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The Impact of Exchange Rate on Exports and Imports: Empirical Evidence from Vietnam

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Abstract

The exchange rate is considered a tool improving the volume of exports and reducing imports. This paper aims to determine the impact of the exchange rate on exports and imports between Vietnam and the United States in the context of the trade war. The research uses Autoregressive Distributed Lag (ARDL) and Nonlinear Autoregressive Distributed Lag (NARDL) Model in the time-series data from 2010:1 to 2020:9. The ARDL's results support that real exchange rate impact on export and import volumes, but less than the trade war. The trade war helps trade balance increase 0.35%, while the exchange rate increases trade balance 0.191% when the Vietnamese currency devalues 1% in the long run. In the short term, the real exchange rate makes the trade balance decrease. Therefore, the J curve exists between Vietnam and the U.S. The NARDL expresses that the exchange rate is asymmetric both in the short term and the long term. The findings of this study point to two important elements. Firstly, the exchange rate plays a minor role in exports and imports. Secondly, trade war plays a vital role in increasing exports and imports volume between two countries, and the J curve exists between the two countries.

Keywords: Exchange Rate, Trade War, NARDL, Vietnam, Asymmetric

JEL Classification Code: F10, F31, F32, F41

1. Introduction

As a small, open, and export-led economy, Vietnam relies mainly on the U.S economy for exports. The trade surplus of Vietnam may be caused by the structure of commodity in exports and imports. Vietnam exports agricultural products such as dragon fruit, cashew nut, and textiles, leathers, etc., which are less value-added products. In contrast, Vietnam imports high value-added products such as computers and electronics.

Table 1 shows the export and import volume between the two countries during the period of 2010–2019. The data indicate the export volume growth rate to the U.S market from 2010 to 2019 is 17.4% on average. Especially, after the trade war (02/2018), export volume increased USD5.94 billion in absolute value or 14.28% in 2018. The record of export volume peaked at USD13.82 billion in absolute value or 29.07% in 2019. The acceleration has increased nearly the same as exports (16.29% per year) like imports. Vietnam's import volume increased 36.4% in 2018 and continuously improved in 2019.

The reason why both exports and imports have sharply increased is explained as follows. When the trade war happened, Vietnam's export products have had more opportunities to penetrate the U.S economy to replace the Chinese products. Besides that, to evade US taxation or technical barriers of the, Chinese enterprises have used the fake practice to have Vietnam Certification of Original (C/O) or "made in Vietnam" on exported products to the U.S. This volume of export is recorded as Vietnamese; however, the truth owners are Chinese.

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Table 1: Exports and Imports Between Vietnam and United State in the Period 2010–2019

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Exports (billion USD)	14.24	16.93	19.67	23.84	28.64	33.47	38.45	41.59	47.53	61.35
Imports (billion USD)	3.77	4.53	4.83	5.23	6.3	2.79	8.7	9.35	12.75	14.36

Source: International Financial Statistics (2019).

The trade war caused companies to withdraw from China, and Foreign Direct Investment (FDI) was reduced in China. Meanwhile, Vietnam witnessed a remarkable growth in FDI attractiveness. New factories need new tools and equipment, some of which are imported from the United States. The more increase in FDI, the more imports from the U.S.

However, in December 2020, the Trump administration labeled Vietnam as a money manipulator because Vietnam meets all three reasons. One of the three reasons is that Vietnam uses the exchange rate to make commodities cheaper; thus, the competitiveness is higher in the US market. Conversely, US goods in Vietnam are more expensive, reducing competitiveness, which means that US export volumes to Vietnam decreased. However, when we observed the data, we found that both exports and imports have increased sharply after the trade war between the United States and China. For that reason, this paper will examine the changes in exports and imports as it relates to the exchange rate in the context of the trade war. Suppose the trade war has a significant effect on imports and exports while the exchange rate plays a minor. In that case, the Biden administration should remove Vietnam from the country's list as currency manipulators.

The contribution of this paper is twofold: first, we are using updated data from 2010:1 to 2020:9. Second, to the best of our knowledge, this is the first paper using the nonlinear autoregressive model for analyzing exports and imports between Vietnam and the United States in the trade war context.

The next part of this study is organized as follows: section 2 discusses the literature review; section 3 briefly explains methodology and data; section 4 presents results and discussion, and section 5 concludes.

