Effects of Foreign Exchange Rates on the U.S.-Japan Trade Balance

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Abstract

Since taking office, President Trump has accused a number of foreign governments of engaging in currency manipulation to boost their respective economies at the expense of American firms. Rather than debate the validity of President Trump's claims, this paper will examine historical U.S. dollar-Japanese yen (USD/JPY) exchange rates and U.S.-Japan bilateral trade data in order to determine the degree to which fluctuations in foreign exchange rates help to predict the United States' bilateral trade balance with Japan. For this study, we employ a vector autoregression (VAR) system to conduct both a Granger test and an impulse response analysis to discover whether any causal relationship exists between our two variables. Ultimately, the analysis fails to establish the USD/JPY exchange rate as a reliable predictor of the U.S.-Japan trade balance, illustrating that the relationship between foreign exchange rates and bilateral trade balances is less direct than macroeconomic theory considers it to be.

I. Introduction

It is well-established in macroeconomic theory that, all things being equal, fluctuations in a national currency's exchange rate will impact that country's trade relations with foreign economies (Mishkin 2016). An increase in the value of one country's currency relative to another's is said to make the former country's exports more expensive relative to those of the latter. As such, a strong national currency is said to discourage foreign consumers from purchasing goods and services from that nation's economy. In sum, a relatively strong currency reduces exports (2016).

Moreover, a strong domestic currency has the effect of making foreign goods and services cheaper in comparison to their domestic equivalents. According to macroeconomic theory, a stronger currency will cause domestic consumers to substitute away from domestically produced goods and services while substituting towards foreign goods and services, thus increasing the nation's overall import levels (2016; Chien 2017). Seeing as gross domestic product (GDP) is calculated by summing an economy's consumption, investment, government spending, and exports less imports, a country intent on increasing its GDP may attempt to increase exports by weakening its currency.

"Currency manipulation" occurs when a central bank buys or sells its own domestic currency in exchange for foreign currencies in order to make its own economy's goods and services more competitive in international markets (Sanford 2011). Currency manipulation has the adverse consequence of distorting markets and artificially inflating a country's export levels while disadvantaging other countries' economies. Due to these damaging side-effects, the World Trade Organization (WTO) and International Monetary Fund (IMF) both require member countries to agree to terms which preclude their central banks from engaging in currency manipulation

(2011). Despite the efforts of the international community, the temptation to adjust exchange rates for economic gain still persists.

In recent years, the issue of currency manipulation has garnered greater levels of attention as the Trump administration has repeatedly hurled accusations of currency devaluation against some of the world's most prominent central banks to include the European Central Bank, the People's Bank of China, and the Bank of Japan (McCurry 2017).While greater media attention has been dedicated to President Trump's accusations against the European Union and China, the U.S.-Japan trade relationship remains vitally important to the well-being of the global economy as the U.S. and Japan comprise the world's first and third largest economies respectively (Takeo 2019).

More recently, the issue of currency manipulation has come to the forefront of U.S.-Japanese diplomatic relations as the two nations commenced a new round of trade talks in April of 2019. The American delegation is currently pushing for the inclusion of a currency provision which would effectively ban either country from intervening in its own domestic currency. Japanese officials worry that this clause would allow the United States to impinge upon the autonomy of Japan's central bank and remain opposed to its inclusion (Cimino-Isaacs & Williams 2019; Takeo 2019). As the Trump administration prepares to expend its political capital in order to ensure the addition of the so-called "currency clause," it is important to consider what such a clause may achieve.

As U.S. trade representatives presses forward with negotiations, it must be determined whether the political capital the Trump administration is willing to expend will promise corresponding gains for the American economy. In order to assess the potential benefits associated with the inclusion of such a clause, it is important to first determine the extent to which currency devaluation causes the U.S. trade deficit, specifically in the context of the United States trade partnership with Japan. This paper will attempt to provide context to the United States' escalating "currency war" by analyzing historical USD/JPY exchange rate and U.S.-Japan bilateral trade data to determine the extent to which foreign exchange rates have contributed to the U.S. trade deficit.

