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Demand Response for Imported and Domestic Poultry Meat Products to Food Safety Regulations in Japan: An Application of the Almost Ideal Demand System Model

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[Abstract]
This study estimates the response of Japanese demand for poultry meat to food safety regulations using the almost ideal demand system (AIDS) with a particular focus on the maximum residue limits (MRL) on pesticides and veterinary drugs. The model allows for asymmetric consumer's response to regulations across goods from different origins. The results indicate the asymmetry of the demand response to a change in MRLs and avian-influenza bans. Tightening the MRLs reduces domestic demand for poultry meat as well as demand for imports from China and the US, and increases demand for imports from Brazil. Thus, the assessment of the impact of regulatory policies needs to take consumers' flexible rearrangement of bundles into account.

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1. Introduction

Sanitary and Phytosanitary (SPS) regulations have been implemented to ensure the health of animals, plants and human beings from countries engaged in trade. Such regulations take various forms such as import bans, tariffs, standards and other technical requirements whose specifications often follow the importing country's domestic regulations. In Japan, the government enacted the Food Sanitation Act in 1947, and the Plant Quarantine Law in 1950 along with the Domestic Animal Infectious Diseases Control Law in 1951, and these SPS rules have been enforced for both domestically produced and imported foods. Japan's Food Sanitation Act had initially prohibited the use of all synthetic antimicrobial drugs, but in 1992, maximum residue limits (MRLs) were introduced to address the residues of such drugs instead. Furthermore, the Food Sanitation Act was modified in May 2006 to adopt the "positive list system", which defined 0.01 ppm as the uniform limit for hazardous chemical residues that were not listed in the MRL table. Furthermore, import bans have been applied upon the occurrence of infectious diseases such as avian influenza and Newcastle disease.

The gravity model has often been used to estimate the impact of regulatory policies on imports (see, for example, Otsuki et al., 2001; Disdier et al., 2008, etc.). However, the gravity model typically assumes a common coefficient for a regulatory variable across bilateral pairs of importers and exporters. It forces the same direction of change in trade on all samples, and thus, it does not allow for consumers' flexible rearrangement of bundles of goods across different origins. In reality, safety regulations can drive a composition change in imports from different origins as well as a change in the total amount of imports. Furthermore, the same can apply to the composition of domestic and imported goods as a group. The composition change can be accounted for by nonneutral consumers' preference and suppliers' capacity to meet the standards of importing countries, where the supplier's capacity can also be enhanced by Japanese distributors and retailers through technical assistance for local production bases.

Thus, we employ a demand system analysis that has been commonly used to estimate consumers' demand response across different products with respect to the prices of the products and total expenditure. The almost ideal demand system (AIDS) also examines consumers' decisions among bundles of goods under budget constraints (Deaton and Muelbauer, 1980). We extend their AIDS model to incorporate the regulation variables in the demand system using the monthly trade statistics and domestic sales of poultry meat as well as the data on food safety regulations. In our case study, we quantify the effect of Japanese food safety regulations on poultry meat products. Particular attention will be given to the standards on residues of pesticides and veterinary drugs, and the bans on imports from countries with avian influenza.

The rest of this paper is organized as follows. Section 2 describes Japan's poultry meat market including domestic and imported poultry meat. Section 3 develops the empirical model based on previous studies. Section 4 describes the data. Section 5 presents and discusses the estimation results. Section 6 demonstrates the impact of policy changes using simulation analyses. Section 7 summarizes our empirical results, and provides policy implications.

2. Poultry meat market in Japan

This section provides an overview of the nature and characteristics of the poultry meat market in Japan based on the existing literature and common knowledge. Although Japanese are known as fish eaters, animal meat has become an essential part of their diet. Beef, pork, and poultry are consumed almost equally in terms of their weights in the Japanese market. While beef consumption is notable in the western part of Japan and pork consumption is dominant in the east, poultry is consumed all over Japan. Poultry meat consumption constitutes approximately one-third of overall meat consumption and is stable over time because of the country's slow income growth and aging population. These kinds of meat are close substitutes for each other. For example, the substitutability between beef and poultry is demonstrated by the fact that a reduction in beef demand during the outbreak of bovine spongiform encephalopathy (BSE) clearly enhanced demand for poultry.

Furthermore, imported and domestic poultry products are close substitutes. Importing of poultry meat started mainly because of its use in restaurants and processing, and the share of domestically produced poultry meat in total domestic consumption came down from above 90% in the mid-1980s to below 70% in the latter half of the 1990s, partially because of the tariff cuts based on the Uruguay Round agreement on agriculture. The share of imported poultry in total poultry consumption in Japan was almost constant in the 2000s.

Imported poultry meat is classified into meat with bones and others. Some of the poultry meat from European countries is half-prepared luxurious meat for expensive restaurants. Poultry meat imported from Thailand and China includes half-processed meat for commercial use. Imports from Brazil have increased greatly since the outburst of avian influenza, and Brazilian poultry has been used for a wide range of purposes. Japanese prefer dark meat to white meat, in contrast to Westerners, and this makes the Japanese market attractive to the latter.

Similar to branded beef products like Kobe beef, branded poultry meat has been gaining favor in line with the growing gourmet trend. Hundreds of poultry meat products all over Japan are listed in specialized catalogs. However, the prices of chickens used for such meat have increased recently, and this has slowed the market’s expansion. Japan does export poultry meat, but its quantity is far smaller than that of imports. Furthermore, such meat is not considered to be as luxurious as exported beef or pork, and the price is close to that of imported poultry meat.