2. Literature Review

The exchange rate and the trade balance are among the hot topics and are always of interest to experts and policymakers. The trade balance is defined as exports minus imports. When the exchange rate is changed, such as the devaluation of the local currency, it will make the domestic currency cheaper, encouraging exports. In contrast, devaluation makes imported goods more expensive and restricts imports.

The devaluation of a local currency that impacts the trade balance is known as the Marshall-Lerner (ML) condition. However, the ML condition does not explain why the trade balance is still in deficit after devaluation of the domestic currency. After a while, the trade balance begins to improve. This phenomenon was found by Magee (1973) when studying the relationship between exchange rate and U.S trade balance. Magee (1973) discovered the J curve, which was explained by Akbostanci (2004). Most exporters and importers have signed the contract before depreciation. In the short run, the volume of exports and imports does not change much; nevertheless, the depreciation makes imported goods cost more in the domestic currency. Therefore, the value of imported goods rises while exported products do not change a lot. As a result, the trade balance becomes deficit.

Besides, the import and export of goods depend on the income of domestic and foreign residents. As the income of the domestic resident increases, the import volume of goods increases. Similarly, a rise in the foreigner's income causes an increase in the export of goods.

There are many papers on this topic looking at trade from developing to developed countries. The results fall into three categories. First, there is no evidence that indicates a relationship between exchange rate and trade balance (Rose & Yellen, 1989; Rahman et al., 1997; Asteriou et al., 2016). Second, there is a negative relationship between exchange rate and trade balance (Arora et al., 2003; Shahbaz et al., 2012; Poon & Hooy, 2013). This means that the devaluation of the domestic currency will make the trade balance deteriorate. Third, there is a long-run positive relationship between two variables (Rose & Yellen, 1989; Matesanz & Fugarolas, 2009). Recently, Abbas et al. (2020) study the effects of the Chinese currency on its main partners; the conclusion is mixed. RMB devaluation improves the trade balance with some countries. However, with some other countries, this makes the balance of trade deteriorate.

The theory shows that the devaluation of the domestic currency will positively affect exports. However, a research paper by Ahmed et al. (2017) shows that the effect of exchange rate on merchandise export volume has declined after the Global Financial Crisis (GFC), especially for participating countries related to the global manufacturing process. Kang and Dagli (2018) pointed out that the exchange rate's positive effect on exports occurred before the GFC. After the

GFC, this relationship has almost disappeared. The above conclusions are similar to the research paper by Khachatryan and Grigoryan (2020). The authors study the effects of domestic currency devaluation on exports in Armenia, a developing country. The conclusion is that exchange rate volatility has no impact on exports in the short run, and has little effect in the long run.

Many technical methods were applied in the studies, such as Vector Autoregression (VAR) method (Nguyen & Do, 2020), and the ARDL method. However, after Shin et al. (2014) developed Nonlinear Autoregressive Distributed Lag (NARDL), many papers have applied it to conduct the research, such as Bahmani-Oskooee and Fariditavana (2015), and Nusair (2017). Because this NARDL has advantages as stated by Arize et al. (2017). First, this method provides asymmetric coefficient estimators in the short run and long run. Second, variables are required to be cointegrated as $I(0)$ when using OLS method and cointegrated as $I(1)$, while using VAR method, the ARDL and NARLD can apply when variables mix as $I(0)$ and $I(1)$.

There are a few papers on this topic in Vietnam. Trinh (2014) use quarterly data from 2000 to 2010 to find out the J curve between Vietnam and 17 primarily trading partners. With the ARDL and ECM methods, the paper finds that the J curve existence. Phan and Jeong (2015) research the impact of exchange rate on the trade balance of Vietnam with FMOLS and DOLS method. Although the long-term cointegration takes place, the exchange rate harms the trade balance. This means when Vietnam devaluates VND, the trade balance deteriorates. This result aligns with Shahbaz et al. (2012). Nguyen et al. (2020) research intra-industry trade of Vietnam with TPP partners. The results support that the exchange rate does not have any effect on the trade balance.

As a developing country labeled as currency manipulation, it is a suitable time to re-examine the effect of exchange rates on the trade balance in Vietnam in the context of the trade war. Therefore, we can propose some suggestions for policymakers.

3. Methodology and Data

3.1. Methodology

We follow the research of Leigh et al. (2017) for modeling exports and imports.

Consider a "two-country" model of trade. The volume of goods that Vietnam exports to the U.S relies on the price of goods and U.S residents' demand.

$$X = f(P_m^*, Y^*) \tag{1}$$

Where P_m^* represents the price of import in the U.S and Y^* represents the U.S' resident income.