II. Data

In order to determine the effects of the USD/JPY exchange rate on the U.S.-Japan bilateral trade balance, data was obtained from official U.S. government databases. Monthly Country and Product Trade Data detailing the amount (in USD) of U.S. exports and imports by country was retrieved from the United States Census Bureau (United States Census Bureau 2019). Data for the U.S.-Japan bilateral trade balance was available dating back to 1985 (See Figure 1). Due to the fact that bilateral trade balances between the United States and Japan were not explicitly listed in the data, trade balances were calculated by subtracting the total amount of U.S. imports from Japan from the total amount of U.S. exports to Japan for a given year.

Monthly U.S. Foreign Exchange Rate data was obtained from the Federal Reserve Economic Database (FRED) for the USD/JPY (Board of Governors of the Federal Reserve System 2019). Units denote the amount of Japanese yen (JPY) equaling one U.S. dollar (USD) (See Figure 2).

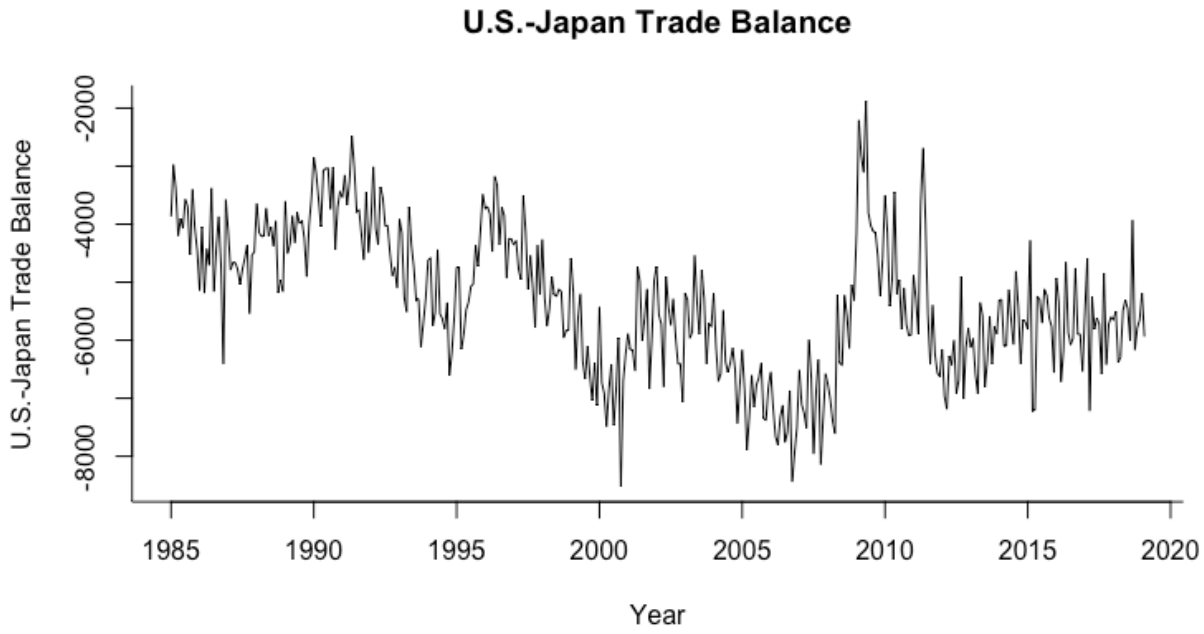

Figure 1 – Time-Series Plot of U.S.-Japan Trade Balance

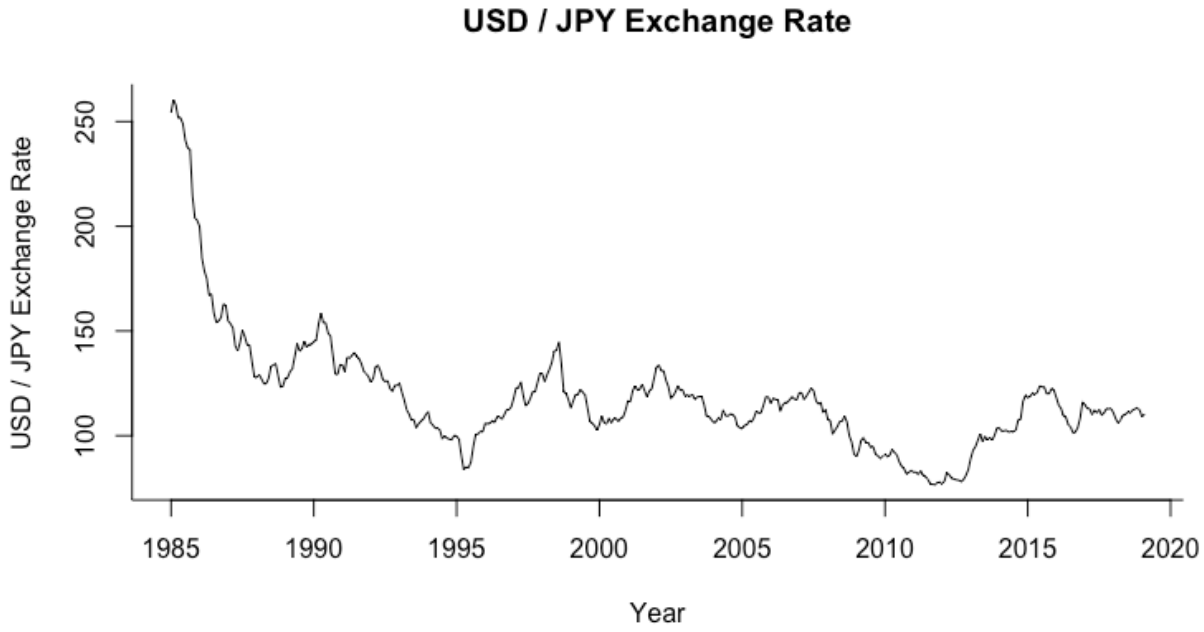

Figure 2 – Time-Series Plot of USD/JPY Exchange Rate

III. Results

In this paper, we utilize our multivariate information set to examine the interdependence of the USD/JPY exchange rate and the U.S.-Japan bilateral trade balance across time. Specifically, we employ a Vector Autoregression (VAR) system to analyze not only the dependence within both series but also the interdependence which exists between the two series. The endogenous variables of the model will be USD/JPY exchange rates and the U.S.-Japan bilateral trade balance.

