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A Time-Series Analysis of Public Diplomacy Expenditure and News Sentiment: A Case Study of the U.S.–Japan Relationship

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This study tested a lagged correlation between Japanese public diplomacy expenditure in the United States and U.S. news sentiment about Japan from 1996 to 2018. We conducted a sentiment analysis to measure news sentiment of *The New York Times*, *The Washington Post*, and *The Wall Street Journal* for 45,822 news articles with 30,197 unique bigram tokens. Using a time-series analysis, this study found that Japanese public diplomacy expenditure was positively related to U.S. news sentiment after controlling for Japanese exports to the U.S. and Japanese real GDP. In our test for the opposite direction, U.S. news sentiment was also positively associated with public diplomacy expenditure, after controlling for Japanese exports to the U.S. and Japanese real GDP.

Keywords: public diplomacy, international news, sentiment analysis, time series analysis

Mass media and personal experience are important routes for forming national images of other nations (Kunczik, 1997; Lee, Toth, & Shin, 2008). Because of geographical distance, people often gain information about other countries from mass media and evaluate it either positively or negatively. This path of

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national image formation drives many countries to actively pursue public diplomacy to target other countries' news media.[2]

Several empirical findings support the influence of public diplomacy on foreign news. Manheim and Albritton (1984), for instance, revealed that the positive valence of *The New York Times* coverage toward Argentina, Indonesia, South Korea, the Philippines, and Turkey increased, and the negative valence toward Rhodesia decreased, after the countries signed contracts with public relations firms in the United States. Investigating 97 countries' public relations contracts in the United States, Lee (2007) found that the number of public relations contracts, in addition to the total dollar amount, contributed to the visibility of these countries in U.S. newspapers and television news. The study verified the positive relationship between public diplomacy efforts and prominence of the countries in the news after controlling for national traits and social significance.

Previous studies, however, examined cross-sectional data or tested a trend after the public diplomacy effort started or ceased (Manheim & Albritton, 1984). More studies are needed to examine the causal relationship of mediated public diplomacy associated with foreign news (Cheng, Golan, & Kiousis, 2016), and the purpose of this study is aligned with this call. This study aims to test the significance of lagged correlation between public diplomacy of a home country and the news sentiment in a target country by employing a time-series analysis, using the Granger causality test (Granger, 1969).

Literature Review

This section explains Japan's public diplomacy in the U.S., the relationship between public diplomacy and international news coverage, and the contribution of a longitudinal approach (time-series analysis) to public diplomacy research.

Japan's Public Diplomacy in the United States

Public diplomacy is defined as purposive and comprehensive activities of state and nonstate actors representing a host country to influence and build relationships with foreign publics in a target country (Gilboa, 1998, 2008). After World War II, Japan played an active role in public diplomacy to reestablish its national identity in global community from a totalitarian war-time regime to a democratic and culture-rich country, as well as a global economic leader. Governmental organizations such as the Ministry of Foreign Affairs (MOFA), the Japan Foundation, and the Japan Broadcasting Corporation (Nihon Hoso Kyokai: NHK) and multinational corporations and private institutions are main players of Japanese public diplomacy to achieve this goal (Ogawa, 2009).

Japan has been a strong political ally and economic partner to the United States. Japan is the fourth largest trading partner to the United States, following China, Canada, and Mexico (U.S. Census

[2] Although the present study focuses on mass media, especially newspapers, recent scholarship in public diplomacy has increasingly focused on the strategic uses of social media and their effects on shaping national images and nation branding (see Sevin & Ingenhoff, 2018).

Bureau, 2019), and the U.S. is the top trading partner of Japan (World Bank, 2019). Approximately 54,000 U.S. military personnel, 8,000 DOD civilian workers, and their dependents are stationed in Japan based on the U.S.-Japan Treaty of Mutual Cooperation and Security (U.S. Forces, Japan, 2019). Americans also recognize Japan as an important country to U.S. interests. According to a national survey of the Chicago Council on Global Affairs (Kafura & Friedhoff, 2018), approximately 91% of Americans said that relationship with Japan is very or somewhat important to the U.S. economy, and roughly 79% said that Japan is very or somewhat important to U.S. security. According to the Pew Research Center (2018) national survey, Americans had warm feelings toward Japan and gave an average rating of 61 on the 0-to-100 feeling thermometer scale. Canada and Britain were only two countries whose ratings were ahead of Japan.

Considering its political and economic significance, the United States has been a vital target country to Japanese public diplomacy. According to Lee (2006), Japan was the most active country of public diplomacy in the United States in terms of the number and dollar amount of contracts with public relations agencies based on an analysis of the FARA (Foreign Agency Registration Act) archive by the U.S. Department of Justice. The FARA is a unique archive to track the record of many foreign countries' public diplomacy activities in the United States. The public diplomacy contracts and activities frequently mentioned in the FARA include, but are not limited to, meeting with government officials and journalists, disseminating information targeting influential news media, and promoting cultural events to capture media attention.

The selection of Japan as a host country and the U.S. as a target country has several benefits, considering the purpose of this study to employ a time-series analysis to understand the relationship between public diplomacy expenditure and news sentiment. Data that track one country's public diplomacy in another country over time are not often available. The FARA provides realistically available periodic data even though FARA has its own limitations. Also, public diplomacy activities of state and nonstate Japanese clients were the most active in FARA records. Lastly, as mentioned above, Japan and the U.S. share politically and economically significant national interests, and the U.S. news media constantly cover news about Japan.

Public Diplomacy and International News

International news studies show that external factors such as geographical distance, economic relations, military cooperation, foreign policy, and social, political, cultural, or ideological relevance were more significant than internal factors, such as unexpectedness, continuity, timeliness, and deviance, to determine newsworthiness of international news (Chang, 1998; Chang, Shoemaker, & Brendlinger, 1987; Galtung & Ruge, 1965; Jones, Aelst, & Vliegenthart, 2011; Wu, 2003).

The external factors have been considered static factors in terms of their approach to explain the volume of international news coverage. However, public diplomacy scholarship has focused on the changes in the power dynamics—political, economic, and cultural significance as well as the influence of these factors on other countries (Nye, 2011)—in global politics, conceptualizing international news as a realm implying a relationship that has been established or changed between countries (Entman, 2008;

Gilboa, 1998, 2008; Golan, Yang, & Kinsey, 2015; Kunczik, 1997; Lee, 2007; Manheim & Albritton, 1984; Sheafer & Gabay, 2009; Signitzer & Wamser, 2006; Taylor & Kent, 2006). Public diplomacy is a contested realm among various actors—including governments, global and local media, multinational corporations, and the foreign publics—to establish a stable and favorable relationship among countries as well as to induce congruent and favorable news coverage toward a home country (Entman, 2008).