The Japanese government has been in charge of setting food safety standards and enforcing them at the border. Imports exceeding legal maximum residue limits for hazardous chemicals have occasionally been detected at quarantine stations in Japan. For example, these include an excess of dieldrin and heptachlor residues in broilers from Thailand in February

1988, an excess of oxytetracycline residues in frozen chicken meat from Brazil in November 2004, and an excess of furaltadone residues in chicken meat and processed chicken meat from China in May 2008. The violations led to Japan requiring preshipment inspection in the exporting countries in the above cases although, none of those cases led to import bans.

Japanese consumers seem to care about the quality and safety of meat products just as much as other industrialized countries' consumers. Therefore, when a food safety threat concerns imports from a certain country, its consumers tend to avoid the imports. However, this is less obvious in regard to other standards. Consumers may not always judge directly changes in the standards in various categories when purchasing food products at supermarkets, but distributors and retailers probably play an important role in ensuring products' safety. For example, some producers in China and Thailand produced poultry products under technical assistance from Japanese food processing firms after the import ban on the imports from those countries, and those products were well accepted by Japanese consumers because of enhanced confidence in their safety. In the case of the maximum residue level (MRL) standards, it is particularly unlikely that consumers judge the change in various MRL standards. The role of the distributors and retailers in ensuring quality and safety is even more important when information is limited, intractably complicated or hardly variable.

3. Empirical model

This study uses the AIDS model to estimate the demand system for domestic and imported poultry meat products. The standard AIDS model based on Deaton and Muelbauer's formulation estimates the demand share equation of each good as a system with prices of all goods and total expenditure as explanatory variables. Subject to data availability and the purpose of our study, we extend the AIDS model such that poultry meat products from different origins are considered to be different products with imperfect substitution. Such an extended AIDS model is referred to as the Source Differentiated AIDS (SDAIDS) model. Winters (1984) estimated the SDAIDS model by treating the UK manufacturing imports from different sources as different products. Yang and Koo (1994) provided a more general and systematic specification for the SDAIDS model by including multiple products and multiple sources. They applied it to Japanese meat imports (beef, pork and poultry). Henneberry and Hwang (2007) elaborated Yang and Koo's model by introducing restrictions to the model. Carew et al. (2005) incorporated both domestic and imported products (table wine) into the SDAIDS framework.

Consider an expenditure function of a representative consumer given utility u:

$$\ln[E(p,u)] = (1-u)\cdot\ln[a(p)] + u\cdot\ln[b(p)], \tag{1}$$

where

$$\ln[a(p)] = \alpha_0 + \sum_i\sum_h \alpha_{i_h}\ln(p_{i_h}) + \frac{1}{2}\sum_i\sum_j\sum_h\sum_h \gamma^*_{i_h j_k}\ln(p_{i_h})\ln(p_{j_k}), \tag{2}$$

and

$$\ln[b(p)] = \ln[a(p)] + \beta_0\prod_i\prod_h p_{i_h}^{\beta_{i_h}}. \tag{3}$$

Here, α, β, γ^* are parameters, and p denotes the vector of prices for imports. The subscripts i and j denote goods, h denotes the origin of the imports, and k denotes the origin of good j. We can obtain the import share equations for each of goods–origin pair, w_{i_h}, by taking derivatives with respect to log price for a given goods–origin pair:

$$w_{i_h} = \alpha_{i_h} + \sum_j\sum_k \gamma_{i_h j_k}\ln(p_{j_k}) + \beta_{i_h}u\beta_0\prod_i\prod_h p_{i_h}^{\beta_{i_h}}. \tag{4}$$

By using the above equations, we can obtain an estimable SDAIDS model with relevant restrictions on the technology parameters:

$$w_{i_h} = \alpha_{i_h} + \sum_j\sum_k \gamma_{i_h j_k}\ln(p_{j_k}) + \beta_{i_h}\ln\left(\frac{E}{P^*}\right), \tag{5}$$

where

$$\ln(P^*) = \alpha_0 + \sum_i \sum_h \alpha_{i_h} \ln\left(p_{i_h}\right)$$

$$+ \frac{1}{2} \sum_i \sum_j \sum_h \sum_k \gamma^*_{i_h j_k} \ln\left(p_{i_h}\right) \ln\left(p_{j_k}\right). \quad (6)$$

Here, E is total expenditure, and P^* is the aggregate price index.

The AIDS models in general do not include the variables for food safety regulations, but Verbeke and Ward (2001) augmented the AIDS share equations with a set of policy dummy variables. Therefore, we add import bans for avian-influenza-infected countries, and pesticide and veterinary drug residue standards as regulatory variables to the share equations in accordance with Verbeke and Ward (2001). Because there are hundreds of categories in the above standards, an index of food safety standards is constructed from all the reported maximum residue limits (MRLs) of the relevant pesticide and veterinary drug residues. The detail is explained in the subsequent section.

Because we focus only on poultry meat, we drop goods subscripts i and j. The complete equation system to be estimated is as follows:

$$w_h = \Omega_h + \sum_k \gamma_{hk} \ln(p_k) + \beta_h \ln\left(\frac{E}{P^*}\right) + \varepsilon_h, \quad (7)$$

where

$$\Omega_h = \alpha_h + \phi_h D_h + \theta_h \ln(MRL), \quad (8)$$

$$\ln(P^*) = \sum_h [\alpha_h + \phi_h D_h + \theta_h \ln(MRL)] \ln(p_h)$$

$$+ \frac{1}{2} \sum_h \sum_k \gamma_{hk} \ln(p_h) \ln(p_k). \quad (9)$$

Here D_h is a dummy variable for avian-influenza-related import bans, which equals 1 for the periods of existing import bans in country k, and 0 otherwise.[1] The import bans have been applied to China, Thailand, France and the US. Because the period of import ban is identical for China and Thailand, we let China's ban dummy represent the period of the import ban for Thailand. MRL is the index of MRLs, which is the average of all the relevant pesticide and veterinary drug residue limits. ε_h is the error term.