This paper concentrates on the effect of exchange rate on exports and imports; therefore, the function for export volume is

$$X = f(\frac{eP^*}{P}, Y^*) \tag{2}$$

Where e is the nominal exchange rate, P^* is the price level of U.S, and P is the price level of Vietnam. The formula $\frac{eP^*}{P}$ is the real exchange rate (RER). As mentioned above, we concentrate on either exchange rate or trade war or both; therefore, we add a dummy variable D to the equation (2) and take the log form. We have

$$\text{Ln}(X) = \alpha_0 + \alpha_1 \ln(\text{RER}) + \alpha_2 \ln(Y^*) + \alpha_3 D \tag{3}$$

Where D is a dummy variable that takes value 0 from 2010:1 to 2018:2 and 1 from 2018:3 to 2020:9.

Equation (3) is the long-form equation; therefore, to judge the short run, we add the method Autoregressive Distributed Lag (ARDL) into (3). ARDL was developed by Pesaran et al. (2001) as in equation (4).

$$\begin{aligned}\Delta X_t = {} & \alpha + \sum_{j=1}^{n} \beta_j \Delta \ln X_{t-j} + \sum_{j=0}^{n} \delta_j \Delta \ln Y^*_{t-1} \\ & + \sum_{j=0}^{n} \pi_j \Delta \ln \text{RER}_{t-j} + \theta_1 \ln X_{t-1} + \theta_2 \ln Y^*_{t-1} \\ & + \theta_3 \ln \text{RER}_{t-1} + D + \varepsilon_t\end{aligned} \tag{4}$$

ARDL model has the advantage compared with equation (3) because it allows analyzing the short run and the long lung. Besides, ARDL can be applied when time-series data are cointegration as $I(0)$ or $I(1)$.

The real exchange rate and export may have an asymmetric when VND depreciates or appreciate. Therefore, we create two new variables represent for VND appreciate, POS, and represent VND depreciate, NEG, as follow:

$$POS_t = \sum_{j=1}^{t} \Delta \ln RER_j^+ = \sum_{j=1}^{t} \max(\Delta \ln RER_j, 0) \tag{5}$$

$$NEG_t = \sum_{j=1}^{t} \Delta \ln RER_j^- = \sum_{j=1}^{t} \min(\Delta \ln RER_j, 0) \tag{6}$$

POS is calculated by the sum of partial appreciation change of Vietnam Dong, and NEG is calculated by the sum of partial depreciation change of Vietnam Dong. Follow

Shin et al. (2014), we replace RER variable in equation (4) by POS and NEG variables. We have:

$$\Delta X_t = \alpha + \sum_{j=1}^{n} \beta_j \Delta \ln X_{t-j} + \sum_{j=0}^{n} \delta_j \Delta \ln Y^*_{t-1} + \sum_{j=0}^{n} \pi^+_j \Delta \mathrm{POS}_{t-j} + \sum_{j=0}^{n} \pi^-_j \Delta \mathrm{NEG}_{t-j} + \theta_1 \ln X_{t-1} + \theta_2 \ln Y^*_{t-1} + \theta_3^+ \mathrm{POS}_{t-1} + \theta_3^- \mathrm{NEG}_{t-1} + D + \varepsilon_t \quad (7)$$

The equation (7) is Nonlinear Autoregressive Distributed Lag Model (ARDL). The coefficients estimation allows analyzing the change of exchange rate on the export in the short run and long run. ARDL also allows investigating the asymmetric of the change of real exchange rate on export. Symmetric is the effect of POS and NEG's exchange rate on export is the same, and asymmetric is the effect of POS and NEG's exchange rate on export is different.

Similarly, we use the equation (8) and (9) for the import model of Vietnam from the U.S in ARDL and NARDL.

