



Asymmetric effects of exchange rate and income changes on maritime freight flows between Japan and the US

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ABSTRACT

Past studies have generally used the perfect reversibility of exchange rate and income changes on trade flows, assuming that the impacts of a positive change in exchange rate (income) are of the same magnitude and move in the opposite direction of the effects of a negative change. To date, no empirical evidence has been found to support the potential asymmetric effects of exchange rate and income on maritime trade flows. The objective of this paper is to explore the long-run exchange rate and income asymmetries in bilateral maritime freight flows between Japan and the US. We use both aggregate and disaggregate industry data from January 2003 to July 2016 in a nonlinear autoregressive distributed lag (ARDL) framework. From the nonlinear ARDL models, the exchange rate is found to be an important factor affecting the maritime freight flows in exporting and importing industries in Japan. This conclusion differs from the findings from the linear ARDL models in which exchange rate is insignificant in the majority of cases. More importantly, we find empirical evidence of the asymmetric effects of exchange rate and income on the bilateral maritime freight flows at both aggregate and disaggregate levels. This suggests that using the perfectly reversible (linear) elasticities of demand could mislead the effects of exchange rate and income changes and result in biased estimation. At the disaggregate level, the asymmetric effects of exchange rate and income changes tend to vary across industries.

1. Introduction

Japan is one of the major US vessel-trading partners. It is the second largest source for the United States (US) imports and the second largest market for the US exports by vessel in 2011. According to the US Department of Commerce (US Census Bureau, 2017), Japan's maritime export volume to the US having grown to 12.4 billion kilograms in 2015, up from 9.7 billion kilograms in 2010. The maritime import volume from the US has been consistently larger than the export volume to the US and it reached more than 41.6 billion kilograms in 2015.

Although the Japan-US trading volume has remained at a high level and their economic relationship is strong, there are political debates about Japan's monetary policy and the devaluation of Japanese yen against the US dollar (Nelson, 2015). Since 2012, Prime Minister Shinzo Abe has made it a priority of his administration to boost Japan's economy and eliminate deflation. The expansionary monetary policies have contributed to a relatively sharp depreciation of the yen, which fell by almost 50% from 2012 to 2015. This raises a concern about the unfair currency policies to weaken their currencies and their effects on the bilateral trade between Japan and its trading partners (Kennedy and Rose, 2013).

There is well-developed literature on trade and transportation, and

the linkage between transportation on international trade has been well documented (e.g., Baldwin et al., 2001; López-Córdova and Meissner, 2003; Clark et al., 2004; Hummels, 2007, 2008, 2009; Jacks and Pendakur, 2010; Valentine et al., 2013). For example, Baldwin et al. (2001) investigated the implications of lowering trade cost by using growth stages and found that high trade and transport costs lead to low growth and dispersed industry (1st growth stage), while low costs contribute to high growth and global divergence (3rd growth stage). López-Córdova and Meissner (2003) examined the determinants of international trade and revealed that a similar money regime and country-pair's gross domestic products have positive effects on bilateral trade. In addition, Hummels (2009) found that transport costs play a crucial role in determining relative prices across exporters and bilateral variation in trade.

Numerous studies have attempted to assess the effects of exchange rate and other determinants of Japan's international trade (Haynes et al., 1986; Nadenichek, 2000; Onafowora, 2003; Bahmani-Oskooee and Goswami, 2004; Bahmani-Oskooee and Ratha, 2007; Bahmani-Oskooee et al., 2016, 2017). As summarized in Table 1, most of these studies found that exchange rate is a significant determinant of Japan's trade flows in at least one direction. For example, Bahmani-Oskooee and Goswami (2004) assessed the exchange rate sensitivity of Japanese

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Table 1

A literature survey on the effects of Japanese yen fluctuations on Japan-US trade flows.

Study	Data	Main Results
Haynes et al. (1986)	Country-level (Japan-US)	Japan's imports highly exchange rate elastic, but her exports are insensitive to exchange rate movements.
Nadenichek (2000)	Country-level (Japan-US)	Primary cause of the US-Japan trade imbalance is the depreciation of the US real exchange rate.
Onafowora (2003)	Country-level (3 partners)	A depreciation of three East Asian countries currencies against the US dollar and Japanese yen leads to an improvement in their trade balance with the US and Japan.
Bahmani-Oskooee and Goswami (2004)	Country-level (9 partners)	Japan's imports are very sensitive or elastic, but her exports are insensitive to real exchange rate in most cases.
Bahmani-Oskooee and Ratha (2007)	Country-level (12 partners)	An S-shaped bilateral cross-correlation function exists in almost all cases.
Bahmani-Oskooee and Hegerty (2009)	Industry-level (117 industries)	Positive long-run effects of yen depreciation on Japan's trade balance. Most short-run effects are in the same direction.
Bahmani-Oskooee et al. (2016)	Industry-level	Third-country risk is significant in a number of cases.
Bahmani-Oskooee et al. (2017)	Country-level (12 partners)	Asymmetric effects of yen fluctuations on Japan's trade balance in most cases.
Bahmani-Oskooee and Kanitpong (2017)	Country-level (7 partners)	Short-run and long-run asymmetric effects of exchange rate changes on the trade balance in most cases.
Bahmani-Oskooee and Mohammadian (2017)	Country-level	Exchange rate changes have asymmetric effects on domestic production in Japan.

yen on the trade balance between Japan and its major trading partners. The results showed that Japan's exports are insensitive to real exchange rate, but its imports are highly sensitive and elastic. Onafowora (2003) investigated the effects of exchange rate changes on the trade balance of three Association of Southeast Asian Nations (ASEAN) countries in their bilateral trade to Japan. The results showed that the depreciation of these countries' currencies tend to improve their trade balance with Japan.

