

Potential Reasons of Recent Beef Export from Japan

Hiroaki Sakurai¹ and Toko Watanabe¹

Abstract

This study estimated three potential factors (policy change, depreciation, and income per cattle house) affecting the beef export amount from Japan, using Revealed Symmetric Comparative Advantage (RSCA) and export data from 1996 to 2023. Although the beef industry in Japan is at a comparative disadvantage compared with other countries because of limited plains, exports have increased in recent years. The Japanese government has recently strengthened cooperation with producers to promote Japanese beef (Wagyu) internationally. The estimated results are as follows. First, the dummy variable for the period after 2018, when a new law was prepared to enact for promoting the export of Japanese agricultural products, was significant in explaining beef exports from Japan. Second, in contrast, this dummy variable was not significant when using RSCA instead of export data. Third, neither income per cattle house nor the exchange rate affected RSCA or export amounts. Overall, government efforts appear to influence product promotion. These results suggest that Japan's beef export initiatives may increase export amounts, although the comparative disadvantage remains unchanged.

JEL classification: O53, Q17.

Keywords: Japan, Beef, Export.

¹ Environmental Education Center, Gakushuin Women's College.

1. Introduction

The Japanese beef industry lacks international competitiveness partly because of limited land and traditional eating habits influenced by religious reasons. After World War II, Japan restricted beef imports, but introduced a tariff system in 1991. The tariff rate was 50% in 1991, decreased annually, and has remained at 38.5% since 2000. As a result, Japanese consumers now have access to both reasonably priced imported beef and high-quality domestic beef, as low-priced beef is easily imported while high-grade, expensive domestic beef remains protected.

Although Japanese high-class beef exports have generally not increased, owing to comparative disadvantage, exports have grown in recent years, as shown in Figure 1. Three potential reasons explain this trend. First, Japanese government policy has supported export growth. Second, yen depreciation since 2021 has contributed to increased beef exports. Third, rising cattle income has supported the export of Japanese high-class beef.

Japanese policy toward agricultural exports can be summarized as follows. The history of promoting Japanese foods is detailed in Yoshida (2021) and Saito (2023). This study summarizes their findings and adds new information. The first stage was the “Basic Plan for Food, Agriculture and Rural Areas,” which the Government of Japan adopted to promote exports of Japanese foods, including Japanese beef. In 2007, a unified Japanese high-ranked beef logo mark was introduced. In 2013, the government established the “Plan to Create Vitality for Agricultural, Forestry and Fishery Industries and Local Communities” and set a target to increase Japanese food exports to JPY 1 trillion by 2020. This target was reached in 2019, and a new law to promote Japanese food exports was enacted. Under this law, a new goal and organization were established to further increase Japanese food exports. Beef in Japan, known as “Wagyu,” is one of the most important Japanese foods.