First, we determine the optimal number of lags to include in our VAR system through estimation and information criteria. While there exists a number of criteria by which to determine the optimal number of lags, the two most prominent include the Akaike information criteria (AIC) and Schwarz information criteria (SIC). According to Table 1, the AIC and SIC have identified the optimal number of lags to be ten and three respectively. In the interest of parsimony, we choose to incorporate just three lags into our VAR system as the SIC suggests we should.

VAR Lag Order Selection Criteria

Endogenous variables: FOREX_JP, BAL_JP
Exogenous variables: Const
Sample: 1985JAN 2019FEB
Included observations: 407

Lag	HQ	FPE	AIC	SIC
1	1.566358e+01	6.198847e+06	1.563987e+01	1.569975e+01
2	1.552176e+01	5.294855e+06	1.548224e+01	1.558203e+01
3	1.539356e+01	4.584743e+06	1.533824e+01	1.547794e+01
4	1.537403e+01	4.425580e+06	1.530290e+01	1.548251e+01
5	1.540025e+01	4.471993e+06	1.531332e+01	1.553285e+01
6	1.542131e+01	4.495609e+06	1.531857e+01	1.557801e+01
7	1.545007e+01	4.554329e+06	1.533152e+01	1.563088e+01
8	1.545060e+01	4.485419e+06	1.531624e+01	1.565551e+01
9	1.547026e+01	4.502934e+06	1.532010e+01	1.569929e+01
10	1.546200e+01	4.396089e+06	1.529603e+01	1.571514e+01