Lee (2007) found that the number and dollar amount of PR contract countries made with the U.S. were significant factors explaining the volume of U.S. newspaper and television coverage about foreign countries after controlling for national traits and social significance of the countries to the United States. Zhang and colleagues (2017) examined the effects of Chinese mediated public diplomacy efforts on international news during the 2014 Hong Kong demonstration. They found the correlations of salience of issues, stakeholders, and their attributes between Chinese state-owned media and multiple foreign media. Cheng and associates (2016) investigated a Chinese government-sponsored news agency (Xinhua) and its second-level agenda building in the U.S. news. They found a correlation of issue salience regarding coverage of President Xi Jinping between Xinhua and *The New York Times.* Even though the correlations were not significant with the other U.S. news outlets, they found a significant intermedia agenda setting between *The New York Times* and the other U.S. news outlets.

Soft power, however, includes the ability of a country to transform its resources into power (Nye, 2011). News valence and its visibility are two dimensions to capture national image from the news (Manheim & Albritton, 1984). Also, the exertion of soft power may result in news valence differently from the volume of the coverage. Jungblut (2017) found that the Hungarian government's mediated public diplomacy was more successful than their German counterpart regarding the visibility of news coverage; but it was less effective than the German government's efforts to build favorable news frames. For another example, the Israeli government was more successful in the United States than in the British media regarding the process of agenda and frame building over the issues of the Israel–Palestine conflict (Sheafer & Gabay, 2009). The effectiveness of cultural and political congruency established between actors in client (home) countries and those in its target countries was found to be an important factor to explain favorable news coverage toward the home country (Sheafer & Gabay, 2009; Sheafer, Shenhav, Takens, & Atteveldt, 2014).

This study, a case study approach to the U.S.–Japan relationship, conceptualizes public diplomacy as a purposeful activity to establish a collaborative and partnering relationship with mutual political economic significance (Gilboa, 1998) as well as a high congruency of political value and policy (Sheafer et al., 2014); it conceptualizes the U.S. news sentiment toward Japan as a venue that shows the effectiveness of Japanese public diplomacy efforts (Entman, 2008).

Following Wu (2003), we derive two control variables of economic significance—that is, Japanese exports to the U.S. and Japanese real GDP. Wu (2003) tested several factors that explain the volume of news coverage of foreign countries and found that trade volume, separately measured by exports and

imports, was the most influential factor regardless to the countries' economic status. He also found that GDP was a significant factor for the news coverage of developed countries.[3]

The underlying theoretical argument supported by literature is that Japanese public diplomacy expenditure aims to generate many newsworthy activities and events that make Japan look positive in the eyes of U.S. news organizations and American publics. Thus, we hypothesize that Japanese public diplomacy has an effect on creating and maintaining positive news sentiment in the U.S. media, controlling for Japan's economic significance to the United States.

Differently from the previous studies, we suggest a time-series model that allows the testing of dynamic relationships between public diplomacy expenditure and news sentiment over time by focusing on a case of the U.S.–Japan relationship. Most previous studies tested this relationship by using cross-sectional data, which may be difficult when considering dynamic relationships among variables (i.e., cumulatively explaining different points in time and constantly changing over time). This study tests a significance of lagged correlation between variables and separate effects of Japanese public diplomacy expenditure on the U.S. news sentiment toward Japan, and vice versa, after controlling for Japanese exports to the U.S. and Japanese real GDP. In the following section, this study builds a conceptual understanding of the time-series model, followed by detailed explanations of our analytical model in Method section.

Public Diplomacy and Time-Series Analysis

Even though time factors are critical for testing public diplomacy effects, neither longitudinal study nor time-series analysis has been popular in public diplomacy scholarship. Time factors should be valued because public diplomacy is a combination of short- and long-term effects (Golan et al., 2015). In addition, time has been a critical factor to test a causal relationship among variables (Blood & Phillips, 1995; Gonzenbach & McGavin, 1997; Lee & Kim, 2018; Simon & Jerit, 2007) because a causal relationship can be more rigorously tested when considering time (Granger, 1969).

Changes that associate with human activities may be considered to violate assumptions for a time-series model, but they tend to be gradual rather than rapid. Thus, a pattern found in a social phenomenon is largely correlated with its own pattern found in the past. For example, news coverage about a country could be influenced by random events at the corresponding time, but the overall coverage about a country might fall under patterns that are ideas implied in the concepts, such as enduring values (Gans, 1979) or lagged correlations (McCombs & Shaw, 1972).

Several studies in the context of communication research have employed the Granger causality test (Granger, 1969). Blood and Phillips (1995) found that recession headlines in the economic news Granger-caused news consumers' sentiment toward the economy. Gonzenbach and McGavin (1997) indicated that the

[3] In our study, Japanese imports from the United States was also considered as a control variable, but the variable was not valid to estimate a testing model when Japanese public diplomacy expenditure was considered as a dependent variable.

media agenda Granger-caused the public agenda. Lee and Kim (2018) found that public diplomacy expenditures of Japan, Belgium, and the Philippines in the U.S. at preceding time points explained the countries' economic outcomes at succeeding time points. Simon and Jerit (2007) show that political frames (word choice in congressional rhetoric) sufficiently predicted media frames (word choice in news contents) in the future term.

To understand the Granger causality test (Granger, 1969), several concepts need to be explained. One of those concepts is a stationarity of series. The correlation among the values at different time points of a single variable is referred to as "autocorrelation" (Box, Jenkins, & Reinsel, 2008). Randomness among the values at different time points of the variable is assumed to be controlled if a serialized data set is significantly autocorrelated and the errors in each time point are independent of each other. The serialized data are referred to as "stationary" if a constant autocorrelation is found over time, which means that errors—covariance—over time in the series is normally distributed (Box et al., 2008). To be specific, the stationary series can be statistically defined as when an error attributed to an interval of two time points is assumed to be the same in any intervals of two time points when the same interval is considered, and the sum of errors across all time points is assumed to be zero (Box et al., 2008). Thus, if two stationary series are significantly correlated to each other with a statistically constant lag between them, one series that comes before can be considered a cause of the other series because covariates are controlled (Granger, 1969).

The second is cointegration, an important idea to handle spurious relationships among variables in the Granger causality test (Granger, 1969). Cointegration is defined as a long-run relationship among series by verifying comovement between the series (see Engle & Granger, 1987, for several testing models for cointegration test, and see Box et al., 2008, for a deeper theoretical explanation about cointegration).

The basic form of the Granger causality test (Granger, 1969) is a vector autoregressive (VAR) model, and Granger and Newbold (1974) detected spurious relationships among variables. To resolve the problem, Engle and Granger (1987) introduced the vector error correction model (VECM), which was a model requiring all the series in the model to be $I(1)$[4] and the existence of cointegration. The residual series from a VAR model of the variables at level is considered an error correction term, and Engle and Granger (1987) verified that the moving average of the VAR model (lagged-error correction term) tends to be corrected to equilibrium only when the variables were all $I(1)$ and when cointegration between variables existed. Thus, VECM's testing is to verify whether "long-run components of the variables obey equilibrium constraints while short-run components have a flexible dynamic specification" (Engle & Granger, 1987, p. 252) and then to test the significance of its coefficient, explaining the model. The short-run components represent each of a single time point independently explaining the model, and the long-run component is a cumulative sum of all time points, considered in the testing model, to explain the model.

