ESTIMATION OF JAPANESE STEEL PRODUCT TRADE ELASTICITIES OF SUBSTITUTION

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Overview

The steel industry is a key sector both for economic competitiveness and for climate policy. The Japanese steel production was 94.1 Mt of steel products in 2016. The CO_2 emissions from the Japanese steel industry would be around 187 $MtCO_2$ in 2016, which accounted for 17% of total energy-related CO_2 emissions in Japan.

Steel product is a typical tradable commodity. In 2016, the Japanese steel industry directly exported 40.7 Mt of steel products (see Figure 1), and imported 6.1 Mt of steel products (JISF, 2017).

This paper focuses on the observation of time series variation in Japanese steel product export and import, i.e., weight (tons) and unit price based on Trade Statistics of Japan (Ministry of Finance, 2017), etc. We empirically estimate Japanese steel product trade elasticity of substitution.

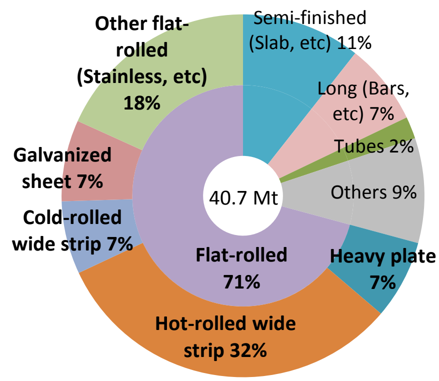

Figure 1. Japan's steel product export in 2016 based on JISF (2017)

Methods

Hoshino (2001) focused on Japanese semi-conductor trade and empirically estimated the elasticity between Japan's export and import using the methodology of Hansson and Lundberg (1989). This paper applies the analysis frameworks of Hoshino (2001) shown in Eq.1 to the Japan's steel export and import.

$$\ln\left(\frac{E}{M}\right) = c + s \cdot \ln\left(\frac{PE}{PM}\right) + g \cdot TIME \tag{1}$$

where E is weight (tons) of Japan's export; M, weight (tons) of Japan's import; PE, FOB price (US$/t) of Japan's export; PM, CIF price (US$/t) of Japan's import; c, constant term; s, elasticity between Japan's export and Japan's import; and g, time trend variable. The time trend variable represents non-price factors, such as relative degree of overcapacity of steel production by region.

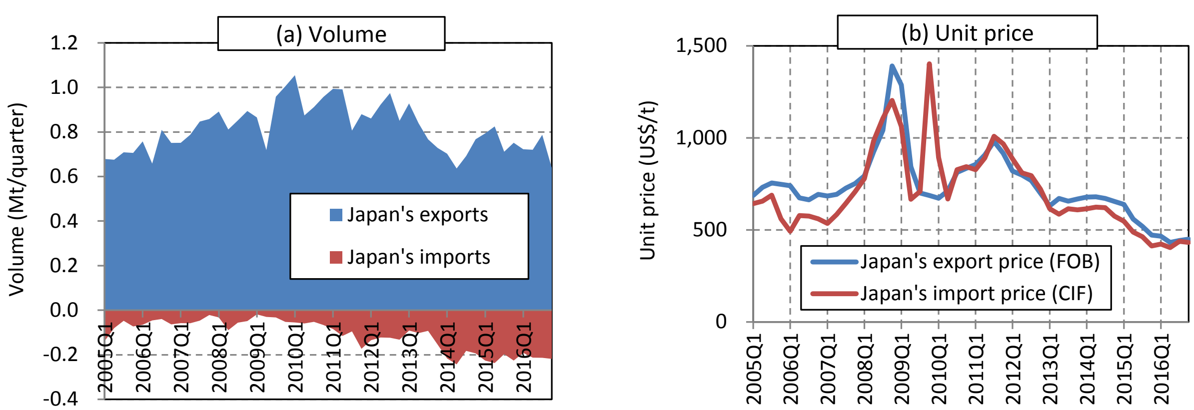

Figure 2. Japan's export and import of <u>heavy plate</u>

Next, we focus on the global demand market of flat-rolled steel products and the elasticity between Japan's export and China's export. The equation used is as follows:

$$\ln\left(\frac{E_{Japan}}{E_{China}}\right) = c + \sigma \cdot \ln\left(\frac{PE_{Japan}}{PE_{China}}\right) + g \cdot TIME \tag{2}$$

where E_{Japan} is weight (tons) of Japan's export to the global market; E_{China}, weight (tons) of China's export to the global market; PE_{Japan}, unit price (US$/t) of Japan's export; PE_{China}, unit price (US$/t) of China's export; and σ, elasticity between Japan's export and China's export.

