.2%).

### Table 3. Impact of nitrogen balance (1,000 tonne, %)

<table>
<thead>
<tr>
<th></th>
<th>Initial 1997</th>
<th>Japan-China-Korea FTA</th>
<th>Japan-Korea FTA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a</td>
<td>b</td>
<td>c=a+b</td>
</tr>
<tr>
<td>Outputs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Harvested crops</td>
<td>368.2</td>
<td>249.0</td>
<td>617.2</td>
</tr>
<tr>
<td>Forage and pasture</td>
<td>226.5</td>
<td>12.9</td>
<td>239.3</td>
</tr>
<tr>
<td>Total Outputs</td>
<td>594.7</td>
<td>261.8</td>
<td>856.5</td>
</tr>
<tr>
<td>Inputs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fertilizer</td>
<td>568.5</td>
<td>446.0</td>
<td>1,014.5</td>
</tr>
<tr>
<td>Livestock manure</td>
<td>487.6</td>
<td>272.5</td>
<td>760.1</td>
</tr>
<tr>
<td>Other nitrogen inputs</td>
<td>179.3</td>
<td>40.8</td>
<td>220.1</td>
</tr>
<tr>
<td>Total Inputs</td>
<td>1,235.3</td>
<td>759.3</td>
<td>1,994.7</td>
</tr>
<tr>
<td>Total Nitrogen Balance</td>
<td>640.7</td>
<td>497.5</td>
<td>1,138.2</td>
</tr>
</tbody>
</table>

Notes: 1) Figures in parentheses are percentage deviations from the initial period.
2) Fertilizer means inorganic fertilizer; livestock manure means net livestock manure; other nitrogen inputs include biological nitrogen fixation, atmospheric deposition, and seeds and planting materials.
3) We recalculated the potential impact caused by the Japan-Korea FTA analyzed in Yamamoto et al. (2009).
As noted above, the increased input from livestock manure in Korea is the main reasons for the anticipated increase in the total nitrogen balance in Japan and Korea.

Our results suggest that the Japan-China-Korea FTA would likely lead to an overall increase in the total nitrogen surplus for Japan and Korea. The same is true of the total nitrogen balance for Japan and Korea under the Japan-Korea FTA (see Table 3).

4. Conclusion

This study aimed to examine the potential impact caused by the Japan-China-Korea FTA using the GTAP model and the OECD Nitrogen Balance Database.

The GTAP results show that total farm outputs would increase in Korea and China but decrease in Japan. Most farm sectoral outputs would decline in Japan, while farm outputs from the Korean livestock sector and the Chinese cereal crop sector would significantly increase.

The nitrogen balance results show that the Japan-China-Korea FTA is likely to lead to an overall increase in the total nitrogen surplus for Japan and Korea. Furthermore, these results also suggest that such an FTA would increase the potential nitrogen pollution from agriculture in Japan and Korea.

Notes

1) In order to modify the GTAP data aggregation and nitrogen balance calculation in Yamamoto et al. (2009), we recalculated the potential impact on real GDP, total farm output, and nitrogen balance under the Japan-Korea FTA using the methods of this study.

2) Although Rae and Strutt (2007) calculated fertilizer input using the modeled changes in usage of agro-chemicals in each farm sector, the focus of this study was not on agro-chemicals but nitrogen. Thus, the changes in fertilizer input were calculated using the average change in output for the crop and pasture-using livestock sectors, weighted by initial output values (Rae and Strutt, 2005). When we calculated the changes in nitrogen fixation by leguminous crops and uptake by forage crops, the detailed sectoral list in the GTAP database was taken into account (Dimaranan and McDougall, 2002). We assumed that nitrogen fixation by leguminous crops changed in proportion to the change in total land use for oil seeds, other crops, cattle and raw milk sectors. Uptake by forage crops was assumed to change from the base level in proportion to the change in total land use of other crops, cattle and raw milk sectors.

3) Note that it was impossible to conduct the same nitrogen balance analysis in China because China’s data is not available in the OECD Nitrogen Balance Database. However, the growth in China’s total farm output under the Japan-China-Korea FTA might lead to an increase in nitrogen pollution.

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References


exe) [Accessed October 7, 2011].


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