A General Equilibrium Analysis of Japanese Rice Market Trade Liberalization

Kiyoshi Taniguchi

FAO of the UN

Food and Agriculture Organization of the United Nations
Room C311, Viale delle Terme di Caracalla
00100 Rome, Italy

Kiyoshi.Taniguchi@fao.org

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Abstract

The main interest of this study is to simulate the domestic rice market under full trade liberalization. Results show that full trade liberalization is welfare enhancing for non-farm as well as farm households, primarily through lower consumer prices. These simulation results apparently undermine the government’s argument against trade liberalization.

*Key Words:* CGE analysis, Japan, Rice, and Trade liberalization.

Acknowledgement

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I Introduction

Rice is the most important staple food for Asian countries. The Japanese government has historically utilized price supports and trade restrictions. These policies have aimed to achieve two goals: to maintain wage and income parity between farmers and non-farmers and to keep national self-sufficiency of rice production. In order to achieve parity, the government introduced price supports for rice, while international trade has been controlled by the Japan Food Agency (JFA) until recently. Price supports combined with trade restrictions have resulted in an excess supply of rice. In order to reduce excess supply and the fiscal costs of storage, the Japanese government introduced acreage control. Thus, Japanese rice policy is characterized by two contradictory policies: price supports and acreage control.

As a result of the GATT Uruguay round, Japan faced pressure to liberalize the rice markets, and this pressure will be greater under forthcoming WTO negotiations. Under this environment, the Japanese government accepted tarrification on rice in 1999. Japanese policymakers are concerned, however, about the income of farmers under full trade liberalization as well as national food security, conceived of as 100% self-sufficiency in rice production. Many previous studies support the government’s concern; they predict that Japanese rice farmers would be devastated by liberalization.

The main interest of this study is to simulate the domestic rice market under full trade liberalization. We simulate the impact on income of farm households and national self-sufficiency. We apply a CGE (Computable General Equilibrium) model of Japan to analyze Japanese rice policies including acreage control and tariff. In order to utilize the CGE model, we built a twelve-sector SAM (Social Accounting Matrix) based on a 1995
Japanese input-output table, where households were divided into farm and non-farm categories. Policy scenarios and model simulation focus on WTO negotiations; we set the current tariff rate as three hundred per cent of c.i.f. import price, which is gradually reduced to zero per cent. It is assumed that imported rice is an imperfect substitute for domestic rice. We calculate the compensating variation welfare changes caused by full trade liberalization.

In section II, we review the data source and social accounting matrix (SAM), which is the base data for computable general equilibrium (CGE) modeling. In section III, there is a brief introduction to CGE modeling and model description. In section IV, the simulation results are presented, and summary and extension in section V follows.

II. Data Source and Social Accounting Matrix

This section describes the structure of the micro-consistent data set. In order to conduct CGE modeling analysis, one often constructs a Social Accounting Matrix (SAM), which captures all transactions amongst agents in the market. In this study, a 1995 input-output table by Management and Coordination Agency, Government of Japan is used as a base table. Table 1 shows a schematic SAM. Table 2 describes the algebraic SAM. Table 3 shows the SAM used in this analysis. There are 12 sectors in this study. Table 4 shows those twelve sectors. Husked rice and milled rice are separated as the different sectors, since the original Input-Output table defines as it is.

A farm household can be divided in many ways. In this study, we classify farm household for three types: the “Business Farm Household” (BFH), the “Semi Business Farm Household” (SeBFH), and the “Side Business Farm Household” (SiBFH). For classification, we follow the official definition of Ministry of Agriculture, Forestry, and
Fisheries (MAFF 1997). We believe this classification is suitable for our analysis. The average age of farm household in Japan tends to be old in recent years, and this classification does not include farmers over 65 years old. Old farmers in general receive pension, and the pension is included as income in other classifications. In another word, income from economic activities is not separated from transfer payment, which would lead to the misspecification of the model, especially income. This definition avoids overestimate of pure farming income by dropping farmers who receive pension.

III Model Description

Most previous studies in this area are partial equilibrium studies, concentrating only on the rice market itself of the Japanese economy. The biggest advantage of general equilibrium study is that the general equilibrium model can capture the effect of trade liberalization on both production and consumption side. One of the critical shortcomings of partial equilibrium modeling is to ignore the differences between Japanese and foreign rice as well as the other sectors and foreign countries in order to determine post-liberalization equilibrium. The general equilibrium approach minimizes the misspecification from the ceteris paribus assumption, on which partial equilibrium analysis is based. By using Japanese SAM, this study investigates magnitude and direction of trade liberalization on households and production sectors.