A group of recent studies have relied on bilateral trade data at an industry or commodity level (e.g., Bahmani-Oskooee and Goswami, 2004; Bahmani-Oskooee and Ardalani, 2006; Bahmani-Oskooee and Ratha, 2007; Bahmani-Oskooee and Hegerty, 2009; Chi, 2016). These studies have raised concerns about an aggregation bias since a significant effect of exchange rate in one industry sector could be offset by insignificant effects of exchange rate in other sectors, resulting in an insignificant relationship and vice versa. For example, Bahmani-Oskooee and Hegerty (2009) investigated Japan's trade balance with the United States for 117 industry sectors and found that a depreciation of the yen has a positive long-run effect on the trade balance for about one-third of industries. The results showed a quick improvement in these industries' trade balance, rather than the evidence of J-curve pattern.¹

Although the effects of exchange rate and income on the Japan-US bilateral trade have been well documented in the literature, several issues remain unresolved. First, almost all past studies used the perfect reversibility of exchange rate and income changes on trade flows. For example, the conventional linear specification assumed that the demand response to an appreciating currency is exactly of the same magnitude and of opposite direction as the response to a depreciating currency. Several researchers found evidence that the assumption of symmetric demand responses to exchange rate changes can be too restrictive (Verheyen, 2013; Nishimura and Hirayama, 2013; Bahmani-Oskooee and Baek, 2016). For instance, Nishimura and Hirayama (2013) found that the exchange rate does not affect Japanese exports significantly, but it is a significant determinant of Chinese exports on Japan-China trade, revealing the asymmetric effects of exchange rates. It is possible that the bilateral trade flows might be different between positive and negative changes in exchange rates and income. A currency appreciation may lead to a higher rate of pass-through than a currency depreciation (Peltzman, 2000). Some commodity prices may rise faster than they fall, leading to asymmetric responses of trade flows of

commodities to exchange rate changes. In the case of income changes, income increases and decreases may have asymmetric demand responses because of loss aversion behavior. Loss averse consumers may not respond to rising income, but react strongly to falling income. To see if the conventional specification misleads the true effects of exchange rate changes and produces biased results, it is necessary to investigate the potential asymmetric demand responses to currency depreciation and appreciation in a newly developed nonlinear framework.

Second, there is a lack of information about whether maritime trade flows are sensitive to changes in exchange rate and income. The effects of these macroeconomic variables on maritime export and import flows of major commodities have been neglected in the literature. From a shipper's perspective, it is important to advance understanding of the main determinants of their commodity flows and the extent of export and import flow sensitivities to positive and negative changes in these determinants (e.g., Cerra and Dayal-Gulati, 1999).

To tackle these unresolved issues, this study explores the long-run asymmetries with respect to exchange rate and income in the bilateral maritime trade flows between Japan and the US. We address the following questions to differentiate this study from previous ones. First, are the exchange rate and income key determinants of maritime freight flows between Japan and the US? Second, does the direction of the change in the exchange rate and income matter for maritime freight flows? That is, do appreciation and depreciation of the yen against the dollar have asymmetric effects on the bilateral maritime trade flows? Do economic growth and decline of its trading partner have asymmetric effects on bilateral maritime trade flows? Finally, do the asymmetric (or symmetric) effects of exchange rate and income vary by industry?

This paper uses both linear and nonlinear autoregressive distributed lag (ARDL) techniques to test for long-run exchange rate and income asymmetries. These cointegration approaches can be applied regardless of whether regressors are purely $I(0)$, purely $I(1)$, or fractionally integrated, and therefore pre-testing procedure for unit root is not required. To examine whether using disaggregated industry data can avoid the aggregation bias, we use both aggregate and disaggregate data over the period of January 2003–July 2016. The main contribution of this study is to analyze the potential asymmetric effects of two macroeconomic variables (exchange rate and income) on bilateral Japan-US maritime trade flows. Therefore, our findings could help policymakers, traders, and shippers develop their long-term strategic plan for maritime freight services.

The rest of the paper is organized as follows. Section 2 outlines the method and the linear and nonlinear ARDL procedure employed in this study. Section 3 provides the data and empirical results of long-run coefficient estimates for the bilateral maritime trade demand models. Based on our findings, Section 4 presents important policy and managerial implications.

¹ The study found lack of evidence of any “J-curve” phenomenon: 4 of 115 cointegrated industries followed the first definition of a J-curve pattern, a negative short-run coefficient followed by a positive coefficient. Only 10 industries followed the second definition, a negative short-run coefficient followed by a positive long-run coefficient (Bahmani-Oskooee and Hegerty, 2009).

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