Does Service Trade Liberalization Benefit Agriculture and Food Industry?

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Abstract

Service sectors are really important since most of service sectors are used by other sectors (forward linkage). In this reason, the service trade may have huge effects on domestic industries. There has been the scare research between the service trade and domestic industries especially in agricultural and food industry sector since there is scare in data. The purpose of this paper is that figures out the relationship between the service trade and the TFP (Total Factor Productivity) of domestic agri-food industry. Moreover, this paper checks the difference between effect of service trade on the agricultural sector and the food sector since the food sectors has the processed industry characteristics compared to agricultural sector. Using multilevel model and STAN data set in OECD, this paper finds that the service trade has a positive effect on the domestic food industry considering the forward linkage of service sectors on food sectors. According to the result of random effect, the country with higher competitive in food industry has a small coefficient of service linkage on food sector compared to the country with lower competitive in food industry.

Key words: Service Trade, Total Factor Productivity (TFP), Multilevel Model

Introduction

The intermediate service inputs, which are used in manufacturing and services industries, are really large. Robinson, et al. (2002) also showed that the service trade, such as banking, insurance, and finance services have been increased, as the world trade has been increased. These two circumstances, large intermediated service inputs and the increasing trend of service trade, means that the increasing trend of service trade may have an effect on manufacturing and services industries.

The trade liberalization in goods typically accounts for less than half of GDP in most countries, on the other hand, the trade liberalization in services explains a large share of GDP (Mattoo, et al., 2006). Considering the trade liberalization in goods has a huge effect on the economic growth even if the trade liberalization in goods is less than half of GDP in most countries, the service liberalization may have a huge effect on GDPs more than the trade liberalization in goods. Thus, service trade issue on GDP is important and the importance of this issue will grow as time goes.

The empirical studies such as Rajan and Zingales (1996) and Fernald (1999) showed that the service trade liberalization has a positive effect on the performance of downstream manufacturing sectors. The study of Arnold, et al. (2011) tried to use the information about the dependent level of intermediate service inputs and showed that the reform of service industries has a positive effect on the performance of downstream manufacturing industries.

The service trade liberalization is related to the downstream firms' choice for the intermediated service inputs since the service trade liberalization gives the chance to downstream firms using new foreign providers. Using the new foreign providers' service can increase the performance of downstream manufacturing producers. If this logic in manufacturing sectors can be adapted to the

agri-food sectors, then the service trade liberalization may have positive effect on the performance of downstream agri-food firms. The increased choices of services affect the performance of agricultural and food producers in two ways.

First, as the more technologically advanced providers come to one country's market, new services become available to producers. Agricultural producers and food industry producers can enhancing productivity. It is because they can use new services in their operation. Theoretical background for this argument is provided by Ethier (1982) and the empirical support for this argument is provided by Amiti and Konings (2007). This approach means that the access to a greater variety of inputs can result in higher productivity of downstream industries' producers.

Second, services were restricted before the services liberalization availability, but after service trade liberalization the availability of services are increased to a certain group of users who did not use services before the trade in service. For example, internet coverage in rural areas or an improved availability of business consulting services to agricultural producers and food producers. Thus, this second approach also is related with higher productivity of downstream industries.

As we mentioned above, the service trade liberalization can be beneficial to agricultural and food producers. Most of studies which are related to the trade in service focused on the manufacturing industry. However, service liberalization issues also important to agricultural and food industries since some countries' economy can be largely depend on the agricultural and food industry. Even if some countries do not largely depend on the agricultural and food industry, the trade in service can be helpful to these industries in some cases. For example, Korea spent lots of money to agricultural producers since Korea considers the agricultural producers as victims of the

trade liberalization. But, if the trade in service enhances the competitiveness in agricultural sector, then Korea government makes more efficient policy for agricultural producers.

In this reason, we have to focus on the service liberalization effects on GDP of agriculture and food industries. But, there is scarce in the empirical work focusing on agri-food industries. Robinson, et al. (2002) showed that the service trade liberalization has a positive effect on outputs and exports of agriculture and processed food sectors in many countries. But, they just used Computable General Equilibrium (CGE) Model to estimate the impact of trade in service on GDP not just focusing on agriculture and food industry. Moreover, they did not consider the inter-period adjustment. And, the CGE model is a very sensitive model for the structure, specification, base year, and closure rule. In this reason, we have to focus on analyzing the effect of service liberalization on the agri-food productivity using the econometrics model.