$$\Delta M_t = \alpha + \sum_{j=1}^{n} \beta_j \Delta \ln M_{t-j} + \sum_{j=0}^{n} \delta_j \Delta \ln Y_{t-1} + \sum_{j=0}^{n} \pi_j \Delta \ln \mathrm{RER}_{t-j} + \theta_1 \ln M_{t-1} + \theta_2 \ln \mathrm{Y}_{t-1} + \theta_3 \ln \mathrm{RER}_{t-1} + D + \varepsilon_t \quad (8)$$

$$\Delta M_t = \alpha + \sum_{j=1}^{n} \beta_j \Delta \ln M_{t-j} + \sum_{j=0}^{n} \delta_j \Delta \ln \mathrm{Y}_{t-1} + \sum_{j=0}^{n} \pi^+_j \Delta \mathrm{POS}_{t-j} + \sum_{j=0}^{n} \pi^-_j \Delta \mathrm{NEG}_{t-j} + \theta_1 \ln M_{t-1} + \theta_2 \ln Y_{t-1} + \theta_3^+ \mathrm{POS}_{t-1} + \theta_3^- \mathrm{NEG}_{t-1} + D + \varepsilon_t \quad (9)$$

Where M represents import volume from the U.S, Y is the Vietnamese resident income.

3.2. Data

This procedure for conducting the models needs export and import volume between Vietnam and the United States, real exchange rate, and resident income of two countries.

RER = $\frac{eP^*}{P}$ where e is nominal exchange rate defined as the number of VND over one USD, P^* is Consumer Price Index of United States, and P is Consumer Price Index of Vietnam.

Because of the limitation of data, this paper uses Industrial Production Index as a proxy for Vietnam and the United States resident income. Data was collected from International Financial Statistics (IFS), except the Industrial Production Index of the Vietnam economy was collected from IFS and General Statistics Office of Vietnam (GSO) and spans from 2010:1 to 2020:9.

4. Results and Discussion

4.1. Unit Root Test and Optimal Lag

Because time-series data is used in this model, we first check the stationary of these data. Augmented Dickey-Fuller (ADF) test, Phillips-Perron (PP) test, and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test are used to check the stationarity at level and first different for all variables. The results are reported in Table 2.

Table 2 shows the unit root tests for Real Exchange Rate (RER), Industrial Production Index of the U.S (IIPUS), and Industrial Production Index of Vietnam (IIPVN). ADF and PP test support all variables have unit root or stationary at level or first difference. Additionally, we used KPSS test for a more persuasive conclusion. The LM-Statistical in KPSS test shows all variables stationary.

Because no variables are integrated as $I(2)$, determining the optimal lag is the next step before conducting ARDL and NARDL. There are five lag-length criteria, namely,

Table 2: Unit Root Test

Variable	ADF		PP		KPSS	
	Level	1st Difference	Level	1st Difference	Level	1st Difference
RER	–5.538***	–5.458***	–4.872***	–10.056***	1.197	0.717***
IIPUS	0.242	–11.690***	–3.035**	–16.55***	0.914	0.5**
IIPVN	–2.440	–13.490**	–4.331***	–16.68***	0.364**	0.128*
M	–0.254	–18.288***	–1.766	–52.408***	1.382	0.102*
X	0.987	–9.906***	–1.003	–30.676***	1.401	0.252*

Note: ***, ** indicate significant at 1% and 5% levels respectively.

Table 3: ARDL for Export and Import Model

Part 1: Short-Run Estimates							
Lags	**0**	**1**	**2**	**Lags**	**0**	**1**	**2**
C	1.009			C	–1.669		
ΔX		0.388***	0.442***	ΔM		0.586***	0.269***
ΔRER		–4.389***	4.701***	ΔRER	–1.69*	1.928**	
ΔIIPUS	1.607***	–1.303*	–0.912	ΔIIPVN	0.758***	–0.719***	
D	0.321**	–0.196		*D*	0.056		
Part 2: Long-Run Estimates							
C	5.931			C	–11.568*		
RER	1.836**			RER	1.645***		
IIPUS	–3.578			IIPVN	0.27		
D	0.74***			*D*	0.39**		

Sequential modified LR test statistic (LR); Final prediction error (FPE); Akaike information criterion (AIC); Schwarz information criterion (SC); and Hannan-Quinn information criterion (HQ), used to check. All five lag criteria have the same power. The FPE and AIC indicate lag 2, and SC and HQ indicate lag 1 for both export and import models. Therefore, we used lag 2 as state as Akaike information criterion for conducting the model as previous papers (Bahmani-Oskooee & Xu, 2012; Olowofeso et al., 2017; Khachatryan & Grigoryan, 2020).

4.2. Linear Autoregressive Distributed Lag

The output of ARDL for export (left-hand side) and import (right-hand side) model are shown in Table 3. The results support that, in the short term, all three variables are statistically significant. RER has negative impact on lag 1 and positive impact after that. The IIPUS representing for the income of U.S's resident have the positive at lag 0 and negative at lag 1. The dummy variable has a positive impact.