[4] In time-series analyses, series data need to meet the assumption of stationarity. If a series is tested to be stationary at level—a series without differencing—it is denoted as $I(0)$. If a series is nonstationary at level, differencing is given to integrate the series. If a series integrated at the first order is tested to be stationary, it is denoted as $I(1)$.

In handling these strict requirements, Pesaran, Shin, and Smith (2001) introduced the modified autoregressive distributed lag (ARDL) model with a bounds test approach. Although the ARDL bounds test cannot deal with $I(2)$ in the model, it deals with both $I(0)$ and $I(1)$ in the model. Moreover, unlike the Johansen cointegration test (Johansen, 1988), which is able to test only cointegration between $I(1)$ series, ARDL bounds test model can test the existence of cointegration between $I(0)$ and $I(1)$. In our Method section, we show that our variables encompassed both $I(0)$ and $I(1)$; thus, we used the ARDL bounds test model.

Time-series data are characteristically different from panel data (Anselin & Rey, 1991; Beck, 2008). A country may not be considered a homogenous variable (Wu, 2003), especially when considering its relationship with other countries, which might violate assumptions to establish a single time-series model (Beck, 2008). A stable testing model is a more important consideration than a large number of units (Anselin & Rey, 1991; Beck, 2008). Also, it is important to consider that data do not produce missing time points (Box et al., 2008; Gonzenbach & McGavin, 1997). Thus, the time-series data tend to deal with "a relatively small number of units observed for some reasonable length of time" (Beck, 2008, p. 475).

Considering its strong diplomatic relationship, the U.S.–Japan relationship is a suitable case for this study to build consistent and constant records for every time point without missing any and that could satisfy with assumptions to estimate a testing model. We address the following research questions:

RQ1: *To what extent does Japanese public diplomacy expenditure over time explain changes in U.S. news sentiment toward Japan over time, controlling for Japanese exports to the U.S. and Japanese real GDP?*

RQ2: *To what extent does U.S. news sentiment toward Japan over time explain changes in Japanese public diplomacy expenditure over time, controlling for Japanese exports to the U.S. and Japanese real GDP?*

Method

Four variables were employed in this study: (1) total dollar value of the contracts made in each of 45 time points between Japanese clients and agencies in the United States, (2) U.S. news sentiment toward Japan for each time point, (3) total dollar value of Japanese exports to the United States in each time point, and (4) Japanese real GDP for each time point.

Japanese Public Diplomacy Expenditure

Japanese public diplomacy expenditure was collected from FARA's semiannual report to the U.S. Congress. In consideration of the best availability of the data, semiannual data series with 45 time points for 23 years were implemented in the analysis from the first half of 1996 to the first half of 2018. FARA data before 1996 were not collected because they were not the same interval of time points, and the first half of 2018 was the latest data available at the FARA archive.

Python was used to collect Japanese public diplomacy expenditure. A Python package (pdfminer.six) was used for parsing FARA reports for each time point. In the process of parsing, a page number was attached to make the follow-up processes easy, for instance, to navigate documents and extract information. The documents' pattern included beginning each country's information with its name in all capitalized letters, and these pages were set as the starting and ending points of each country's data. Another document pattern was that each contract contained one financial information starting with a "$" sign. By using a Regex function, the exact amount of financial information for each contract within each country's data was extracted. Some contracts did not report their financial information, and were excluded in our data. Japan made at least one contract that disclosed financial information for all 45 time points; hence, there was no missing time point.

All dollar values were adjusted according to the U.S. inflation rate, calculated based on the Consumer Price Index (CPI) over time. The CPI in January was considered an index for the first half of the year, and in July it was considered as an index for the second half of the year. The baseline of the adjustment was set to the first half of the year 1996.

Japanese public diplomacy expenditure was denoted as "PD" in this study. On average, Japan made 42.8 contracts in each time point during the 45 time points and spent US$18,996,849 before the adjustment and USD$15,268,119 after the adjustment in each time point. The adjusted dollar value was used in this study. Figure 1 shows the variable, PD, over time.

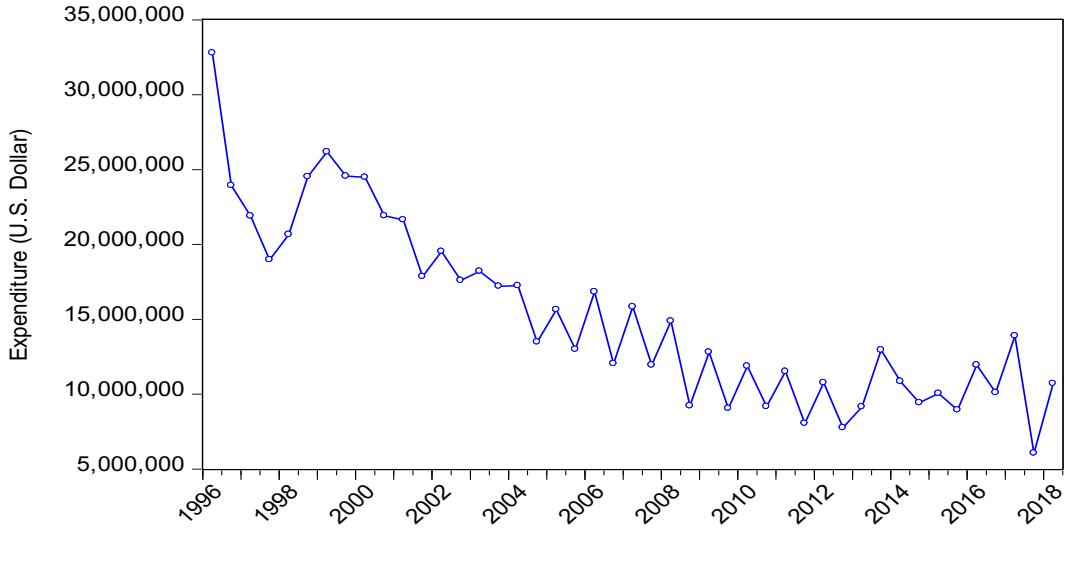

Figure 1. Japanese public diplomacy expenditure (U.S. dollars).

U.S. News Sentiment Toward Japan

The U.S. news sentiment over time toward Japan was measured by analyzing the sentiment of the news articles from three newspapers: *The New York Times*, *The Washington Post*, and *The Wall Street Journal* (respectively, hereafter, NYT, WP, and WSJ). These three newspapers are the major dailies in the U.S., and their different editorial stances can represent both conservative and liberal viewpoints in the country.

Headlines and lead paragraphs from three newspapers were collected, and sentiment scores of each news article were computed by sentiment analysis. The search term for data collection was "Japan," which appeared either in the headline or in the lead paragraph. For the sentiment analysis, joint sentiment/topic modeling (Lin & He, 2009) was employed.