To test the relationship between the service liberalization and the performance of services users or industries, we rely on the OECD STAN input-output data. This data contains 33 OECD countries and 3 years (1995, 2000, and 2005 years). At the first, we regress the total factor productivity (TFP) of sectors in C01T05 (Agriculture, hunting, forestry, and fishing) and C10T14 (Food products, beverages, and tobacco) weighted by the respective agri-food sector's reliance on inputs from service sector since TFP may be considered as the performance. TFP is estimated by Cobb-Douglas function which contains the labor and the intermediate goods. In the basic estimation of TFP contains the capital inputs, however this paper does not contain the capital inputs since the intermediate inputs of input-output table contains the capital input.

As mentioned at the study of Arnold, et al. (2011), our paper's identifying assumption is that the effect of service liberalization should have more impact on agri-food sectors relying more

heavily on service inputs. Service sectors' liberalization are time varying in our study. And, the reliance of the agri-food sectors on services inputs is assessed base on the each nation's input-output matrix in OECD countries. Several measures for service liberalization are presented. But, we use the basic measure of openness, which is exports plus imports divided by GDP. A large number studies used trade shares in GDP such as Frankel and Romer (1999), Harrison (1996), Irwin and Terviö (2002).

This paper is structured as follows. Section 2, we shows the related literature. And at section 3, we explain the data and model. At section 4, we will introduce the model result. At the last section, we will mention the conclusion.

Related Literature

The study of services trade occupies a very small share of total output of international trade studies. And, the scarcity of data makes the share of empirical studies which are related with service trade too small (Hoekman, 2006). Francois (1990) argued that the growth of intermediate service is an important factor of economic growth using his theoretical model. Markusen (1989) also emphasized that the trade of producer service has a important role in enhancing welfares. He used the monopolistic competition with the increasing returns to scale, and showed that the producer service is helpful to enhancing welfare by the intermediated producer service trade. tEschenbach and Hoekman (2006) found that there is a positive relationship between the extent of trade in service and economic growth in transition countries during the 1990-2004 period.

The relationship between service trade liberalization and downstream productivity for agri-food industry has not been tested in the empirical literature by the best of our knowledge. There are studies like Arnold, et al. (2011) tried to test the relationship between the service trade liberalization and productivity in the manufacturing sectors. However, we have to examine the relationship between service liberalization and downstream productivity for the agri-food industry. It is important because if service liberalization has a positive impact on the agri-food industry, then we can make better policy for agri-food business sector. Normally, main focus on agri-food industry sector production side is a productivity which is defined on labor, capital, and intermediate input. But, the intermediate input normally does not contain the service intermediate input. Thus, we have to think about the impact of the intermediate service input as well as the intermediated service input trade in agri-business sector. It is important because there is the study that trade in service has a positive impact on growth or welfare (Francois, 1990, Markusen, 1989).

One of reason to examine for service liberalization's impacts on downstream productivity for agri-food industry is difficult because of data problem. This data problem exists especially in measuring the service liberalization or openness of service trade. There are several ways to estimate the openness of trade.

First one is the exports plus imports divided by GDP, which is the most basic measure of openness. As the review in Harrison (1996), many studies used shares in GDP has a positive and strong relationship with growth. Second measure includes average tariff rates, export taxes, total taxes on international trade, ad non-tariff barriers. Many studies have focused on the relationship between average tariff rates and growth in the last several decades (Edwards, 1993, Harrison, 1996, Lee, 1993). Third measure is bilateral payments arrangements (BPAs) which measure the trade

orientation of countries. Since the early years of the post-war era, there were severe restrictions on international trade and payments. Thus, several studies argued that BPAs can be regarded important steps toward more liberal trading and payments regimes (Auguste, 1997, Trued and Mikesell, 1955). The fourth measure is the exchange rate. The black market premium is the most commonly used measure in this category. The final one is indices of trade orientation which are constructed by some studies to examine the effects of trade openness on growth. These indices' example is Leamer's openness index (1988), Dollars's price distortion and variability index (1992), and Sachs and Warner's openness index (1997). Among these five measures of trade openness, this paper chooses the first one which is exports plus imports divided by GDP. It is because this first one is measureable by OECD STAN data set. In other words, it is easily measurable comparing to other measures. Second measure has a problem in service openness because of service trait which is invisible. The third measure is so old one, thus it is not meaningful nowadays. The fourth one is also a problem with measuring. The last one is the trade orientation. However, it is not exactly matched with service trade characteristics.