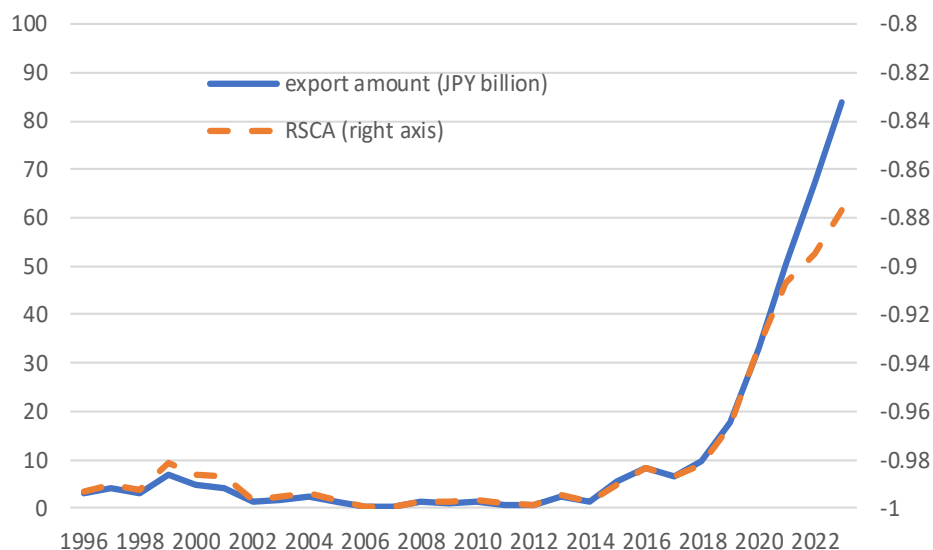


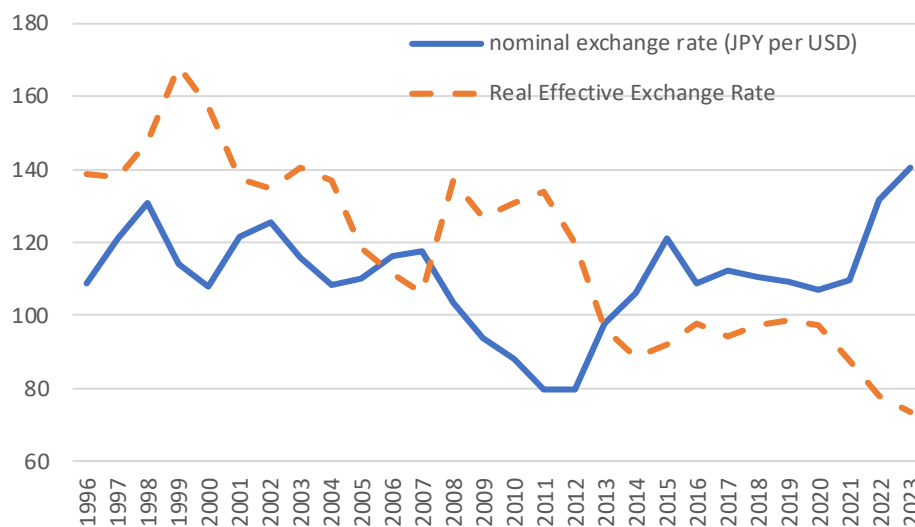
Figure 1: Beef export from Japan

Table 1: Policies promoting beef exports

Year	Policies and Movements	Entities
2005	Basic Plan for Food, Agriculture and Rural Areas for promoting Japanese foods was decided.	Government of Japan
2007	unified Japanese high-ranked beef logo mark was decided.	Government of Japan
2013	Japanese cuisine was added to UNESCO's Intangible Cultural Heritage of Humanity.	UNESCO
2013	The Plan to Create Vitality for Agricultural, Forestry and Fishery Industries and Local Communities was decided.	Government of Japan
2013	Goal of the Japanese food export as 1 trillion yen by 2020 was decided.	Government of Japan
2014	Japan Livestock Products Export Promotion Council was founded.	Livestock industries in Japan
2016	Strategy for Strengthening the Export Capacity of Agriculture, Forestry and Fisheries was decided.	Government of Japan
2019	Act on Facilitating the Export of Agricultural, Forestry, and Fishery Products and Food was enacted in Japanese Parliament.	Government of Japan
2019	Japanese food export was attained to 1 trillion yen.	
2020	New goal of Japanese food export was decided as 2 trillion yen in 2025 and 5 trillion yen in 2030.	Government of Japan
2020	Headquarters for the Export of Agricultural, Forestry, and Fishery Products and Food was founded.	Government of Japan

(Source) Author summarized by referring to Yoshida (2021) and Saito (2023).

The second potential reason is Japanese yen depreciation. Figure 2 shows the exchange rate of the Japanese currency. The solid line indicates the nominal exchange rate with the US dollar, and the dashed line represents the Real Effective Exchange Rate (REER), which includes other currencies. Figure 2 demonstrates two points. First, the nominal exchange rate remained relatively stable after the global financial crisis in 2008 until 2021. After 2021, the Japanese yen depreciated against the US dollar, as shown by the nominal exchange rate. Second, this depreciation occurred not only against the US dollar, but also against other currencies, as indicated by the REER.