Furthermore, we incorporate Japan's domestic consumption of poultry meat in the demand system because the share of domestic poultry meat in the total expenditure of Japanese consumers on poultry meat has been high.

To comply with economic theory, the above AIDS model needs to satisfy the following general demand conditions.

Adding-up: $\sum_h \alpha_h = 1$; $\sum_h \gamma_{hk} = 0$; $\sum_h \beta_h = 0$; $\sum_h \theta_h = 0$

Homogeneity: $\sum_k \gamma_{hk} = 0$

Symmetry: $\gamma_{hk} = \gamma_{kh}$

This AIDS model is linear in parameters and can be estimated by a seemingly unrelated regression (SUR) estimator. Using the estimated parameters, expenditure elasticities, η_h, and Marshallian price elasticities, ϵ_{hk}, can be computed as follows:

$$\eta_h = 1 + \frac{\beta_h}{\bar{w}_h}, \tag{10}$$

$$\epsilon_{hk} = -\delta_{hk} + \frac{\gamma_{hk}}{\bar{w}_h} - \frac{\beta_h[\alpha_h + \theta_h \ln(\overline{MRL})]}{\bar{w}_h} - \frac{\beta_h}{\bar{w}_h} \sum_k \gamma_{hk} \ln(p_k), \tag{11}$$

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[1] We do not include import ban dummies for the case of Newcastle disease because the disease is not common among the countries in our sample. France is the only country in our sample for which the import ban was implemented.

where $\bar{w}_h$ and $\bar{w}_k$ are the average import shares in countries h and $k,$ respectively. $\overline{MRL}$ is the average of the index of MRLs. Kroneker delta δ_{hk} is equal to 1 if $h = k$ (own price elasticity), and 0 otherwise (cross-price elasticity). We also compute the effect of index of MRLs on imported quantity, called MRL elasticity, as follows:[2]

$$\rho_h = \frac{1}{\bar{w}_h}[\theta_h - \beta_h(\sum_k \theta_k \ln(p_k))]. \quad (12)$$

4. Data

In this study, we employ monthly data on poultry meat imports from the Trade Statistics of the Ministry of Finance from 1988 to 2010. Exporting countries are selected based on data availability and importance in terms of import share. France and Denmark are chosen among the EU countries, and China, Brazil, the US and Thailand are chosen among the countries outside the EU. The other countries are aggregated into a single category "the rest of the world" for completeness. Data on domestic sales of poultry meat are available from Japan's Agricultural and Livestock Industries Corporation, and data on import bans due to the avian influenza outbreak are from the Animal Quarantine Services of the Ministry of Agriculture, Forestry and Fisheries.

The data on MRLs are from the Japan Food Chemical Research Foundation. This database contains MRLs only in 1998 or if the limit changes later. Hence, we approximate the MRL values from 1998 to 1992 such that they are the same as the 1998 values based on the general observation that the regulation has not generally been changed over time. Also, this

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[2] The import share from country h is $w_h = \frac{p_h x_h}{E}$, where x_h is the quantity of import from country h. The MRL elasticity $\rho_h = \frac{\text{dln}x_h}{\text{dln}MRL} = \frac{\text{dln}w_h}{\text{dln}MRL} + \frac{\text{dln}E}{\text{dln}MRL} - \frac{\text{dln}p_h}{\text{dln}MRL}$. Assuming that the impact of MRL does not affect price and expenditure, it can be simplified to $\rho_h = \frac{\text{dln}w_h}{\text{dln}MRL} = \frac{MRL}{w_h}\frac{\partial w_h}{\partial MRL} = \frac{MRL}{w_h}[\theta_h - \beta_h(\sum_k \theta_k \ln(p_k))]\frac{1}{MRL} = \frac{1}{w_h}[\theta_h - \beta_h(\sum_k \theta_k \ln(p_k))]$. We use the average share in computing elasticities.

database contains 371 limits of materials for the muscular portions of poultry, 226 pesticide residues, 97 veterinary drugs, and 48 others based on EU classifications. We aggregate all of these after standardization of each material. The pesticide residue limit is also important for the producers of meat products because pesticides taken into animal bodies from feed are also considered to affect consumers' health. We construct an index of all the residue limits by summing all the standardized residue limits. Although an average is commonly used in constructing an index, it underrepresents the variation of each residue limit when there are many more items than those which vary. Furthermore, the total is more convenient for the simulation analysis with respect to varying residue limit standards. The descriptive statistics from January 1988 to December 2009 are reported in Table 1. The rest of the world is dropped as the numeraire, and all the other price variables are the prices of each country relative to the numeraire. Figure 1 plots aggregated pesticide residues and veterinary drugs.

Prior to the AIDS model estimation, we conduct an exploratory analysis of the effect of residue standards on total expenditure on poultry meat by running a regression of total expenditure on the MRL variable. The result indicates a negative but insignificant coefficient for the MRL variable, implying insensitivity of that expenditure on the whole.[3] Thus, the residue standards could cause a rearrangement of the bundles between the imported and domestic poultry meat products, and also across imported poultry meat products.

5. Estimation results

We report the results of estimation of the AIDS model in Table 2. because of the nonlinearity resulting from our specification, a nonlinear SUR is used to estimate the AIDS

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[3] The regression result is Expenditure = 3.67e+07 – 8,658*MRL.
(249,621) (106,133)

However, this regression is not theoretically founded, or linked with our AIDS model, which is introduced in the following section.

model as was done in Verbeke and Ward (2001) and Ishida et al. (2010). The results of the nonlinear SUR indicate that 32 of the total 70 coefficients are significant at least at the 10% level, taking the symmetry into account.