An overview of the model is given in Figure 1. The primary factors, labor and capital, are supplied by households. Using these primary factors, industry produces

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commodity outputs. Industry activities and commodities are not distinguished in this study. Commodities are either consumed by domestic demand sectors or exported to the rest of the world. In addition to domestic production, there are imports from the rest of the world. Industry pays competitive wages or capital rents to the input suppliers at a determined price. Government corrects tax and tariff revenue, and distributes it to demand sectors in the form of transfer payments and subsidy. Production function is in Generalized Linterf type, and consumption function is Linearly Approximated Almost Ideal Demand system (LA/AIDS).

In order to model trade policy issues, empirical studies tend to depart from the standard perfectly competitive models. One possible way to incorporate imperfect substitution is the so-called Armington assumption (Armington 1969). Under the Armington assumption, goods in the same industry classification produced in the different countries are viewed as imperfect substitutes by demanders. Shoven and Whalley (1984) point out two possible advantages of the Armington assumption. First, it is consistent with “cross-hauling” observed in trade data, which some of the early trade modelers encountered with difficulties. If a modeler assumes complete specialization of homogeneous goods, the policy change overestimates its effect on the economy due to too strong specialization assumptions. A whole economy tends to move from one extreme specialization to another. Second, the model can utilize econometrically-estimated import- and export-demand elasticities. In the homogeneous goods model,

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there is no substitution between domestic and foreign produced goods, which is unrealistic for trade data.

In this study we utilize the LA/AIDS model for consumption function. The origin of the AIDS model derived from the preference specification called Price Independent Generalized Logarithmic Class of Preference (PIGLOG). (See Muellbauer (1976) for PIGLOG class of preference. Muellbauer’s PIGLOG class is further investigated by Deaton and Muellbauer (Deaton and Muellbauer 1980a; Deaton and Muellbauer 1980b).

The AIDS cost function in logarithmic form can be expressed as follows:
\[
\log C(U, p) = (1 - U) \log[a(p)] + U \log[b(p)]
\]
where \( C(U, p) \) is a cost function, \( p \) is a vector of prices, and \( U \) is the utility level.

Following Banks et al (1997) notation, \( a(p) \) and \( b(p) \) can be expressed as follows:
\[
\ln a(p) = \alpha_0 + \sum_{i=1}^{n} \alpha_i \ln p_i + \frac{1}{2} \sum_{i=1}^{n} \sum_{j=1}^{n} \gamma_{ij} \ln p_i \ln p_j ,
\]
and
\[
b(p) = \prod_{i=4}^{1} p_i^{\beta_i},
\]
where \( i \) and \( j \) denote the commodity, and other Greek letters are the coefficients estimated from AIDS model.

As Hoffman and Johnson (1999) put, the base-weighted true cost of living index from the cost function presented above can be written as follows:
\[
\log P(p^0, p^1, U^0) = (1 - U^0) \log[\frac{a(p^1)}{a(p^0)}] + U^0 \log[\frac{b(p^1)}{b(p^0)}],
\]
where \( U^0 \) is the base utility level, and \( p^0 \) and \( p^1 \) are the price vectors before and after the change, respectively. For the base utility level, we use as follows:

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Theories and Predicting Trade Flows.” Handbook of International Economics, R. W. Jones and P. B.
\[
U^0 = \frac{\log \left[ \frac{X}{a(p^0)} \right]}{\log \left[ \frac{b(p^0)}{a(p^0)} \right]},
\]

where \( X \) is the total expenditure on commodities.

With the AIDS coefficient estimation and CGE simulation, the compensating variation in cost function, \( CV = C(p^1, U^0) - C(p^0, U^0) \), for a representative household can be simulated.

**IV Empirical Results**

In the next WTO negotiation round, the reduction of tariff rate will be the main focus. In this counterfactual simulation, we set the base-line ad-varlorem tariff of rice and processed rice at 300%, and gradually reduce to zero percent.

**Figure 2** shows the overall price and quantity according to the tariff level. Increase in the import of rice and processed rice reduces the overall domestic price. This is due to the supply effect. In natural resource sector, meat sector, and food away from home (FAFH) sector show the slight increase in price. **Figure 3** shows the quantity level increase in all agriculture and food sectors. The highest increase is processed rice sector, and then raw rice sector follows. Other sector follows; however the level of increase in quantity is negligible level. In sum, the over all effect on a whole economy is very small, except the rice sectors by themselves.