**Figure 2: Nominal exchange rate (JPY per USD) and real effective exchange rate in Japan**

The third reason concerns income per cattle farm, as shown in Figure 3. The line chart displays income per cattle house, while the bar chart presents the growth rate of income per cattle house using a three-year moving average after 1996. These data indicate two main points. First, income per cattle house remains relatively high, despite certain risks and demanding work. In 2023, income per cattle house was nearly JPY 19 million (approximately USD 13,600), which is more than four times the average income of an employed person in Japan. Second, there is a time lag between income growth and export growth. Figure 2 shows that income per cattle house increased during the 2010s, while beef exports from Japan rose in the 2020s.

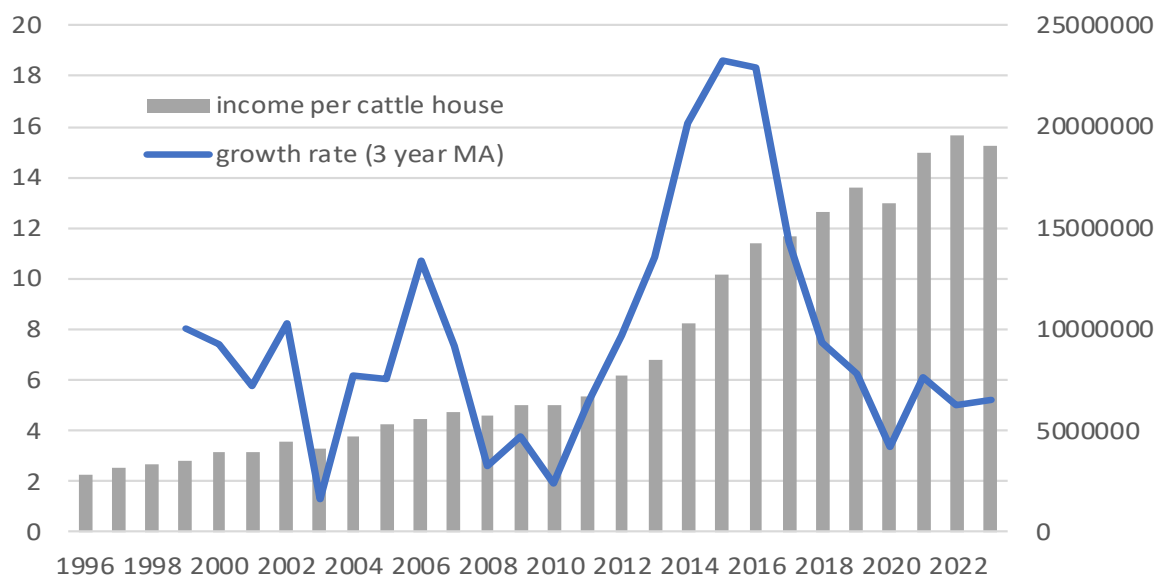


Figure 3: Income per cattle house in Japan (JPY nominal)

Although strengthening a comparative disadvantage industry is challenging, identifying competitive segments within the industry is important for the survival of those involved. By seeking the strengths of the industry, weaknesses can be addressed, and expanding sales, including exports of related industries and products, can build confidence among stakeholders.

This study examines the main reasons for the recent export of beef from Japan using export amounts and RSCA. The remainder of this paper is organized as follows. Section 2 reviews the related literature. Section 3 presents the data and methodology. Section 4 discusses the estimation results. Section 5 concludes the paper.

2. Literature Review

Previous literatures of the export and policy making are summarized by Reed (2024). Summarizing literature review of this paper by using Reed (2024), reasons of increasing the export are consisted with some categories. First, the increase of the world market leads to the export increase. Reed (2024) shows the relationship between the international demand for export growth rate and per capita GDP growth rate. Second, strengthening the industry in the world competition is the reason of increasing export. The strength of the world competition is considered as the comparative advantage and measuring index is developed. Third, the policy for strengthening industry is different by country. Increasing productivity is one way but relatively long-term relationship. Based on these assumption, previous literature of this paper can be categorized as the following four categories: world market, index for measuring the comparative disadvantage, productivity for realizing the export-led growth, and the case of Japanese beef export.