The coefficients for the MRL variable indicate how the composition of the goods changes in response to a change in the MRL variable. Given the insensitivity of the total expenditure on poultry meat to the MRL variable in the exploratory regression, the MRLs can be said mainly to cause substitution of goods from different sources within the budget. The MRL variable is significant in all equations except those for Denmark and France. Their coefficients are positive in the equations for China, the US, and Japan, and negative in the equations for Thailand and Brazil. This implies that the shares of imports from Thailand and Brazil will increase when the regulation is tightened (the MRL is lowered). In contrast, the shares of domestic poultry meat and imports from China and the US will decrease when the regulation is tightened. This is perhaps because consumers' relatively high prior confidence in producers' compliance with the low residue levels in the poultry meat from China and the US becomes no longer important when the border regulation on those residues is tightened. If uncertainty about the levels of pesticide and veterinary drug residues has previously discouraged consumers from purchasing developing countries' poultry meat products, ensuring a lower contamination level would increase imports from those countries. While the AIDS model intends to estimate consumers' response to varying food safety standards, the possibility of producers' reaction to varying standards should not be completely ruled out. A change in the standards may not be demonstrable to general consumers but distributors and retailers are assumed to be responsive to the change. They may change the local producers from which they import, or provide technical assistance for them to meet the tightened standards even if local producers do not react to the change by themselves.

The avian-influenza-related import bans seem to have a more drastic impact on poultry meat imports as they might totally suspend or drastically reduce imports from the infected countries. The nature of the bans critically limits our analysis because trade data are often unavailable because of the suspension of imports. Even though data are available, the trade amount reflects a discrete change because of the discrete nature of the bans. By including ban dummies, our model is only able to control for the change in imports due to partially applied bans such as a ban with regional arrangement (some part of the infected countries is allowed to export) or a ban with incomplete enforcement. The model cannot incorporate the periods where trade data are missing because of the import bans. This implies that we are not able to predict directly the counterfactual trade amount as an estimate of the trade loss due to import bans in the case of total suspension. Therefore, we approximate the counterfactual trade amount by the predicted values from the estimated AIDS model. We substitute the imputed poultry meat prices (such as overtime average or interpolated prices) into the model.

Using the estimated parameters, we also calculate the elasticities.[4] Table 3 indicates that the Marshallian own-price elasticities for all exporting countries are negative. This implies that an increase in the import price from country k leads to a decrease in the import quantity of poultry from those countries. Furthermore, the magnitudes of the imports' elasticities are around unity. The signs of Marshallian cross-price elasticities are mixed.

6. Simulation analysis: response to change in food safety standards

We conduct simulations in order to demonstrate the impact of varying standards on pesticide and veterinary drug residues in poultry meat products consumed in Japan. First, we make a prediction of the shares of each country based on the estimated parameters of the AIDS model under a scenario that there is no import ban related to avian influenza. The predicted

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[4] The parameters of the rest of the world are restored using estimated parameters and general demand conditions.

shares imply the shares under the assumption that none of the import bans was implemented in Japan. In Table 4, this result is compared with the results under the assumption that all the import bans were implemented in Japan. We calculate the predicted values of the shares at the average prices over the studied period as well as the 2007 period. We use the 2007 average although the year 2008 is the most recent year, because there are countries with zero trade throughout the 2008 period. The import ban is found to decrease import shares from the infected countries (China, Thailand, France, Denmark and the US) and to increase imports from the uninfected country (Brazil) as well as domestic products. This result illustrates the substitution that might have occurred during the period in which import bans were in place.

Second, we predicted the shares under alternative levels of the MRLs in order to give an idea of how the shares would change in response to tightened or relaxed pesticide and veterinary drug standards specified by Japan. The result is presented in Table 5. We consider scenarios of 50% higher and 50% lower MRLs compared with the average level over the period. When evaluated at the all-period average, the share of domestic sales will increase most (0.0901), followed by China (0.0529), the US (0.0331), and Denmark (0.0000648), if MRL is raised by 50%. In contrast, the shares of Thailand, France, and Brazil will decrease by 0.0456, 0.000120, and 0.124, respectively. If MRL is reduced by 50%, the shares of Thailand, France, and Brazil will increase by 0.0795, 0.000205, and 0.212, respectively. In contrast, the shares of China, Denmark, the US and domestic sales will decrease. The results remain largely unchanged when evaluated at the 2007 average.

This simulation is done to estimate the import share during the period in which trade data is missing because of the complete bans. Thus, these predicted shares can be used, although with caution, as the loss of poultry meat imports due to the bans. Under this assumption, the trade loss due to the complete ban is estimated to be 6.02 billion yen (US$ 75.3 million at the 2011 exchange rate) or 18% of total expenditure on poultry meat in Japan.[5]

We focus on the simulation of import shares associated with alternative scenarios of MRLs. We simulate the changes of import shares if the regulations are tightened or more relaxed compared with the 1998 level. When the regulations are tightened, the MRL index declines by 50%, whereas the index rises by 50% when the regulations are relaxed.

In order to demonstrate the effect of varying MRLs over time, we present the predicted share of each country across time in Figures 2 to 6. The baseline is drawn based on the predicted share evaluated at the levels of prices and expenditure at each time period. The line breaks during the periods dropped in estimation due to the missing data. The line shifts up and down depending on the signs of the coefficients of the MRL index. The blue line is the base scenario, the red line is the scenario of a 50% higher MRL index, and the green line is the scenario of a 50% lower MRL index. As expected, the lines of Thailand, France, and Brazil shift down when the MRL is raised by 50% and shift up when it is reduced by 50%. In contrast, the lines for China, Denmark, the US, and domestic sales shift up when the MRL is reduced by 50% and shift down when it is reduced by 50%. The magnitude of the shift of the line is greater for the US, France, and domestic products. The share of domestic poultry meat is estimated to increase by 0.09 when MRL is increased (relaxed) by 50% and to decrease by 0.154 when MRL is decreased (tightened) by 50%.