Data

This paper uses data of OECD STAN input-output data set with domestic and imports. We use OECD 33 countries (Austrailia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estoina, Finland, France, Germany, Greece, Hungary, Ireland, Israel, Italy, Japan, Korea, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom, and USA) with 3 years period (1995, 2000, 2005). This input-output data shows the linkage of input and output. In the input-

output matrix, the row means the industry processing and the column means the industry purchasing. Moreover, we can get a data of export and import by the industry in the input-output table. And, each industry's total output means the each industry's GDP. Thus, we can calculate the service trade openness using this data set by calculating exports plus imports divided by GDP.

The measure of agricultural and food industry performance, we estimate the total factor productivity (TFP). The TFP is estimated as the residual of sector-specific two-factor Cobb-Douglas production function. In this paper, we use two factors which are labor and intermediate inputs. But, the intermediate input contains capital factor, so it is not matter that we suppose two-factor Cobb-Douglas production function. We use labor cost as the compensation of employers, and use intermediate input as the intermediate inputs at the input-output table (OECD STAN input-output).

In this paper, we divide agri-food sector to agricultural and food industry sector. Because, the ratio of service input to each industry is different. We suppose that industries 1 to 5 are considered as agricultural sector, and industries 15 to 16 are considered as food-industry sector.

Method and Model

Our empirical work used the multi-level model. There are several reasons to choose the multi-level model. First, the multi-level model estimates the change in dependent variable considering all levels of information (Steenbergen and Jones, 2002). The multi-level model uses the concept of the random coefficient model, which made us to estimate the independent variables' effect on the dependent variable using the all level of information. Regression model estimates

only one coefficient, but the multi-level model estimates the average coefficient of all groups and the coefficient of each group deviate from average. Second, the multi-level model can check the heterogeneity by Welch test or the residual of Box Plot (Littell, et al., 2006). When we find the heteroskedasticity, we can solve the problem by fixing G matrix which shows the variation in the group. Third, the multi-level model can estimate even when the panel data does not have the same period or interval by using the structure of variance-covariance matrix defined by the model.

Our empirical model relies on the assumption that agri-food sectors which are more dependent on services inputs should be affected to a greater extent by the service liberalization. But, we also assumed that the agriculture sector and the food industry sector are different in the effect of the service liberalization because the food industry sector is process industry. Thus, we can expect that the food industry uses more traded intermediate inputs more than agricultural sector. In this sense, we also can expect that food industry uses more traded intermediate service inputs more than agricultural sector. Thus, we make two models for agricultural and food industry. For make two models, we need to make the service linkage index that considers linkage between liberalization index and input-output structure. As we mentioned before, we can calculate the liberalization index which is export plus import divide by GDP. We can also calculate service trade linkage by equation 1 following the study of Arnold, et al. (2011). This equation shows the each industry j at time t :

$$Service\_linkage_{jt} = \sum_k a_{jk} \cdot Liberalization\_index_{kt} \quad \text{(equation 1)}$$

where a_{jk} is the amount of inputs sourced from services sector k, expressed as a fraction of the overall inputs used by each agricultural sector and food industry sector.

To estimate whether there is a relationship between the performance of OECD agriculture and food industry and downstream effect of service liberalization, we set up two models. To estimate the downstream effect of service liberalization, we choose the control variables which are own industry linkage and other industry linkage. To control the autoregression, we divide error terms to two parts which are e_{1it} (considering autocorrelation) and e_{2it}(normal error term). We can represent these models like below equation.