First, regarding demand and supply in the beef industry, Komarek et al. (2021) found that demand for livestock-derived food is projected to increase by 38% in 2050 compared with 2020. During the situation, primary beef exporting countries struggle for increasing productivity and export of beef summarized by Smith et al. (2018). Additionally, analyzing each country for the beef industry and export is seen as Drouillard (2018) in the United States, Greenwood et al. (2018) in Australia, Hocquette et al. (2018), and Ermgassen et al. (2020) in Brazil, for example.

Second, the index of comparative disadvantage used in the analysis is summarized as follows. Balassa (1965) developed the concept of competitiveness in the international economy, known as Revealed Comparative Advantage (RCA), which is shown in equation 1.

$$RCA_i = \frac{X_i / \sum_i X_i}{X_{iw} / \sum_i X_{iw}}, \quad (1)$$

Where X_i denotes the export amount of product i from the country, and X_{iw} is the export amount of product i from all over the world.

Although RCA is widely used because it accounts for the share of both the country and product, its range extends from zero to infinity. To address this issue, Laursen (2015) developed the Revealed Symmetric Comparative Advantage (RSCA), as shown in equation 2. RSCA constrains the range to between -1 and 1:

$$RSCA_i = \frac{RCA_i - 1}{RCA_i + 1}. \quad (2)$$

Third, effect of the policy is as follows. Basically, the natural conditions such as climate, water supply, flat ground, and soil characters affect to the strength of the agriculture. Costinot and Donaldson (2012) shows that natural conditions increase the output of crops. In addition, Costinot et al. (2012) shows that the trade is decided by the gravity model including the population, distance, and income of both import and export countries, meaning that the productivity is no relationship with the trade. In addition, Hanson et al. (2015) finds that half of the comparative advantage is dismissed for around 5.5 years from the initial shock. This infers that that policy for support will have to continue for more than 5 years, which is longer than most executives' terminology.

Fourth, the international competitiveness of Japan's agricultural industry has been examined. Min (2010) analyzed the strength of the Japanese wood industry using several indices and found that the paper industry maintained international competitiveness compared with lumber or wood panels. This suggests that technological advancement in the wood industry is important. For the beef industry, Jin et al. (2021) estimated the demand in overseas markets (China, Hong Kong, the United States, Singapore, and the European Union, the five largest export destinations) for Japanese beef. They found that a lower price for Japanese beef increases the quantity exported from Japan, although it does not increase the total export value.

Although some studies examine the export characteristics of the beef industry in Japan, international competition in this sector has not yet been studied. Because this study investigates the main reasons for recent beef exports from Japan using export amounts and RSCA, it remains a relevant research topic.

3. Methodologies and Data

This section presents an estimation of selected elements of beef exports from Japan, outlining the methodology in Section 3.1 and describing the data in Section 3.2.

3.1 Methodology

The methodology in estimating the elements of the beef export from Japan for the following two steps.

First, we conduct unit root tests to convert variables to $I(0)$ and prevent spurious regressions. Most economic statistics show an upward trend and are typically integrated of order one, $I(1)$, so we take first differences to achieve $I(0)$. In cases of significant rapid growth, the trend may be $I(2)$, requiring second differences, defined as $\Delta(\Delta x_t) = \Delta x_t - \Delta x_{t-1}$. In this estimation, we use the augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests to determine the order of integration. The ADF test includes the $AR(p)$ process, while the PP test accounts for serial correlation and heteroscedasticity in the differenced time series error term. The stationarity tests use null hypotheses of a unit root in both the levels and first differences, applying both “intercept” and “trend and intercept” specifications.