7. Conclusions

This study estimates Japanese consumers' response to food safety regulations at the border using the almost ideal demand system (AIDS) with a particular focus on the maximum

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[5] The value of trade loss is calculated by multiplying the decreased share of the total poultry meat imports by the total expenditure on poultry meat. The 2011 exchange rate is used.

limits on pesticide and veterinary drug residues and bans on imports from avian-influenza-infected countries. The results imply that the assessment of the impact of regulatory policies needs to take into account consumers' flexible rearrangement of bundles. Such information complements the gravity model, which produces the common coefficient for regulations among all countries. Source-specific response may be of policy interest particularly when the source has a particular political importance or when the country is simply the biggest supplier to the importing country.

Our results suggest that import bans for avian-influenza-infected countries have caused a shift in demand from imports from infected countries to domestic products and imports from uninfected countries. The trade loss due to the complete ban is estimated to be 6.02 billion yen (US$ 75.3 million at the 2011 exchange rate).

The impact of the food safety standards is heterogeneous across products from different origins. For example, tightening the standards will result in a decrease in domestic demand as well as demand for imports from China, Denmark, and the US, and in an increase in demand for imports from the other major exporting countries such as Thailand, France, and Brazil. If the standards are tightened by 50%, the loss to China, the US, and Denmark in terms of share is estimated to be 0.09%, 0.06% and 0.0001%, respectively. On the other hand, the gain to Thailand, France, and Brazil is estimated to be 0.08%, 0.0002%, and 0.2%, respectively. This shift may imply that the demand-promoting effect of compliance to the more stringent standards may be more prominent for food imports from countries with a lower compliance capacity.

References

Deaton, A. and J. Muelbauer (1980) "An Almost ideal demand system," American Economic Review 70(3), pp312-326.

Yang, Seung-Ryong and Won. W. Koo (1994) "Japanese Meat Import Demand Estimation with the Source Differentiated AIDS Model," *Journal of Agricultural and Resource Economics*, Vol.19(2), pp.396-408.

Verbeke, W. and R. W. Ward (2001) "A Fresh Meat Almost Ideal Demand System Incorporating Negative TV Press and Advertising Impact," *Agricultural Economics*, Volume 25, Issue 2-3, pp.359-374.

Ishida, T., N. Ishikawa, and M. Fukushige (2010) "Impact of BSE and Bird Flu on Consumers' Meat Demand in Japan," Applied Economics 42(1), pp.49-56.

Henneberry, S. R. and Seong-huyk Hwang (2007) "Meat Demand in South Korea: An Application of the Restricted Source-differentiated Almost Ideal Demand System Model," Journal of Agricultural and Applied Economics 39(1), pp47-60.

Carew, R., W. J. Florkowski, and S. He (2005) "Demand for Domestic and Imported Table Wine in British Columbia: A Source-differentiated Almost Ideal Demand System Approach," Canadian Journal of Agricultural Economics 52, pp.183-199.

Disdier, A.-C., L. Fontagné, and M. Mimouni. 2008. "The Impact of Regulations on Agricultural Trade: Evidence from the SPS and TBT Agreements." American Journal of Agricultural Economics 90(2):336-350.

Otsuki, T., J.S. Wilson, and M. Sewadeh. 2001. "Saving Two in a Billion: Quantifying the Trade Effect of European Food Safety Standards on African Exports." Food Policy 26(5):495-514.

Winters, A. L. 1984. "Separability and the Specification of Foreign Trade Functions." Journal of International Economics 17: 239-263.

Table 1. Descriptive statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
$share_{CHN}$	254	0.0603	0.0504	0.0000113	0.203
$share_{THA}$	214	0.131	0.147	0.0000126	0.624
$share_{DNK}$	206	0.000481	0.000710	0.0000162	0.00318
$share_{FRA}$	261	0.001134	0.00212	0.00000560	0.0101
$share_{USA}$	264	0.0681	0.104	0.000641	0.436
$share_{BRA}$	264	0.100	0.0739	0.00783	0.290
$share_{DOM}$	225	0.774	0.0488	0.660	0.899
$share_{ROW}$	264	0.00642	0.0101	0.0000313	0.0580
$price_{CHN}$	254	268.623	86.221	153.868	647.220
$price_{THA}$	214	278.768	64.664	157.235	479.832
$price_{DNK}$	206	207.348	28.633	151.476	339.031
$price_{FRA}$	261	370.929	288.786	93.442	1327.014
$price_{USA}$	264	167.352	30.624	110.227	234.737
$price_{BRA}$	264	226.061	46.934	128.049	374.426
$price_{ROW}$	264	289.589	76.124	142.186	642.305
$price_{DOM}$	240	280.229	67.857	184.000	451.000
Expenditure	264	32676224	13796425	2945724	63053624
MRL	264	21.637	6.642	1.000	25.427

Source: Japan Food Chemical Research Foundation, and the Trade Statistics of Ministry of Finance.

Note: Variable units are yen/kg for import prices, thousand yen for total expenditure and ppm for index of MRLs(MRL). The subscripts of country h and k denote CHN – China; THA – Thailand; DNK – Denmark; FRA – France; USA – the U.S.; BRA – Brazil; DOM – Domestic sales in Japan; ROW – the rest of world.