Table 1 - Lag Order Selection in VAR

Having selected the optimal number of lags, we proceed with a VAR(3) system with six parameters plus the variances and covariance of the error terms so that our equations read as follows:

$$BAL\_JP_t = c_1 + \alpha_{11}BAL\_JP_{t-1} + \alpha_{12}BAL\_JP_{t-2} + \alpha_{13}BAL\_JP_{t-3} + \beta_{11}FOREX\_JP_{t-1} + \beta_{12}FOREX\_JP_{t-2} + \beta_{13}FOREX\_JP_{t-3} + \varepsilon_{1t}$$

$$FOREX\_JP_t = c_2 + \alpha_{21}BAL\_JP_{t-1} + \alpha_{22}BAL\_JP_{t-2} + \alpha_{23}BAL\_JP_{t-3} + \beta_{21}FOREX\_JP_{t-1} + \beta_{22}FOREX\_JP_{t-2} + \beta_{23}FOREX\_JP_{t-3} + \varepsilon_{2t}$$

By running the estimation for our VAR(3) system, we receive the following results:

Vector Autoregression Estimate **Sample (adjusted): 1985JAN 2019FEB** **Included observations: 407 after adjustments** **Standard errors in ( ), t-statistics in [ ], & p-value in { }**		
	FOREX_JP	**BAL_JP**
FOREX_JP (-1)	1.251e+00 (4.999e-02) [25.032] {< 2e-16}***	16.53304 (11.51373) [1.436] {0.1518}
BAL_JP (-1)	3.133e-04 (2.002e-04) [1.565] {0.11835}	0.43526 (0.04612) [9.439] {< 2e-16} ***
FOREX_JP (-2)	-3.210e-01 (7.806e-02) [-4.112] {4.76e-05}***	-1.42148 (17.98090) [-0.079] {0.93703}
BAL_JP (-2)	-1.654e-04 (2.214e-04) [-0.747] {0.45553}	0.05500 (0.05101) [1.078] {0.28152}
FOREX_JP (-3)	3.436e-02 (4.781e-02) [0.719] {0.4727}	-13.19549 (11.01168) [-1.198] {0.23150}
BAL_JP (-3)	-9.119e-05 (2.001e-04) [-0.456] {0.64878}	0.38339 (0.04608) [8.320] {1.4e-15} ***
Const	4.210e+00 (1.291e+00) [3.261] {0.00121}**	-899.60040 (297.36521) [-3.025] {0.00264}**

Signif. codes: 0 '*' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1**		
Residual standard error	3.081	709.7
Multiple R-squared	0.986	0.6651
Adj. R-squared	0.9858	0.66
F-Statistic	4702	132.4
Log Likelihood		-4277.863

Table 2 - Vector Autoregression Estimate

Next, we will use the VAR(3) system to determine whether the USD/JPY exchange rate is useful for predicting the trade balance between the United States and Japan. We will accomplish this by conducting a Granger test.

Under the classical assumptions of a linear regression model, the null hypothesis for Granger-causality can be tested using an *F*-statistic. The null hypothesis and corresponding alternative hypothesis for the Granger test are as follows:

$$H_0 : = \alpha_1 = \alpha_2 = \alpha_3 = \beta_1 = \beta_2 = \beta_3 = 0$$
$$H_A : any\ \alpha\ or\ any\ \beta \neq 0$$

By running the test, we receive the following results:

VAR Granger Causality			
Sample: 1985JAN 2019FEB **Included Observations: 407**			
Dependent Variable: FOREX_JP			
Excluded	**Chi-sq**	**df**	**Prob.**
BAL_JP	0.8179	3	0.4845
All	0.8179	3	0.4845
Dependent Variable: BAL_JP			
Excluded	**Chi-sq**	**df**	**Prob.**
FOREX_JP	1.7998	3	0.1466
All	1.7998	3	0.1466

Table 3 - Testing for Granger-Causality in VAR

With a numerator degree of freedom of three and a denominator degree of freedom of 400, we consult the chi-square distribution to determine that our critical value is equal to 2.6. The value of the chi-square test for FOREX_JP is $F^* = 0.8179$ with a p-value of 0.4845, which means that

to fail to reject the null hypothesis. The value of the chi-square test for BAL_JP is $F^* = 1.7998$ with a p-value of 0.1466, therefore, we fail to reject the null hypothesis.