Second, we examine the relationship between beef exports from Japan and several factors, as shown in equations 3 and 4. Equation 3 explains beef exports from Japan in nominal USD terms using the real effective exchange rate, productivity, and a policy dummy variable. The real effective exchange rate is used because it reflects not only the USD exchange rate but also Japan’s trade with the rest of the world. The dummy variable equals 1 after 2018, when the new law for beef promotion abroad was considered to begin for enacting the Japanese parliament.

$$EXPORT_t = \beta_0 + \beta_1 REER_t + \beta_2 INCOME_t + \beta_3 DUMMY_t + u_t \quad (3)$$

$$RSCA_t = \beta_0 + \beta_1 REER_t + \beta_2 INCOME_t + \beta_3 DUMMY_t + u_t, \quad (4)$$

where:

$EXPORT_t$: beef export from Japan in the period t under the nominal US dollar base

$REER_t$: real effective exchange rate in the period t

$INCOME_t$: income of the cattle farm in Japan in the period t

$DUMMY_t$: policy dummy in Japan (1 after 2018 as preparation for the law for food export)

Exchange, income, and real effective exchange rate are converted into logarithms because the growth rate more clearly shows the effect of increased export. The number of observations for each variable is relatively small, making it difficult to conduct a time series analysis using methods such as Autoregressive Distributed Lag (ARDI) or cointegration techniques. Additionally, panel data analysis is not feasible because all variables are single country data. Therefore, this study uses simple OLS estimations.

3.2 Data

The data used in this study are derived from several sources. First, export amounts from Japan and the world, including beef and all materials, are from UN Comtrade. Second, the real effective exchange rate is from the Bank of Japan. Third, income and cattle house data are from the "Statistics of Agricultural Income Produced" by the Ministry of Agriculture, Forestry and Fisheries, Government of Japan. All statistics cover the period from 1996 to 2023. Table 2 presents the data description.

Table 2: Data description

	RSCA	EXPORT	REER	INCOME
mean	-0.979	115.590	117.297	8928823.414
median	-0.993	30.503	119.010	6234683.853
std	0.033	208.270	24.710	5547438.457
min.	-0.999	3.062	73.400	2782440.284
max.	-0.876	837.889	168.510	19612826.603

4. Estimation Results and Discussion

We present the results of the unit root tests and OLS estimations. First, unit root tests were conducted to confirm the validity of the OLS estimation equations. The estimation results in Table 3 show that all variables have at least one unit root, I(1) or I(2), indicating a positive trend in each variable. In particular, the EXPORT and RSCA statistics for beef export indicate rapid growth, as both are I(2). In this study, I(1) variables, REER and INCOME, are transformed using first differences, while I(2) variables, EXPORT and RSCA, are transformed using second differences.

Table 3: Estimation results of unit root tests

RSCA: I(2)				
	ADF		PP	
	intercept	intercept & trend	intercept	intercept & trend
level	0.955	3.338	3.125	2.020
first difference	-2.077	-2.530	-2.077	-3.209
second difference	-4.398***	-5.064***	-8.443***	-10.161***
ln(EXPORT): I(2)				
	ADF		PP	
	intercept	intercept & trend	intercept	intercept & trend
level	0.768	2.955	6.510	5.467
first difference	-0.245	-1.605	-0.121	-1.605
second difference	-5.530***	-5.784***	-5.530***	-6.029***
REER: I(1)				
	ADF		PP	
	intercept	intercept & trend	intercept	intercept & trend
level	-0.694	-4.271**	-0.729	-3.038
first difference	-4.394***	-	-4.446***	-4.390***
ln(INCOME): I(1)				
	ADF		PP	
	intercept	intercept & trend	intercept	intercept & trend
level	-0.403	-1.720	-0.397	-1.830
first difference	-5.148***	-5.043***	-5.159***	-5.045***

Note: ***, **, and * indicate significance levels of 1%, 5%, and 10%, respectively.

Next, OLS estimations for equations 3 and 4 were conducted after converting the variables to $I(0)$. Table 4 presents the estimation results of the equation 3, beef export in nominal terms across equations, summarized as follows. First, the estimated coefficients of the dummy variable from 2018 are effectively estimated in all equations from (1) to (5). In addition, coefficients in all equations are similar around 30. These facts infer that the policy change may affect to the beef export from the Japanese domestic side. Second, the exchange rate and income are insignificantly estimated in all equations from (1) to (5), inferring that these factors do not affect to the beef export from Japan.