Table 2. Estimated parameters of the AIDS model

	Equation						
	China	Thailand	Denmark	France	USA	Brazil	Domestic
$price_{CHN}$	0.0581**	0.00551	3.10e-05	-0.000588***	0.0110	0.0596***	-0.131***
	(0.0271)	(0.0151)	(0.000127)	(0.000219)	(0.00839)	(0.0159)	(0.0197)
$price_{THA}$	0.00551	-0.0597***	0.000240	0.000616**	0.0349***	0.0157	-0.000734
	(0.0151)	(0.0186)	(0.000151)	(0.000241)	(0.00839)	(0.0129)	(0.0115)
$price_{DNK}$	3.10e-05	0.000240	0.000139	4.23e-05**	-9.53e-05	-7.95e-05	-0.000263***
	(0.000127)	(0.000151)	(0.000101)	(1.89e-05)	(0.000125)	(0.000118)	(9.37e-05)
$price_{FRA}$	-0.000588***	0.000616**	4.23e-05**	-0.000126***	-0.000353*	1.55e-05	0.000376**
	(0.000219)	(0.000241)	(1.89e-05)	(2.67e-05)	(0.000191)	(0.000194)	(0.000159)
$price_{USA}$	0.0110	0.0349***	-9.53e-05	-0.000353*	-0.00854	-0.0103	-0.0251***
	(0.00839)	(0.00839)	(0.000125)	(0.000191)	(0.00778)	(0.00758)	(0.00610)
$price_{BRA}$	0.0596***	0.0157	-7.95e-05	1.55e-05	-0.0103	0.0215	-0.0871***
	(0.0159)	(0.0129)	(0.000118)	(0.000194)	(0.00758)	(0.0167)	(0.0122)
$price_{DOM}$	-0.131***	-0.000734	-0.000263***	0.000376**	-0.0251***	-0.0871***	0.243***
	(0.0197)	(0.0115)	(9.37e-05)	(0.000159)	(0.00610)	(0.0122)	(0.0215)
Expenditure	-0.00163	-0.0141***	5.30e-05	0.000166	0.00288	-0.00534	0.0172
	(0.0103)	(0.00524)	(7.88e-05)	(0.000106)	(0.00283)	(0.00634)	(0.0106)
MRL	0.130*	-0.115***	0.000162	-0.000290	0.0818***	-0.306***	0.223***
	(0.0752)	(0.0381)	(0.000338)	(0.000569)	(0.0215)	(0.0462)	(0.0766)
Ban_{CHN}	-0.0608***	-0.0819***	-9.28e-05	-0.000108	-0.0157**	0.0739***	0.0842***
	(0.0211)	(0.0120)	(8.47e-05)	(0.000152)	(0.00629)	(0.0133)	(0.0216)
Ban_{FRA}	-0.00931	-0.0139	-1.38e-05	-0.000138	-0.000893	-0.0167	0.0430*
	(0.0217)	(0.0107)	(7.40e-05)	(0.000137)	(0.00565)	(0.0131)	(0.0221)
Ban_{USA}	-0.0434**	0.0123	-2.34e-05	0.000125	-0.0128***	-0.0148	0.0573***
	(0.0171)	(0.00861)	(6.56e-05)	(0.000116)	(0.00462)	(0.0104)	(0.0169)
Cons.	-0.274	0.708***	-0.00125	-0.00189	-0.280***	1.141***	-0.324
	(0.304)	(0.153)	(0.00201)	(0.00294)	(0.0848)	(0.187)	(0.309)
Obs.	145	145	145	145	145	145	145
R^2	0.859	0.949	0.774	0.801	0.944	0.948	0.998

Notes: "***", "**", "*" denote significance at the 1%, 5%, and 10% level, respectively. Standard errors are in parentheses. R^2 is uncentered. Each column corresponds to the share equation of the country.

Table 3. Price, Expenditure, and MRL elasticities

	China	Thailand	Denmark	France	USA	Brazil	Domestic	Rest of world
$price_{CHN}$	-0.0332	0.0781	0.0645	-0.518	0.163	0.605	-0.178	-0.377
$price_{THA}$	0.0942	-1.421	0.499	0.544	0.513	0.168	-0.00980	0.544
$price_{DNK}$	0.00338	0.0378	-0.711	0.0377	-0.000427	0.00982	-0.00919	-0.00104
$price_{FRA}$	-0.00690	0.0407	0.0880	-1.110	-0.00421	0.0108	-0.00837	0.00389
$price_{USA}$	0.186	0.303	-0.198	-0.311	-1.124	-0.0925	-0.0413	-0.220
$price_{BRA}$	0.991	0.156	-0.165	0.0141	-0.151	-0.775	-0.121	0.114
$price_{DOM}$	-2.174	0.0303	-0.546	0.332	-0.368	-0.859	-0.695	0.147
$price_{ROW}$	-0.0374	0.0626	-0.0308	0.0152	-0.0199	0.0179	-0.00765	-1.201
Expenditure	0.973	0.892	1.110	1.147	1.042	0.947	1.022	1.123
MRL	0.00786	-0.0150	7.72E-08	-3.32E-07	0.00557	-0.0306	0.172	-9.02E-05