(Model 1 : Agricultural industry)

$Ln(TFP)_{it} = \pi_{0i} + \pi_{1i}(s\_link)_{it} + \beta_{20}(a\_link) + \beta_{30}(other\_link) + r_{it}$ (equation 2)

$r_{it} = e_{1it} + e_{2it}$, where $e_{1it} \sim AR(1)$

$$e_{2it} \sim iid\ N(0, \delta^2)$$

TFP : Total Factor Productivity

s_link : Service_Linkage

a_link : Agriculture_Linkage

other_link : Other Industry_Linkage

i : country

t: time

and

$\pi_{0i} = \beta_{00} + u_{0i}$ UN (Unstructured)

$\pi_{1i} = \beta_{10} + u_{1i}$, where $\left[N\begin{pmatrix}0\\0\end{pmatrix}, \begin{pmatrix}\tau_0^2 & \tau_0\tau_1\\ \tau_1\tau_0 & \tau_1^2\end{pmatrix}\right]$

(Model 2: Food Industry)

$Ln(TFP)_{it} = \pi_{0i} + \pi_{1i}(s\_link)_{it} + \beta_{20}(f\_link) + \beta_{30}(other\_\text{link}) + r_{it}$ (equation 3)

$r_{it} = e_{1it} + e_{2it}$, where $e_{1it} \sim AR(1)$

$$e_{2it} \sim iid\ N(0, \delta^2)$$

TFP : Total Factor Productivity

s_link : Service_Linkage

f_link : Food_Linkage

other_link : Other Industry_Linkage

i : country

t : time

and

$\pi_{0i} = \beta_{00} + u_{0i}$ UN (Unstructured)

$\pi_{1i} = \beta_{10} + u_{1i}$, where $\left[N\begin{pmatrix}0\\0\end{pmatrix}, \begin{pmatrix}\tau_0^2 & \tau_0\tau_1\\ \tau_1\tau_0 & \tau_1^2\end{pmatrix}\right]$

One of characteristics of multilevel model is that we can estimate the average effect as well as industry effect by making structure of π_{0i}, π_{1i}. For example, β_{00} shows the average industry intercept. And u_{0i} show the industry difference at intercept. Using UN (Unstructred), we construct within industry residual which is not explained by industry level.

Results

The results of Model 1 and 2 are represented at table 1. As you can see table 1, LR test is rejected at 1% significant level in both models. LR test's null hypothesis is random effects are zero. Thus, our specification for random effect is not rejected at 1% significant level in both models.

As you can see table 1, fixed-effects' coefficient at model 1 are not significant at 10% significant level. This means that there is no correlation between service liberalization linkage's downstream effect and agriculture TFP as well as agricultural liberalization linkage and other industry liberalization linkage. But, fixed-effects' coefficient at model 2 has one significant beta variable which is our main purpose variable, service_linkage, at 1% significant level. This means that service liberalization has a positive downstream effect on food industry sector but not in the agricultural sector. This is possible because food industry consumes more intermediate service than agricultural industry. The average service input ratio to agricultural sector GDP is 13.6%, and the average service input ratio to food sector GDP is 18.3% in our data. In this reason, the service liberalization has a positive downstream effect on food industry sector and has not significant effect on agricultural sector.

Table 1. Fixed effects and Random effects for two models

Fixed-effects				
	Model 1 (Agriculture)		Model 2 (Food)	
ln(TFP)	Coefficient (Std. Err)		Coefficient (Std. Err)	
Service_linkage	0.000505 (0.0000685)		0.00003520*** (0.00000741)	
Own_linkage	-0.0000126 (0.0000225)		-0.00001040 (0.00000917)	
Other_linkage	0.0000083 (0.00000505)		0.00000597 (0.00000385)	
Constant	-0.0383414 (0.0327508)		-0.05866220 (0.052175)	
Random-effects				
Id : Unstructured				
Parameters	Estimate	Std. Err	Estimate	Std. Err
sd(service_linkage)	0.0001579	0.0000862	0.00002	0.00000924
sd(constant)	0.0880999	0.0310779	0.2474186	0.0387586
corr	1	.	-1	0.0000048
Residual : AR(1)				
rho	0.6001296	0.2114435	0.3827997	0.3252484
sd(e)	0.0986305	0.0257521	0.0854097	0.0211628
log likelihood	62.222295		54.443627	
LR test(chi2)	0.0000		0.0000	

*** 1%, ** 5%, * 10% significant level

Using the random effect part, we can do postestimation. Using postestimation method based on random effect, we can know each countries' service linkage difference from the average service linkage effect. This result shows at table 2.