**Figure 4** shows the change in c.i.f. import price and the import. At zero tariff, import price goes down by 74.26% compared to base-line. In quantity base, the processed rice increases by approximately 2867%. Since the base-line quantity of import is under the prohibitively high tariff; hence this ratio is not unexpected. **Figure 5** shows

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Kenen, eds., Elsevier Science, 467-517. shows the application for international trade theory.
the change in imports and the ratio of domestic to foreign rice. This ratio represents the self-sufficiency level. Self-sufficiency level drops to 65%. Considering that current self-sufficiency rate for rice is 100%, this decrease in self-sufficiency rate would be felt strongly by policy makers as well as consumers.

**Figure 6** shows the change in employment. The impact of trade liberalization is minimal; employment in rice and non-crop sector shows the slight decline, while crop and natural resource sector shows the slight increase. **Figure 7** shows the change in income. Non-farm household shows the slight increase in the income due to the lower price of rice; however, the increase is merely around 1.5% at zero tariffs compared to 300% tariff level. The biggest and negative impact hits full-time farm household: 6.28% of income reduction due to the trade liberalization. These full-time farmers are the victims of the trade liberalization; the government needs to consider lump-sum income transfer to compensate for the trade liberalization.

**Figure 8** shows the change in welfare. Non-farm household as well as farm households show the welfare gain; this gain is due to the reduction of rice. Trade liberalization is welfare enhancing even for Japanese farmers.

**V Conclusion**

Food Basic Law in Japan was established in the early 60’s. Until now, the base concept of the law has been the same: income parity of farm and non-farm household and self-sufficiency of food supply. The environment of agriculture domestically as well as internationally has changed. Income level of farm household exceeds the one of urban household due to part-time farming. Migration to the urban area accelerates the aging
population of agricultural sector. International wave of trade liberalization hit Japan in 1995; since then Japan gradually changes its domestic policy, and in 1999 Japan accepted the tariffication of rice.

This study simulates the direction and magnitude of trade liberalization of rice. The results show that the impact of trade liberalization is minimal: full trade liberalization is welfare enhancing for non-farm as well as farm households at any tariff rate, primarily through lower consumer prices. Full-time farm household income declines by only 6.3 per cent at the zero tariff, but is more than compensated by falling prices at the consumer side. Regarding national self-sufficiency, the ratio of domestic to imported rice in the market becomes seven to three. These simulation results apparently undermine the government’s argument against trade liberalization.

The average age of farmers keeps increasing. If this trend continues, sooner or later, Japanese agriculture would lose its competitiveness completely, since there is no successors. Whenever possible, the market should be opened; trade liberalization is welfare enhancing and cost reducing. Japanese consumer’s welfare increases, and the rice exporters gain the share of its benefit.

Reference:


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4 In this simulation, the model is closed in a way that agricultural workers are not allowed to “migrate” in non-agricultural sectors according to the tariff rate. Hence, the total amount of four agricultural sectors


keeps constant.


Figure 1: Overview of Japanese CGE model

Demand

- Farm Household
- Non-farm Household
- Government
- Investor

Production

- Industry
- Commodity

Rest of the world

- Export
- Import

Primary Factor

- Labor
- Capital
- Land

Income

Factor Payments
- Tax
- Transfer Payments
- Savings

Nominal Flow

Real Flow
Table 1

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### Table 2

**Algebraic Social Accounting Matrix**

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**Notes:**
- $p_1 \times q_2 \times r_3$ represents the product of three variables.
- $\text{fact}_{lb} \times \text{inc}_{r}$ denotes the multiplication of labor and income.
- $\text{tax} \times p_{d} \times r_{d}$ indicates the tax multiplied by two variables.
- $n_3 \times \text{pre}_4 \times \text{er}$ signifies another product involving three variables.

**Symbols:**
- $\text{prior}$
- $\text{grant}$
- $\text{sum}$
### Table 3

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Source: Author
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Figure 2

Overall Price Change

- 250% - 200% - 150% - 100% - 50% - 0%

-5.00% -5.00%

-10.00%

-15.00%

-20.00%

-25.00%

-30.00%

-35.00%

Categories:
- rice
- crop
- ncrop
- nst
- meat
- ricepr
- faih
Figure 5

Ratio of Import to Consumption (Quantity Base)
Figure 7

Income Change

- hh - sibf - secf - bfh