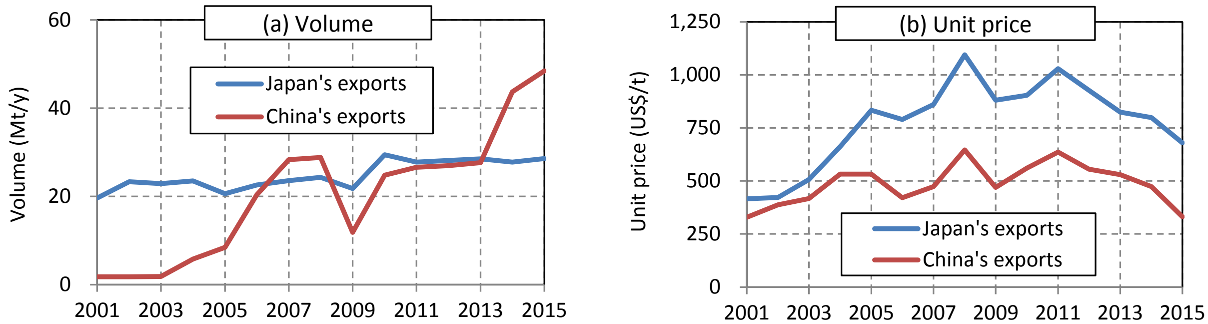

Figure 3. Japan’s export and China’s export of flat-rolled steel products

Results

We applied Eq.1 to the Japan’s export and import by steel product. The estimated elasticity of hot-rolled wide strip is relatively small and the time trend is plus as shown in Table 1, which is consistent with the active overseas production of Japan’s steel and car companies, e.g., in Thailand. Since flat-rolled steel is the aggregated category shown in Figure 1, the composit change inside the category affects the results and the adjusted R^2 is very low (0.05). Other results reveal that the elasticity is relatively large (from -0.76 to -1.83), which means that price competitiveness is intensive. Even after the remove of price effects, the time trends are minus, which means that Japanse export has been relativelly decreasing for the analysis period.

Table 1. Estimated elasticity between Japan’s export and import by steel product and time period (monthly)

	(i) 12 years (from Jan. 2005 to Jan. 2017)			(ii) Four years (from Jan. 2013 to Jan. 2017)		
	s, elasticity	*g* (/y), time trend	R^2adj	*s*, elasticity	*g* (/y), time trend	R^2adj
Flat-rolled	-0.66**	-0.01	0.05		N/A	
Heavy plate	-1.18**	-0.17**	0.53	-1.83**	-0.24**	0.50
Hot-rolled wide strip	-0.64**	0.07**	0.59		N/A	
Cold-rolled wide strip	-0.99**	-0.01	0.13		N/A	
Galvanized sheet		N/A		-1.16**	-0.23**	0.50
Other flat-rolled	-0.76**	0.07**	0.31		N/A	

Note) N/A means that we can’t observe significant results. * denotes significant level < 10%. ** denotes significant level < 5%.

We applied Eq.2 to the Japan’s export and China’s export to the global flat-rolled steel markets. Table 2 shows the results of estimated elasticity. Since availability of comparable price and volume data is limited, Table 2 referred to annual data set of flat-rolled steel and covered the period from 2001 to 2015. If the estimated elasticity (-3.34) is simply combined with hypothetical one-sided Japan’s carbon tax, e.g., 30\$/tCO_2, Japan’s export price could rise by 66 US\$/t (+11%) and Japan’s export volume could decrease by 4.2 Mt/y (-15%). In the case, the China’s export volume increase by 4.2 Mt/y (+9%). As a result, net global CO_2 emissions increase by 1.3 MtCO_2/y. Noted that this example is based on the assumptions of full cost pass-through rate of carbon cost, no price elasticity of global steel demand, market condition in 2015, and only two exporters (i.e., Japan and China) in the market.

Table 2. Estimated elasticity between Japan’s export and China’s export (yearly)

	15 years (from 2001 to 2015)		
	σ, elasticity	*g* (/y), time trend	R^2adj
Flat-rolled	-3.34**	-0.11**	0.87

Conclusions

This paper empirically examined Japan’s steel product trade elasticity of substitution. The overall results indicate relatively large elasticity and minus time trends, which means that price competitiveness is very intensive and Japanese steel industry is losing global market share of steel products. Further analysis including value-added steel (e.g., stainless), explicit consideration of overcapacity, and multi-regional analysis remains as future work.

References

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