The NYT API was used to collect NYT news articles, to extract the published dates, headlines, and lead paragraphs. A total of 12,098 news articles were collected. The WSJ's website was directly scraped from the screen of the search results that yields published dates, headlines, and summary texts of each news article. A total of 27,046 news articles were collected. To collect WP news articles, Nexis Uni was scraped because the oldest date for search in the WP website was limited to the year 2005. The published dates, headlines, and lead paragraphs of each news article were extracted to yield a total of 8,652 news articles, after excluding duplicates.

There are mainly two different approaches in sentiment analysis. The first is a lexicon-based approach, based on the idea that an individual word is independent of other words. The second is a context-based approach, conceptualizing that sentiment of a word can influence that of other words in the same context. The joint sentiment/topic modeling (hereafter, JST) approach is advanced from the context-based approach by jointly combining the latent Dirichlet allocation (LDA) topic modeling with a sentiment analysis (Lin & He, 2009). By implementing a sentiment variable in the Gibbs sampling process of LDA topic modeling, Lin and He (2009) achieved the maximum of 84.6% of accuracy in detecting sentiment of documents.

We used JST because international news covers various topics, and individual words may have polysemic meanings and sentiments depending on its context. The lead paragraphs of news articles were lemmatized after being tokenized and removing stop words. Bigrams of tokens were used by setting the minimum counts of tokens of three with a thread of 100. News articles with less than three tokens were excluded, which produces 45,822 news articles with 30,197 unique bigram tokens. Using the elbow method—a method to compare coherence scores of the models by adjusting the number of topics of the model—this study obtained the optimal number of topics, K = 18, with coherence score of 0.5526.

For the JST algorithm, this study referred to a GitHub page.[5] The number of topics, K, was set to 18. Alpha (α) was set to 50/K, and beta (β) was set to 0.01, following Lin and He (2009). Gamma (γ)

[5] https://github.com/ayushjain91/Sentiment-LDA

was remained to a default value (i.e., 0.03). In every iteration, the model adjusts weights for each word based on its conditional probability to be assigned to one of 18 topics as well as the sentiment, either positive or negative, given the probability of other words in the same document to be assigned to the same topic and the same sentiment. The result of JST was trained with the multinomial naïve Bayes classifier "scikit-learn." In the training, we used a 5-point scale (−1.0 = *very negative* to +1.0 = *very positive*). With the trained model, headlines and lead paragraphs of news articles were analyzed. The mean of the proportional distribution for each news article was calculated to assign a sentiment score of each article. The data were converted into time-series data. Figure 2 displayed the sentiment scores of headlines and lead paragraphs. For the variable of U.S. news sentiment, we used the average score of headlines and lead paragraphs for each time point, and this variable was denoted as "NEWS" in this study.

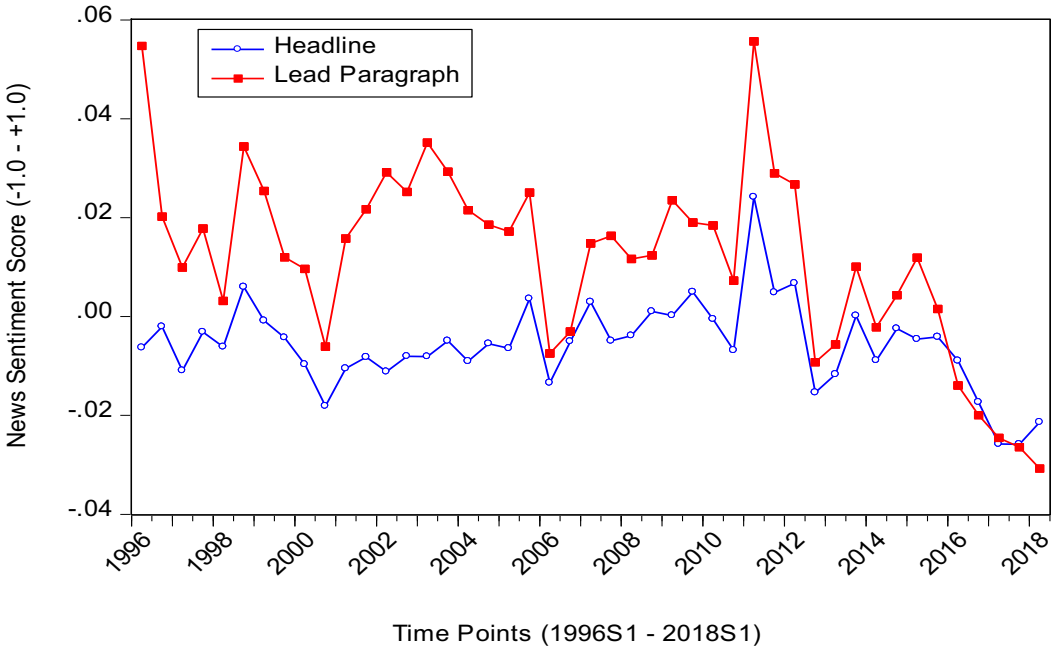

Figure 2. News Sentiment of NYT, WP, and WSJ toward Japan.

Control Variables

Japanese exports to the U.S. over time was monthly data collected from the foreign trade data of the U.S. Census Bureau. The dollar value of the monthly data was adjusted before they were transformed to semiannual data. Monthly inflation rate in the United States was used by setting January 1996 as a base. This variable was denoted as "EXP" in this study.

Japanese real GDP over time in U.S. dollars was collected and calculated from multiple data sources because there was no single source to meet the time interval of this study. Using the data from the Federal Reserve Economic Data (FRED) and Data Services of the International Monetary Fund (IMF),

semiannual data were calculated and adjusted. Japanese GDP in JPY was adjusted to Japanese real GDP based on Japan's inflation rate using January 1996 as a base. The JPY was transformed to USD by using U.S.–Japan exchange rate over time. The dollar value was then adjusted based on the U.S. inflation rate, using January 1996 as a base. This variable was denoted as "GDP" in this study. Figure 3 shows the variables EXP and GDP over time.