Table 4: OLS estimation results of the beef export from Japan

Dependent variable: $D(EXPORT,2)$

Estimation period: 1996-2023

Equations	(1)	(2)	(3)	(4)	(5)
D(REER)			0.685 (0.487)	0.760 (0.476)	0.743 (0.483)
D(INCOME)					0.000 (0.000)
DUMMY	28.522 (8.578)***	29.445 (6.666)***	30.488 (8.097)***	28.636 (14.051)*	30.223 (8.302)***
C	0.896 (5.157)		2.317 (5.059)		-0.316 (6.249)
AR(1)	-0.312 (0.181)*	-0.310 (0.180)*	-0.328 (0.211)	2.250 (6.202)	-0.356 (0.224)**
Adj. R^2	0.100	0.137	0.156	0.142	0.135
D.W. Ratio	1.929	1.931	1.820	2.482	1.841

Notes: 1. $D(--)$ denotes the first difference, and $D(--,2)$ refers to the second difference.

2. ***, **, and * indicate significance levels of 1%, 5%, and 10%, respectively.

Additionally, the equation results of the equation 4, comparative advantage converted into RSCA, is estimated as shown in Table 5, summarized as follows. First, the dummy variable was not significant when using RSCA, shown from estimated equations from equations (6) to (8) in Table 5. Second, real effective exchange rate and income per cattle house showed no relationship with beef export in all equations from equations from (6) to (8) in Table 5. These results infer that all elements including the depreciated Japanese currency, Japanese cattle farm income, and Japanese policy do not affect to the comparative advantage.

Table 5: OLS estimation results of the RSCA of the beef export from Japan

Dependent variable: D(RSCA,2)

Estimation period: 1996-2023

Equations	(6)	(7)	(8)
D(REER)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
D(INCOME)			0.000 (0.000)
DUMMY		0.003 (0.004)	0.003 (0.002)
C	0.001 (0.002)	0.001 (0.002)	0.001 (0.002)
AR(1)			-0.305 (0.284)
Adj. R ²	0.063	0.050	0.036
D.W. Ratio	2.532	2.595	1.987

Notes: 1. D(--) denotes the first difference, and D(--,2) refers to the second difference.

2. ***, **, and * indicate significance levels of 1%, 5%, and 10%, respectively.

In total, following three points are inferred from OLS estimations. First, Japanese policy for beef export may influence export volume of beef export from Japan through the campaign of Japanese high value beef promotion. Second, these policy changes do not affect to the comparative disadvantage, which is suitable for previous studies since comparative advantage is mainly decided by natural condition and increasing productivity takes time by previous literatures. Third, depreciated Japanese currency and income increase of Japanese cattle farm do not affect to Japanese beef export as well as comparative advantage. These results are also suitable to previous studies since the trade is mainly decided by the distance, income and population of both export and import countries shown in the gravity model.

5. Conclusion

This study analyzed the potential reasons for beef exports from Japan using RSCA and export data from 1996 to 2023. The analysis considered three main factors: exchange rate, income of cattle households, and policy change. The exchange rate was measured as the real effective exchange rate, while policy change was represented by a dummy variable from 2018, when a new law promoting the export of Japan's agricultural products was considered to be prepared for enacting the parliament. Although Japan's beef industry has a comparative disadvantage compared with other countries because of limited arable land and traditional eating habits influenced by religious practices, exports have increased in recent years. In this context, the Japanese government has recently strengthened cooperation with producers to promote Japanese beef (Wagyu) internationally.

The estimated results are summarized in three main points. First, the dummy variable for the period after 2018, which represents the preparing enactment of the new law to promote Japanese agriculture, is

significant when explaining beef exports from Japan. Second, in contrast, this dummy variable is not significant when using the RSCA instead of export values. Third, neither income nor the exchange rate has a significant effect on RSCA or export. Overall, government efforts have influenced the promotion of these products.

These estimation results suggest that Japan's beef export efforts may influence export volumes, even though the country's comparative disadvantage remains unchanged. The implications and limitations of this study are summarized in two points. First, the period following the promotion of beef exports under the new law is short, which may reduce the effectiveness of the estimation results. In this context, the policy effect may be estimated more accurately using the RSCA if these government efforts continue. Second, there is limited previous literature on this topic, partly because effective estimation is challenging.