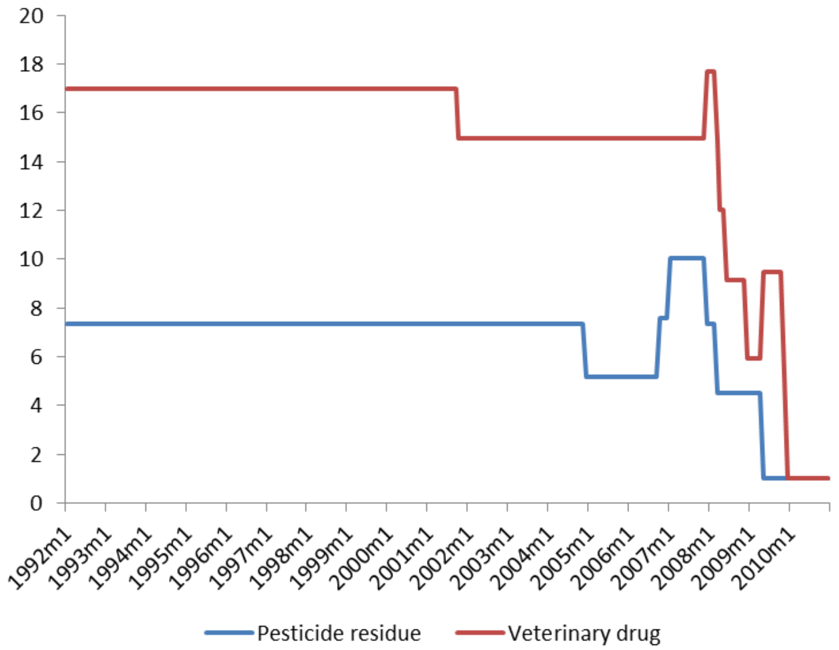
Table 4. Simulation: trade shares with respect the avian-influenza related import bans

	All periods		2007	
	Base prediction	Ban simulation	Base prediction	Ban simulation
CHN	0.0848	-0.0287	0.137	0.0235
THA	0.104	0.0210	0.0648	-0.0200
DNK	0.000157	0.0000267	0.000424	0.000299
FRA	0.0000168	-0.000106	-0.0000731	-0.000178
USA	0.0240	-0.00547	0.0574	0.0282
BRA	0.111	0.153	0.116	0.158
DOM	0.672	0.857	0.621	0.808
ROW	0.00369	0.00349	0.00315	0.00304

Table 5. Simulation: trade shares under alternative MRLs

	All periods			2007		
	Base prediction	MRL 50% up	MRL 50% down	Base prediction	MRL 50% up	MRL 50% down
MRL	21.637	32.455	10.818	24.002	36.004	12.001
CHN	0.0848	0.138	-0.00559	0.137	0.190	0.047
THA	0.104	0.0578	0.184	0.0648	0.0180	0.145
DNK	0.000157	0.000222	0.0000465	0.000424	0.000490	0.000311
FRA	0.0000168	-0.000103	0.000221	-0.0000731	-0.000189	0.000125
USA	0.0240	0.0572	-0.0326	0.0574	0.0906	0.000583
BRA	0.111	-0.0132	0.322	0.116	-0.00819	0.328
DOM	0.672	0.762	0.518	0.621	0.712	0.467
ROW	0.00369	-0.00202	0.0134	0.00315	-0.00253	0.0129

Figure 1. Pesticide residue and veterinary drug



Source: Japan Food Chemical Research Foundation, and the Trade Statistics of Ministry of Finance.