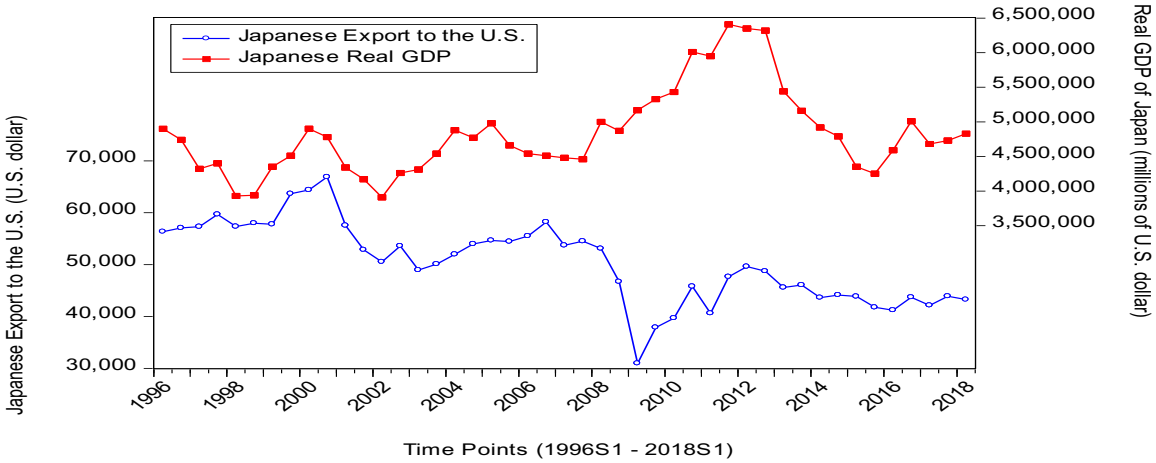

Figure 3. Japanese exports to the U.S. and Japanese real GDP.

Data Analysis

As addressed in our review of literature, we used an ARDL bounds test because the variables encompassed both $I(0)$ and $I(1)$. Except for the variable NEWS, other three variables, PD, EXP, and GDP were log transformed. The unit root test—a test for stationarity assumption—was conducted with augmented Dickey–Fuller test, and the optimal lag length for the unit root test was selected based on the Akaike information criterion (AIC). Table 1 shows the results of the unit root test.

Table 1. Augmented Dickey–Fuller Unit Root Test.

	ADF test statistics		
Variables	At level	First order	Decision
NEWS	−3.683** (0.0341)	N/A	$I(0)$
LN_PD	−2.566 (0.2972)	−4.477*** (0.0051)	$I(1)$
LN_EXP	−4.184** (0.0106)	N/A	$I(0)$
LN_GDP	−2.018 (0.5754)	−5.584*** (0.0002)	$I(1)$

Note. p values are provided in parentheses.
**$p < .05$. ***$p < .01$.

This study employed two ARDL models. Model 1 considered NEWS as a dependent variable, and Model 2 considered LN_PD as a dependent variable. Structural breaks for each model was detected by using the Bai–Perron test. Structural breaks refer to structural differences in the model, which can be

controlled by implementing a dummy variable to the testing model. In Model 1, two different structures were detected, partitioned by the second half 2012. The break test between zero break and one break was significant (the scaled *F* statistic = 36.7204; the Bai–Perron critical value for $p < .05 = 16.19$). The dummy variable for Model 1 was denoted as BREAK_01 in this study. In Model 2, the second half of 2004 was a starting point of a different structure of the model (the scaled *F* statistic = 32.8124; the Bai–Perron critical value for $p < .05 = 16.19$). The dummy variable for Model 2 was denoted as BREAK_02 in this study.

The optimal lag length was decided by AIC to estimate a valid ARDL model. Model 1 was estimated as ARDL (2, 4, 4, 4), which indicated that two lags of NEWS, and four lags of independent variables, respectively LN_PD, LN_EXP and LN_GDP, were included in the model. Model 2 was estimated as ARDL (3, 4, 0, 1), which indicated that three lags of LN_PD, four lags of NEWS, zero lag of LN_EXP, and one lag of LN_GDP were included in the model. There was no trend found in both models, and the dummy variable (i.e., structural breaks) for each model was significant.

To diagnose each model, a Breusch–Godfrey serial correlation LM test was conducted to find a serial correlation in the residual; Breusch–Pagan–Godfrey's heteroskedasticity test was employed to find nonlinearity in the model; and a cumulative sum (CUSUM) control chart test was given to confirm stability of the model. For Model 1, the result of the LM test revealed there was no serial correlation in the residual up to four lags, $F(4, 18) = 0.918$, $p = 0.4751$. The result of the heteroskedasticity test showed that there was no nonlinearity in the model, $F(18, 22) = 1.034$, $p = .4649$. As for Model 2, the result of the LM test confirmed that there was no serial correlation in the residual up to four lags, $F(4, 24) = 0.998$, $p = 0.4279$, and the result of the heteroskedasticity test indicated that there was no nonlinearity in the model, $F(12, 28) = 1.929$, $p = 0.0745$. The CUSUM test for both models also revealed that the models were stable (see the Appendix). As the models were diagnosed as valid, the ARDL bounds test model—which is referred to as the conditional error correction model (Pesaran et al., 2001)—for both Models 1 (Equation 1) and 2 (Equation 2) were established as follows:

$$\Delta NEWS = c_{01} + \sum_{j=0}^{p} a_{1j}\Delta NEWS_{i,t-j} + \sum_{j=0}^{q11} a_{2j}\Delta LN\_PD_{i,t-j} + \sum_{j=0}^{q12} a_{3j}\Delta LN\_EXP_{i,t-j} + \sum_{j=0}^{q13} a_{4j}\Delta LN\_GDP_{i,t-j} + b_{11}NEWS_{i,t-1} + b_{12}LN\_PD_{i,t-1} + b_{13}LN\_EXP_{i,t-1} + b_{14}LN\_GDP_{i,t-1} + BREAK\_01 + \varepsilon_{1it}$$

$$\Delta LN\_PD = c_{02} + \sum_{j=1}^{p} a_{2j}\Delta LN\_PD_{i,t-j} + \sum_{j=0}^{q21} a_{1j}\Delta NEWS_{i,t-j} + \sum_{j=0}^{q22} a_{3j}\Delta LN\_EXP_{i,t-j} + \sum_{j=0}^{q23} a_{4j}\Delta LN\_GDP_{i,t-j} + b_{22}LN\_PD_{i,t-1} + b_{21}NEWS_{i,t-1} + b_{23}LN\_EXP_{i,t-1} + b_{24}LN\_GDP_{i,t-1} + BREAK\_02 + \varepsilon_{2it}$$

In the ARDL bounds test model, Δ denoted the first difference operator, *p* and *q* denoted the lag length of the estimated model, *a*s are the coefficients relating to the short-run dynamics, and *b*s are the coefficients relating to the long-run dynamics. The bounds test is to verify the existence of cointegration in the model with the null hypothesis of $b_{11} = b_{12} = b_{13} = b_{14} = 0$ for Model 1 and $b_{21} = b_{22} = b_{23} = b_{24} = 0$ for Model 2. The critical bounds for *F* statistics are given in Pesaran and colleagues (2001, p. 300). If the null hypotheses are rejected, we can verity the existence of cointegration in the model and lagged-error-correction-term

(ECT_{t-1}) replaces the long-run variables to establish the ARDL error correction model (ECM; Pesaran et al., 2001). The error correction term (ECT) is a residual series from the ARDL model with level series, and a lagged ECT is referred to ECT_{t-1}. Short-run dynamics are interpreted based on the ECM model (Giles, 2013; Narayan, 2004; Pesaran et al., 2001). The coefficient of the ECT_{t-1} should be a minus value, and it indicates the speed of adjustment of the model's convergence to equilibrium (Giles, 2013; Narayan, 2004, 2005; Pesaran et al., 2001).