Finally, the further issue of this study is as follows. First, longer time after policy change will be necessary in the near future to measure the policy effect. Previous study indicates that it will take longer time even if productivity growth will affect to the export. Second, statistics of high value beef is missing. Limited to the high value beef may help to find out the policy effect more easily although the statistics of beef is unified both in high and low value now. Further research on Japan's beef exports as compensation for comparative disadvantage can be developed.

References

- Balassa, B. (1965) Trade Liberalisation and Revealed Comparative Advantage. *The Manchester School*, 33(2), 99–123.
- Costinot, A., and Donaldson, D. (2012) Ricardo's Theory of Comparative Advantage: Old Idea, New Evidence, 102(3), 453–458.
- Costinot, A., Donaldson, D., and Komunjer, I. (2012) What Goods Do Countries Trade? A Quantitative Exploration of Ricardo's Ideas, *review of Economic Studies*, 79, 581–608.
- Drouillard, J. S. (2018) Current Situation and Future Trends for Beef Production in the United States of America - A Review, *Asian-Australas Journal of Animal Sciences*, 31(7), 1007–1016.
- Ermgassen, E. K. H. J., Godar, J., Lathuilliere, M. J. Lofgran, P., Gardner, T., Vasconcelos, A., and Meyfroidt, P. (2020) The Origin, Supply Chain, and Deforestation Risk of Brazil's Beef Exports, *PNAS* 117(50), 31770–31779.
- Greenwood, P. L., Gardner, G. E., and Ferguson, D. M. (2018) Current Situation and Future Prospects for the Australian Beef Industry – A Review, *Asian-Australas Journal of Animal Sciences*, 31(7), 992–1006.
- Hanson, G. H., Lind, N., and Muendler, M. (2015) The Dynamics of Comparative Advantage, NBER Working Paper, 21753.
- Hocquette, J., Ellies-Oury, M., Lherm, M., Pineau, C., Deblitz, C., and Farmer, L. (2018) Current situation and future prospects for beef production in Europe - A review, *Asian-Australas Journal of Animal Sciences*, 31(7), 1017–1035.
- Jin, S., Takahashi, K., and Maeda, K. (2021) An Econometric Analysis of Demand for Japanese Beef on Overseas Markets. *Agricultural Marketing Journal of Japan*, 30(2), 1–12. (in Japanese)
- Komarek, A. M., Dunston, S., Enahoro, D., Godfray, H. C., Herrero, M., Mason-D'Croz, D., Rich, K. M., Scarborough, P., Springmann, M., Suser, T. B., Wiebe, K., and Willenbockel, D. (2021) Income, Consumer Preferences, and the Future of Livestock-derived Food Demand. *Global Environmental Change* 70, 102343.
- Laursen, K. (2015) Revealed Comparative Advantage and the Alternatives as Measures of International Specialization. *Eurasian Business Review* 5, 99–115.
- Min, K. (2010) Analysis of International Competitiveness of the Japanese Wood Industry. *Bulletin of the University of Tokyo Forests*, 122, 27–39. (in Japanese)
- Reed, T. (2024) Export-Led Industrial Policy for Developing Countries: Is There a Way to Pick Winners? *Journal of Economic Perspectives*, 38(4), 3–26.

- Saito, M. (2023) Promotion of the Export of Agricultural, Forestry and Fishery Products and Food. Research Materials, 2023e-3, Tokyo: Research and Legislative Reference Bureau, National Diet Library, 2023. (Translated from ISSUE BRIEF, No. 1187, 2022.3.29.)
- Smith, S. B., Gotoh, T., and Greenwood, P. L. (2018) Current Situation and Future Prospects for Global Beef Production: Overview of Special Issue, Asian-Australas Journal of Animal Sciences, 31(7), 927-932.
- Yoshida, S. (2021) Nihon no Gyuniku Yushutsu no Genzyo to Kadai (temporary translation: Current Situation and Issues Japanese Beef Export). Ph. D dissertation, Nihon University. (in Japanese)