Thus, we conclude that the USD/JPY exchange rate is not predictive of the U.S.-Japan bilateral trade balance. The data, therefore, fails to support our initial hypothesis that the U.S.-Japan bilateral trade balance depends heavily on the USD/JPY exchange rate. Since the foreign exchange rate between the U.S. dollar and Japanese yen does not help to predict the trade balance between these two economies, we *cannot* say that USD/JPY exchange rates Granger-cause the U.S.-Japan trade balance.

Despite a lack of Granger-causality between the USD/JPY exchange rate and the United States' trade balance with Japan, we will continue our analysis by investigating the orthogonal impulse-response functions of the two variables. Using our VAR(3) system, we will be able to track how shocks to one variable are transmitted to the other. This will allow us to determine the magnitude and persistence of responses to shocks in either of the two variables.

We will choose to order our variables (FOREX_JP, BAL_JP), which implies that a shock to the U.S.-Japan trade balance does not have any contemporaneous effect on the USD/JPY exchange rate, while a shock in the USD/JPY exchange rate is expected to have a contemporaneous effect on both trade balances and foreign exchange rates.

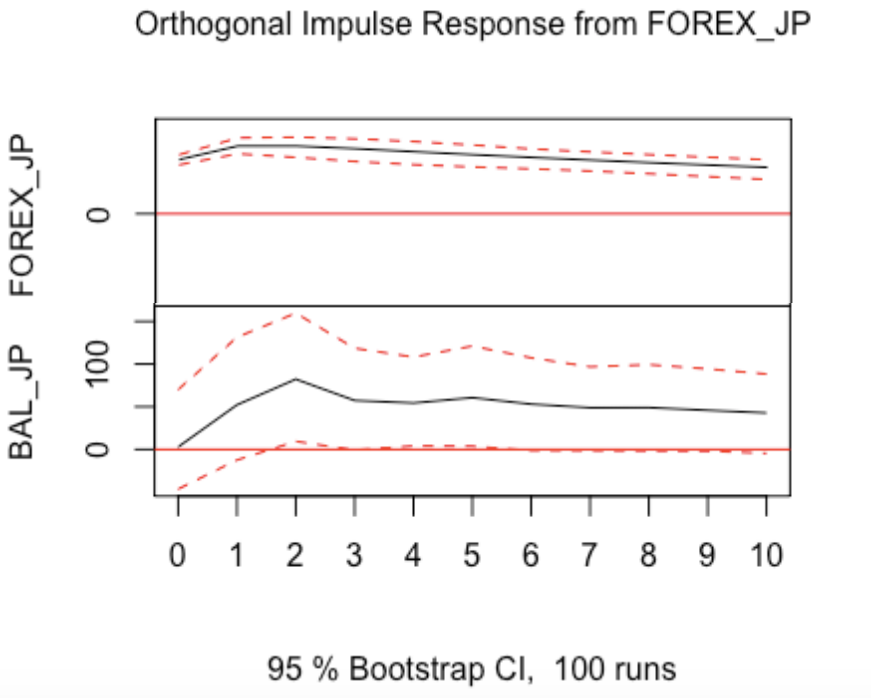

Figure 3 – Orthogonal Impulse Response from USD-JPY Exchange Rate (FOREX_JP)