Figure 2. The simulation results of France with respect to the MRL

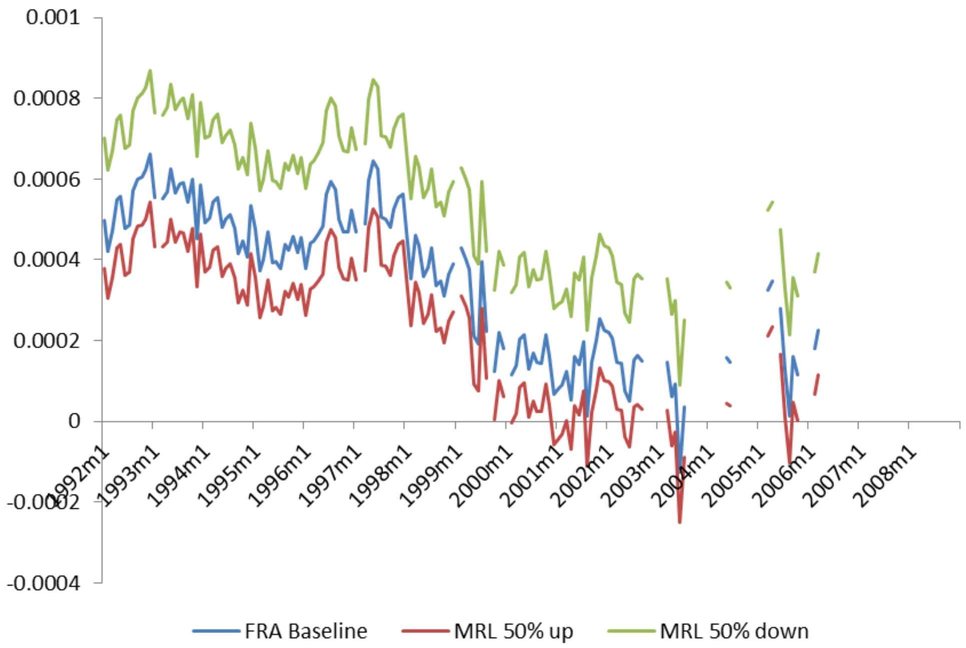


Figure 3. The simulation results of Brazil with respect to the MRL

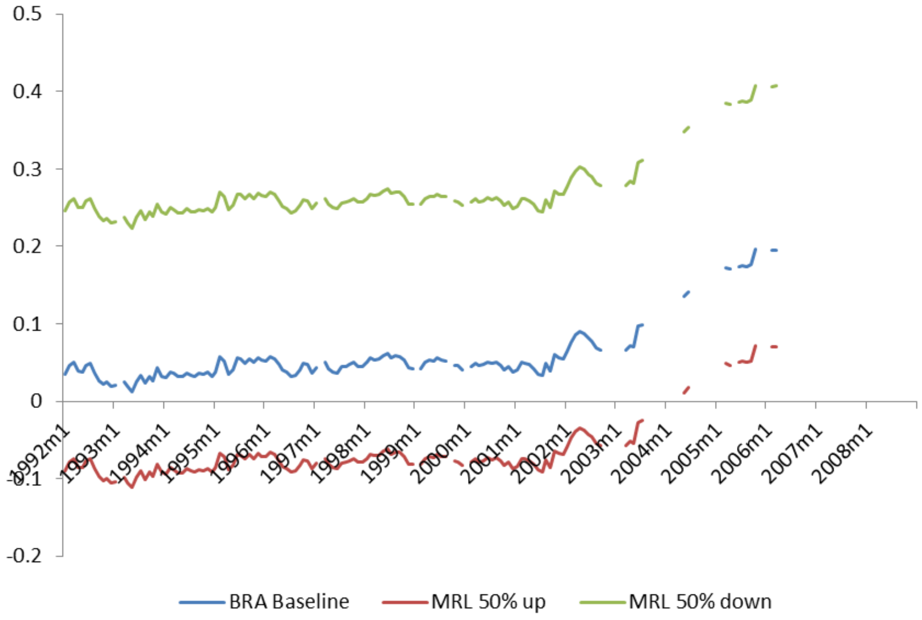


Figure 4. The simulation results of the U.S. with respect to the MRL

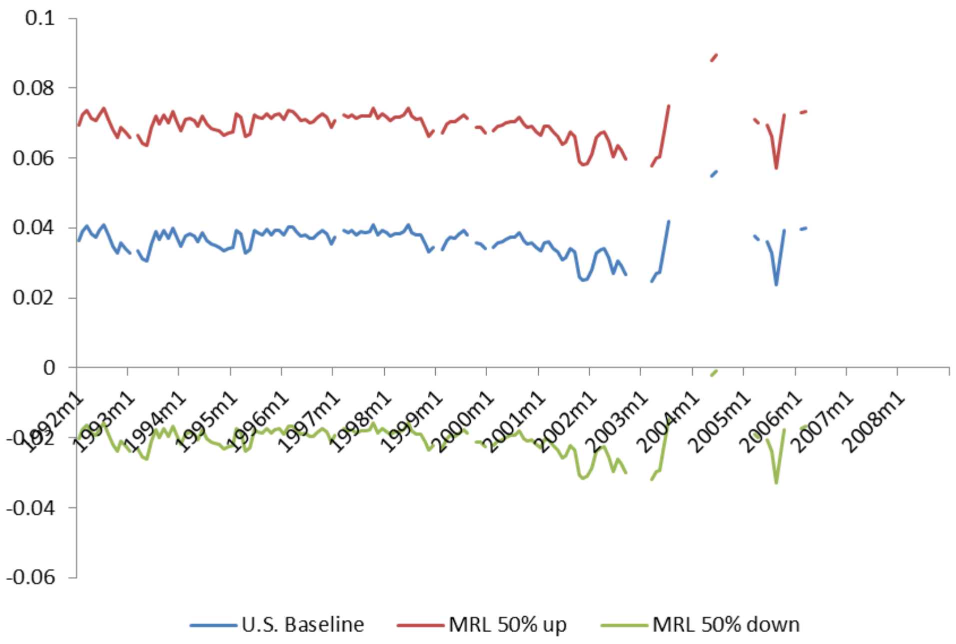


Figure 5. The simulation results of Denmark with respect to the MRL

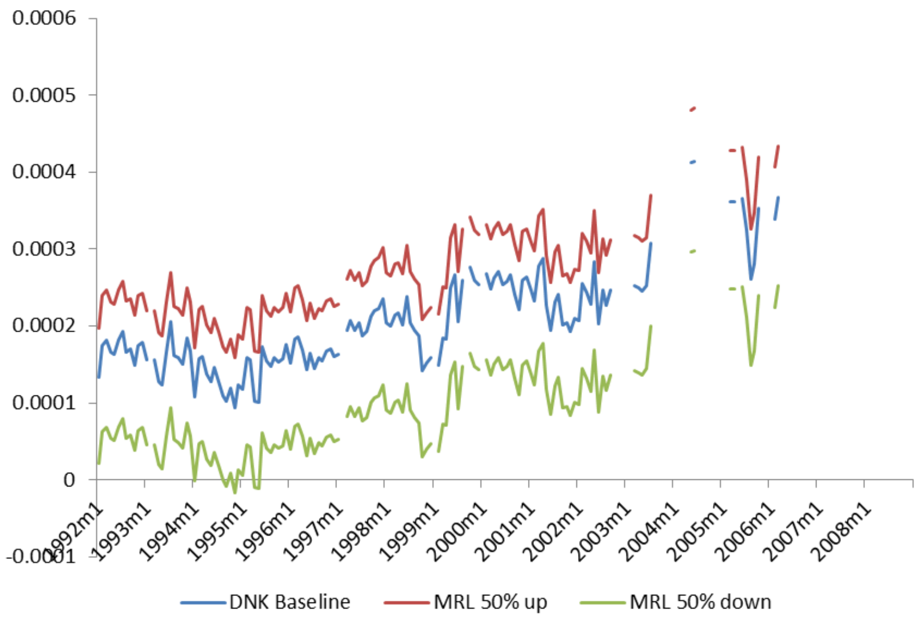


Figure 6. The simulation results of Japan with respect to the MRL