Regarding conducting the bounds test, however, this study referred to the critical bounds for *F* statistics from the Appendix in Narayan (2005). Narayan (2004) questioned that the critical bounds provided in Pesaran and associates (2001) may not be conservative in verifying tests with a smaller sample size, suggesting reformulated critical bounds for sample size 30 to 80. Our study had 45 time points falling under this category. This study verified the test results with the corresponding table in Narayan (2005, p. 1988). Among five cases of the ARDL bounds test, both Models 1 and 2 in this study fell under Case III, included observations were 41 (compared with critical bounds for $n = 40$ in the table), and the number of regressors, $k = 3$.

Results

This study addresses two research questions: (1) To what extent does Japanese public diplomacy expenditure explain changes in U.S. news sentiment toward Japan over time, controlling for Japanese exports to the U.S. and Japanese real GDP? and (2) To what extent does U.S. news sentiment toward Japan explain changes in Japanese public diplomacy expenditure over time, controlling for Japanese exports to the U.S. and Japanese real GDP? With these research questions, we addressed four variables: NEWS, PD, EXP, and GDP, as mentioned above, and PD, EXP, and GDP were log transformed in the analysis.

The following summarizes the process of model estimation. We estimated two ARDL models, with NEWS as a dependent variable in Model 1 and LN_PD as a dependent variable in Model 2. Structural breaks in both models were found in each model. Model 1 was estimated with ARDL (2, 4, 4, 4), Model 2 was estimated with ARDL (3, 4, 0, 1), and both were diagnosed as valid. The ARDL bounds test models were established as Equations 1 and 2, and the *F* bounds test was given to verify the existence of cointegration in each model. The null hypotheses of the *F* bounds test are mentioned above. To interpret the results of long-run dynamics of each independent variable to dependent variable, the coefficients of long-run variables are calculated as $-\left(\frac{coefficient\ of\ lagged\ independent\ variable}{coefficient\ of\ lagged\ dependent\ variable}\right)$, which are also automatically calculated by EViews with *t* statistics for each variable. Table 2 shows the results of the *F* bounds test and long-run dynamics of each independent variable.

Table 2. Long-Run Dynamics of the Model and Existence of Cointegration.

Models	Dependent variable	Independent variables (*t* statistics)				*F* bounds test (*F* statistics)
		NEWS	LN_PD	LN_EXP	LN_GDP	
1 (*n* = 41)	NEWS	N/A	0.0360**	−0.1277**	0.051*	9.462***
			(2.0996)	(−2.6797)	(1.7526)	
2 (*n* = 41)	LN_PD	16.8396**	N/A	0.6755**	−1.3148***	5.305**
		(2.7421)		(2.7238)	(−3.1471)	

Note. The number (*n*) of observations included in the model is given under each model number. Coefficients for long-run dynamics of each independent variable are given with *t* statistics in parentheses. *F* statistics are given under *F*-bounds test results. Critical bounds from Narayan (2005, p. 1988) for Case III, $k = 3$, and $n = 40$ are 1% [5.018, 6.610]; 5% [3.548, 4.803]; and 10% [2.933, 4.020], respectively. $^{*}p < .1$. $^{**}p < .05$. $^{***}p < .01$.

The *F* bounds verified that cointegration exists in both Model 1 at $p < .01$ and Model 2 at $p < .05$. Long-run dynamics of variables showed that in Model 1, Japanese public diplomacy expenditure was significant, explaining U.S. news sentiment toward Japan in a positive direction, after controlling for other variables ($p < .05$). Japanese exports to the U.S. was significant, explaining negative U.S. news sentiment toward Japan, after controlling for other variables ($p < .05$). Japanese real GDP was not significant, explaining U.S. news sentiment toward Japan, compared with *p* values less than 5%. In Model 2, U.S. news sentiment toward Japan was significant, explaining Japanese public diplomacy expenditure in a positive direction, after controlling for other variables ($p < .05$). Japanese exports to the U.S. was significant, explaining Japanese public diplomacy expenditure in a positive direction, after controlling for other variables ($p < .05$). Japanese real GDP was significant, explaining Japanese public diplomacy expenditure in a negative direction, after controlling for other variables ($p < .01$).

As cointegration between independent variables and dependent variable was found to be significant in both models, an error correction model was established by replacing long-run dynamics with lagged-error correction term (ECT_{t-1}). As stated above, coefficient ECT_{t-1} should be a minus value if the model is valid. For a more conservative estimation, the coefficient should not exceed −2, which was satisfied in this study. Table 3 shows the error correction model, which represented short-run dynamics of variables to the model and the speed of adjustment of the long-run dynamics.

Table 3. ARDL Error Correction Model.

	Model 1 ARDL (2, 4, 4, 4) Dependent: $\Delta NEWS_t$		Model 2 ARDL (3, 4, 0, 1) Dependent: ΔLN_PD_t	
Variables	Coefficients	*t* statistics (*p* value)	Coefficients	*t* statistics (*p* value)
ECT_{t-1}	−0.7550	6.5581*** (0.0000)	−0.8108	−4.8470*** (0.0000)
$\Delta NEWS_t$	N/A†	N/A	3.6281	1.7054* (0.0992)
$\Delta NEWS_{t-1}$	−0.1656	−1.4873 (0.1511)	−9.1810	−2.9464*** (0.0064)
$\Delta NEWS_{t-2}$			−11.012	−3.7874*** (0.0007)
$\Delta NEWS_{t-3}$			−5.3436	−2.1585** (0.0396)
ΔLN_PD_t	0.0107	1.3864 (0.1795)	N/A†	N/A
ΔLN_PD_{t-1}	−0.0067	−0.6785 (0.5045)	−0.2930	−1.7509* (0.0909)
ΔLN_PD_{t-2}	−0.0102	−0.9186 (0.3683)	0.3486	2.1198** (0.0430)
ΔLN_PD_{t-3}	0.0165	1.7515* (0.0938)		
ΔLN_EXP_t	−0.0636	−4.3583*** (0.0003)		
ΔLN_EXP_{t-1}	0.0583	3.4564*** (0.0022)		
ΔLN_EXP_{t-2}	0.0317	2.0747** (0.0499)		
ΔLN_EXP_{t-3}	0.0689	4.4800*** (0.0002)		
ΔLN_GDP_t	−0.0039	−0.1863 (0.8539)	0.1324	0.3022 (0.7647)
ΔLN_GDP_{t-1}	−0.0646	−3.0669*** (0.0056)		
ΔLN_GDP_{t-2}	−0.0747	−3.6390*** (0.0014)		
ΔLN_GDP_{t-3}	−0.0715	−3.1591*** (0.0045)		
Constant	−0.5131	−6.5279*** (0.0000)	38.6003	4.8441*** (0.0000)
BREAK	−0.0280	−6.9756*** (0.0000)	−0.2201	−3.5502*** (0.0014)

Note. Coefficients for all variables in the error correction model are given;
p values for each coefficient are given in the parentheses under *t* statistics.
R^2 of Model 1 was 79.3%, and Model 2 was 80.6%.
† Denotes dependent variable of the model which does not consider a lag zero in the model.
*$p < .1$. **$p < .05$. ***$p < .01$.