According to table 2 result, coefficient and ln_TFP has an opposite effect if you arrange this data by top-down by coefficient. This means that if a country has advanced food industry, then the effect of service liberalization downstream effect on food industry is low. In a contrary, if a country has less advance food industry, then the effect of service liberalization downstream effect

on food industry is high. We can interpret this way because TFP is high, which means that this industry is competitive or advanced.

Table 2. Postestimation Result (Difference in coefficient on service_linkage)

country	coefficient	ln_TFP	country	coefficient	ln_TFP
Austrailia	-0.00001110	0.121009	Japan	-0.00002960	0.395549
Austria	0.00001400	-0.21839	Luxembourg	0.00004920	-0.68473
Belgium	-0.00000022	0.022073	Netherlands	-0.00001250	0.183792
Canada	-0.00000524	0.059422	Norway	0.00000924	-0.14998
Czech	-0.00000667	0.03332	Poland	-0.00001340	0.121945
Denmark	0.00000288	-0.07665	Portugal	0.00000189	-0.06775
Estonia	0.00002140	-0.33974	Slovak	0.00000928	-0.17473
Finland	0.00002220	-0.33445	Slovenia	0.00003410	-0.50467
France	-0.00001710	0.258873	Spain	-0.00000240	0.088814
Germany	-0.00000384	0.182002	Sweden	0.00001160	-0.18186
Greece	-0.00001080	0.092764	Turkey	-0.00004630	0.538105
Hungary	0.00000280	-0.07711	UK	0.00001870	-0.13813
Ireland	-0.00000816	0.228334	United States	-0.00001630	0.429106
Italy	-0.00001370	0.19308			

Conclusion

In this paper, we followed the measure of service liberalization and mixed them with linkage on the degree to which agriculture and food industry created by the study of Arnold, et al. (2011). Using the variable service linkage we can estimate the downstream effect on TFP in agriculture and food industry.

According to our results, service linkage has no significant effect on agricultural TFP. And, service linkage has a positive effect on food industry TFP at 1% significant level. This can be

explained by the service input divide by agricultural GDP or food industry GDP. The service input divide by agricultural GDP is less than food industry. In this reason, service linkage has no significant effect on agricultural TFP and has a positive effect on food industry TFP.

To estimate the country difference in service linkage effect on food industry TFP, we use postestimate method using random effect part. This postestimate result means the country difference with the average service linkage impacts on the food industry TFP. According to this result, a country with high TFP has a negative difference with the average service linkage on the food industry TFP, and a country with low TFP has a positive difference with the average service linkage on the food industry TFP. To sum up, a country with low TFP, which means low competitiveness, has a high service linkage effect on the food industry sector. And, a country with high TFP, which means high competitiveness, has a low service linkage effect on food industry TFP.

This paper's contribution can be divided by two parts. First, this study results show that the service trade liberalization linked with input ratio has a positive impact on food industry TFP and no impacts on agriculture industry TFP since service inputs are divide by food industry GDP is higher than agricultural industry. This result is meaningful because we know that if the industry with higher intermediate service input, then this industry can get a benefit from service trade liberalization. Moreover, most of trade in service related studies focus on manufacturing industry, thus our study is meaningful because our paper focus on agri-food industry. Second, this paper also shows that a country with higher competitiveness can get a low benefit from service liberalization and a country with low competitiveness can get a higher benefit from service liberalization. It is important because most of service liberalization related studies did not show

the relationship between competitiveness and service liberalization effect. This result can be showed by the method of multi-level model.

But, there is a need for study about more in trade in service issue. As mentioned at the study of Markusen (1989), trade in producer service has an important role in enhancing welfare. Thus, we need to divide the service by service characteristics. We can expect that the producer service liberalization linked with input-output table has more positive impact on food industry TFP than non-producer service liberalization linked with input-output table.

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