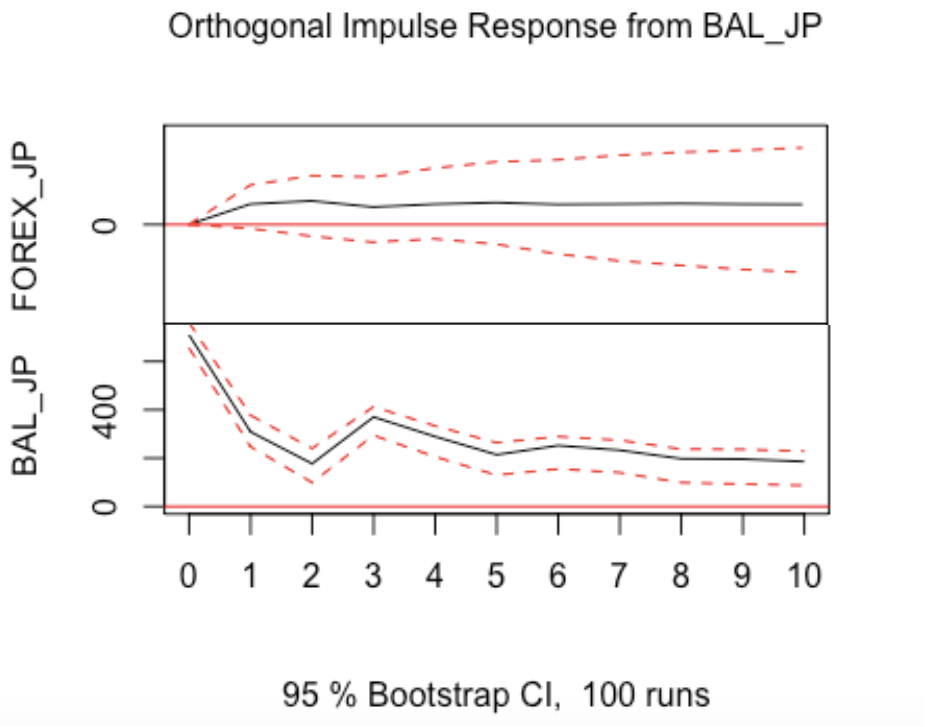

Figure 4 - Orthogonal Impulse Response from U.S.-Japan Bilateral Trade Balance (BAL_JP)

The 95% confidence bands on either side of the solid black lines illustrate the statistical significance of our responses. The plots show that a shock to the USD/JPY exchange rate is expected to be followed by an increase in the USD/JPY exchange rate as well as an increase in the U.S.-Japan trade balance, although the 95% confidence band is extremely close to zero meaning that these results may be regarded as statistically insignificant. Next, a shock in the U.S.-Japan bilateral trade balance is predicted to result in a statistically significant spike in the U.S.-Japan trade balance which will gradually decline over time as well as a slightly positive statistically insignificant effect on the USD/JPY exchange rate. The fact that shocks to both the USD/JPY exchange rate and U.S.-Japan trade balance fail to elicit statistically significant responses from one another, thus indicating that the USD/JPY exchange rate and U.S.-Japan bilateral trade balance do not exhibit a causal relationship.

IV. Conclusion

In sum, the USD/JPY exchange rate does not have a statistically significant impact on the dynamics and variability of U.S.-Japan trade relations. This is due to the fact that Granger-causality between the two variables could not be established by our statistical analysis. Our findings fail to support our initial hypothesis that foreign exchange rates will have a measured impact on countries' bilateral trade balances. While this appears to contradict well-established macroeconomic theory, this finding may be explained by the fact that the effect of exchange rates on bilateral trade relations may often be overstated. Regardless of whether the Bank of Japan is intentionally engaging in currency manipulation, it appears that any meddling taking place has not yet proven effective enough to Granger-cause significant changes in the U.S.-Japan bilateral trade balance.

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Codebook – Effects of Foreign Exchange Rates on the U.S. Trade Deficit

Variable	Description
FOREX_JP	U.S. / Yen Foreign Exchange Rate monthly data; retrieved from the Federal Reserve Economic Data.
BAL_JP	U.S.-Japan Trade Balance calculated by subtracting Japanese imports to U.S. from U.S. exports to Japan; retrieved from the United States Census Bureau.