From the result of Model 1, we found that speed of adjustment was 75.5%, indicating that changes of one unit of independent variables (i.e., Japanese public diplomacy expenditure, Japanese exports to the U.S., and Japanese real GDP) altogether explained changes of 0.755 units in U.S. news sentiment within one lag (six months). To examine the results of short-run dynamics, Japanese public diplomacy expenditure was not significant in explaining the changes of U.S. news sentiment toward Japan—short-run dynamic was significant at $p < .1$ only at Lag 3 in a positive direction. Also, Japanese exports to the U.S. was significant in explaining U.S. news sentiment toward Japan at Lags 1, 2, and 3, respectively, at $p < .01$, $p < .05$, and $p < .01$, all of which showed a positive direction. Japanese real GDP was significant in explaining U.S. news sentiment toward Japan at Lags 1, 2, and 3, all *p*s < .01, in a negative direction.

The Model 2 results showed that the speed of adjustment was 81.1%, showing that changes of one unit of independent variables (i.e., U.S. news sentiment toward Japan, Japanese exports to the U.S., and Japanese real GDP) altogether explained changes of 0.811 units in Japanese public diplomacy expenditure within one lag (six months). To examine the results of short-run dynamics, U.S. news sentiment toward Japan was significant in explaining Japanese public diplomacy expenditure at Lags 1, 2, and 3, respectively, at $p <$

.01, $p < .01$, and $p < .05$ in a negative direction. Japanese exports to the U.S. and Japanese real GDP were not significant in explaining Japanese public diplomacy expenditure. Instead, Japanese public diplomacy expenditure was significantly explained by its past expenditure. At Lag 2, Japanese public diplomacy expenditure was significant at $p < .05$ in a positive direction, meaning that the country's expenditure showed a significant lagged correlation with its value within two lags (one year). Table 4 summarizes the results.

Table 4. Summary of the Results.

Model 1						
Dependent variable	Speed of adjustment	Long-run dynamics	Short-run dynamics			
			Lag 0	Lag 1	Lag 2	Lag 3
NEWS	75.5%	LN_PD (positive) LN_EXP (negative) LN_GDP† (positive)	LN_EXP (negative)	LN_EXP (positive) LN_GDP (negative)	LN_EXP (positive) LN_GDP (negative)	LN_PD† (positive) LN_EXP (positive) LN_GDP (negative)
Model 2						
Dependent variable	Speed of adjustment	Long-run dynamics	Short-run dynamics			
			Lag 0	Lag 1	Lag 2	Lag 3
LN_PD	81.1%	NEWS (positive) LN_EXP (positive) LN_GDP (negative)	NEWS† (positive)	NEWS (negative) LN_PD† (negative)	NEWS (negative) LN_PD (positive)	NEWS (negative)

Note. † Indicated a variable significant at p value less than 10%. Other variables were significant at p value less than 5% or 1%.

Discussion

Power dynamics in global politics might be undeniable factors to explain international news coverage, as numerous studies have theoretically and empirically examined (Chang et al., 1987; Galtung & Ruge, 1965; Shoemaker & Reese, 2014). However, our study aimed to understand whether one country's public diplomacy efforts have an effect on its images in other countries, represented by international news coverage. Our findings suggest that the fluctuation of Japanese public diplomacy expenditure in the United States influences the changes of U.S. news sentiment toward Japan over time, even though more comparative studies are needed to confirm whether this finding can be withheld in different contexts, especially with other smaller countries than Japan.

Past public diplomacy expenditure of Japanese state and nonstate actors significantly explains U.S. news sentiment toward Japan in the future term. This finding aligns with the previous studies (e.g., Manheim & Albritton, 1984). Specifically, this study demonstrates that a change of one unit in the

independent variables (i.e., Japanese public diplomacy expenditure together with economic significance of Japan to the United States, measured by Japanese real GDP and exports to the U.S) accounts for the change of U.S. news sentiment by 0.755 unit within six months. Although the speed of adjustment may vary depending on the economic size of countries, our study shows that Japanese public diplomacy expenditure significantly explains U.S. news sentiment, after controlling for the economic significance of Japan. The more public diplomacy expenditure Japan spent in the United States, the higher positive news sentiment the country received from U.S. newspapers.

It is noteworthy to mention that the effect of Japanese public diplomacy expenditure on U.S. news sentiment toward Japan is relatively long term rather than short term. For the short-run dynamics, our study shows that public diplomacy expenditure was only significant at Lag 3 with the *p* value less than 10%. Although the mediated public diplomacy has been considered to have short- to mid-term objectives (Golan et al., 2015), our result—based on a case study—shows that mediated public diplomacy may be better suited for a long-term objective, at least in the context of news sentiment, but not in the context of news visibility.

This study also shows the bidirectional relationship between public diplomacy expenditure and news sentiment over time. Statistically speaking, a cointegration is obvious in the reversed direction if a cointegration existed in the forward direction. The change of one unit in U.S. news sentiment together with economic significance of Japan to the United States explains the change of 0.811 units in Japanese public diplomacy expenditure within six months. Again, U.S. news sentiment toward Japan, after controlling for economic significance, significantly explains Japanese public diplomacy expenditure.

Another contribution of this study is the inclusion of economic significance variables as controls to rigorously test the relationships between public diplomacy expenditure and news sentiment. It was a methodologically big challenge to construct multivariate time-series data, which can pass many assumption tests of time-series analysis. The economic significance variables were measured over time rather than that in a single point in time; thus, dynamics of economic significance of Japan to the United States was considered together in terms of explaining the effect of public diplomacy expenditure on news sentiment, and vice versa. Variables that are constantly changing over time, cumulatively influencing other variables in different time points, are considered in our test. Future studies may consider our findings as a baseline for comparison to understand the extent to which contextual factors change the effectiveness of public diplomacy on news sentiment, and vice versa.

Considering the economic significance variables independently, Japanese exports to the U.S. has a negative long-term effect on U.S. news sentiment toward Japan. Meanwhile, it has a positive long-term effect on Japanese public diplomacy expenditure. The United States has recorded a long trade deficit with Japan, which may potentially increase negative sentiment in U.S. newspapers in a longer term. This finding partially supports previous studies (e.g., Wu, 2003) that demonstrate that the trade volume between countries is a significant factor to predict international news coverage.

This study adopted a computer-assisted methodology, the so-called big data analysis. Using Python, the volume of Japanese public diplomacy expenditure data was systematically extracted from 23 years of the FARA archive with fewer human errors. Python also makes it much easier to collect and

analyze the sentiment of 45,822 news articles. Data scientists have improved their algorithms to conduct a sentiment analysis more like humans' reading of documents. The JST algorithm, which we got from GitHub, uses a Python package, "synsnet," to initially assign sentiment to each word, and then weights the sentiment of each word to adjust for each iteration of the whole document.

This study has several limitations. First, future studies must consider other controlling variables. Only two economic variables were controlled for in our study regarding a lagged correlation between public diplomacy expenditure and news sentiment. There are always possible alternative explanations (social and cultural variables) that can make the findings of this study as spurious correlations. Nevertheless, our findings show more than a mere correlation between variables. As mentioned above, satisfaction of the assumption of "stationary" statistically means that the series is not a random walk sufficiently explained by its past terms. Also, addressing the existence of cointegration, we showed that the moving average of the vector model converges into equilibrium. A vector of multiple series is verified to have the same patterns of fluctuation. Then, we examined the significance of each coefficient to explain the model. Yet our future studies would continue to alternative variables to reduce potential spuriousness between the variables tested in this study.

Second, the quantity of public diplomacy expenditures in dollar amounts may not fully reflect the quality of its influence, such as efficiency. Fastly growing digital technologies in public diplomacy can make public diplomacy activities more efficient over time (Cull, 2013). Cost-effective public diplomacy activities got more ground (Sevin & Ingenhoff, 2018). A downward trend of expenditures, as our data shows, does not necessarily indicate that there have been less public diplomacy activities over time, but may mean that more activities are remotely executed and become cost effective. Indeed, in the relatively recent FARA contracts, we observed more frequent descriptions of social media and digital communication. However, the activities and social media and digital communication contracts are not required by FARA to disclose their financial information; thus, our study, which focused on expenditure, could not capture this changing trend.

Lastly, we merely examined one case of the U.S.–Japan relationship, which lacks generalizability to other countries. Constructing and analyzing a quality time-series data set was a challenge because of the availability of data and difficulty in satisfying various assumptions in statistics. However, the more future studies can tackle this challenge in the contexts of other countries, the more holistic picture we can see between public diplomacy and international news.

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Appendix

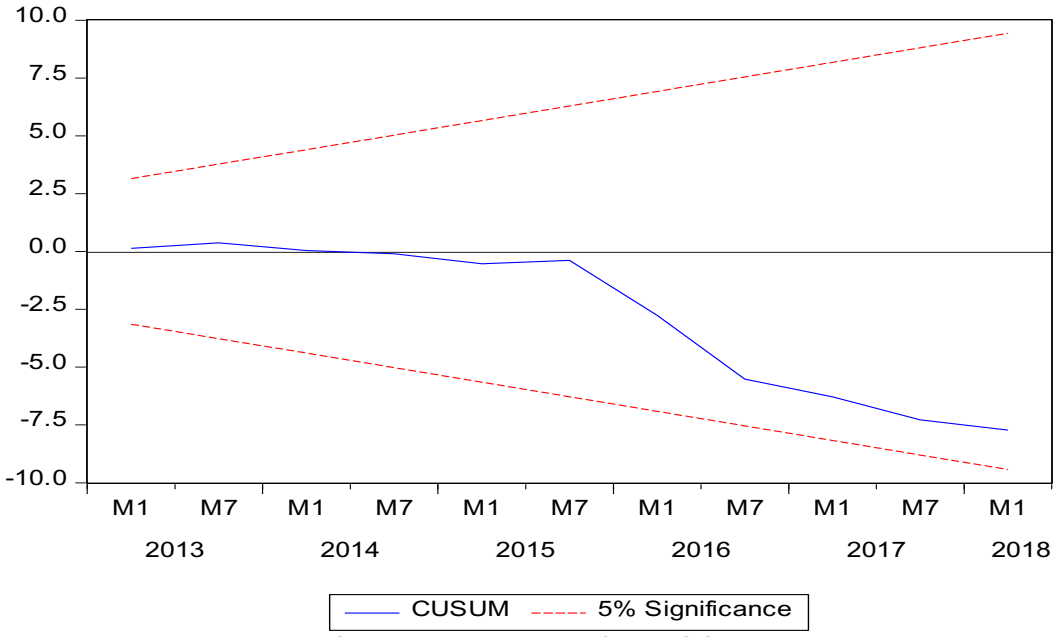

Figure 1A. CUSUM test for Model 1.

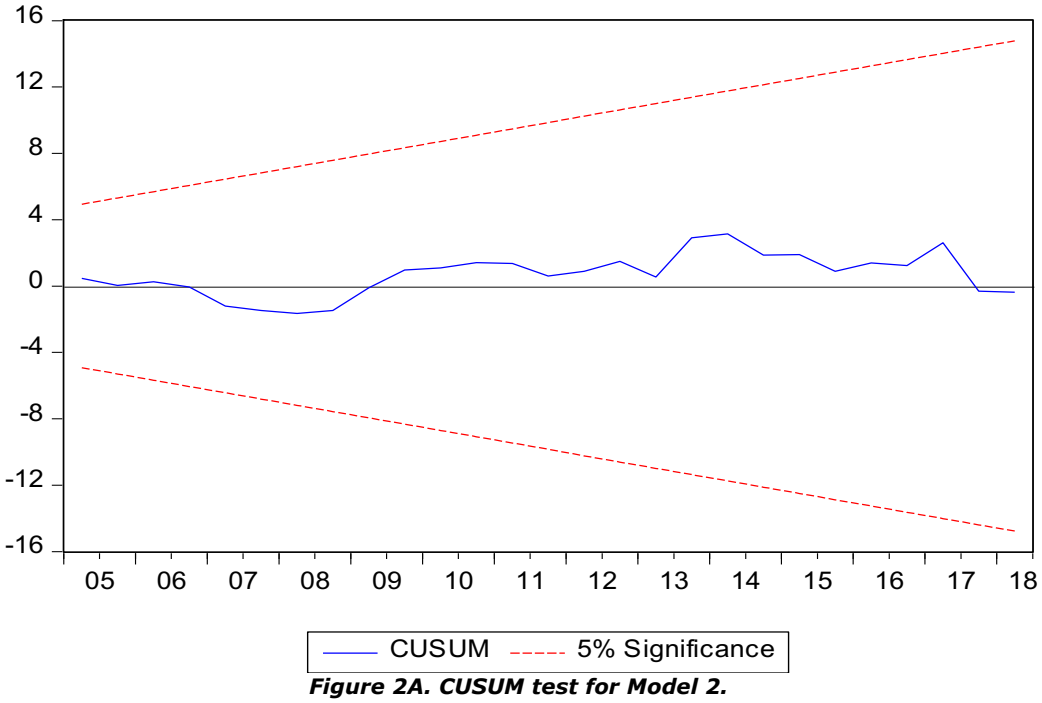

Figure 2A. CUSUM test for Model 2.