In the long run, the coefficient estimation of RER has positive impact on exports and significant at 5%. This implies that, when VND devalues 1%, the export volume increases by 1.836%. The dummy variable is statistically significant at 1%. This means after the trade war helps Vietnam export to the U.S 0.74%. When the trade war began, to avoid taxation or technical barriers, many Chinese enterprises took advantage of Vietnam's origin to export commodities to the U.S. In brief, both the exchange rate and trade war support the export volume of Vietnam.

The import model on the right-hand side indicates the effect of independent variables on the import volume of Vietnam. The real exchange rate supports imports at lag 0; after that, when the Vietnamese currency is devalued 1%, the import volume increases by 1.928%. In contrast with exports, the trade war did not affect import volume in the short term. This happens maybe for three reasons. First, Vietnam's economy is a small market for U.S enterprise and absorbs all the U.S products at that time. Second, Chinese enterprises in the struggle with the trade war have been replaced in the US market, and have turned to other countries especially Vietnam, which shares the same border and with people liking the same cheap price product because the Vietnamese GDP/capita is in the low middle income. Finally, many contracts had been signed before the trade war happened.

In the long term, the dummy variable is significant, which implies the import volume increase by 0.39% when the trade war takes place. The reason is that Vietnam and the U.S enterprises have changed the structure of imports and exports. Vietnam's companies have signed more contracts with the U.S because Vietnamese love the U.S commodity more than Chinese commodity and to reduce the potential risk in the future. The RER has significance at 1%, which implies that when VND devalues 1% the exports of the U.S increase 1.465%.

To sum up, both trade war and real exchange rate impact on trade balance between Vietnam and the U.S in the long term. The trade war helps trade balance increase 0.35% (0.74–0.39%) more than RER 0.191% (1.936%–1.645%). In the short term, the real exchange rate makes the trade balance decrease at lag 0 and lag 1. Therefore, the J curve exists between Vietnam and the U.S.

4.3. Non-Linear Autoregressive Distributed Lag

For a deeper understanding of the impact of the exchange rate on import and export, NARDL is conducted. Table 4 shows the short-run and long-run output of exports and

Table 4: Nonlinear Autoregressive Distributed Lag for Export and Import Model

Part 1: Short-Run Estimation							
Lags	**0**	**1**	**2**	**Lags**	**0**	**1**	**2**
C	4.88***			*C*	2.043***		
ΔX		0.094	0.23***	ΔM		0.409***	0.147**
ΔPOS	–2.933***	3.23***		ΔPOS	–1.224	2.714**	–1.268
ΔNEG	–9.2***			ΔNEG	–5.249***		
ΔIIPUS	1.629***	–0.654	–0.985**	ΔIIPVN	0.669***	–0.559***	
D	0.113***			*D*	0.084**		
Part 2: Long-Run Estimation							
C	7.217***			*C*	4.604***		
POS	0.439*			POS	0.499*		
NEG	–13.605***			NEG	–11.826***		
IIPUS	–0.014			IIPVN	0.248*		
D	0.167***			*D*	0.189***		

Table 5: Wald Test for Short Run and Long Run Asymmetric of Export and Import

	Test Statistic	**Value**	**df**	**Probability**
Short run of export	*F*-statistic	34.06	(1, 117)	0.00
Long run of export	*F*-statistic	7.73	(1, 117)	0.006
Short run of import	*F*-statistic	15.78	(1, 116)	0.0001
Long run of import	*F*-statistic	15.78	(1, 116)	0.0001

imports. The variables POS and NEG are statistically significant both on the short term and long term. In part 2, long-run estimation indicates when VND devalues 1%, exports increase by 0.439%, while imports increase by 0.499%. In contrast, when VND appreciates 1%, the exports decrease 13.61%, and Vietnam's imports decrease 11.83%.

Table 4 shows the significant difference between POS and NEG in either exports or imports, which implies the asymmetric exchange rate on the trade balance. To answer that question more scientifically, Wald test is used for detecting the evidence. In all cases that have the null hypothesis, POS and NEG are symmetric.

Table 5 presents the Wald test for checking the asymmetric. All cases show that the probability of chi-square is less than 1%. Therefore, the null hypothesis is rejected, which implies the short-run and long-run asymmetric relation of export and import models.

4.4. Diagnostic Check

Table 6 shows the diagnostic check for the linear and nonlinear model. *F* test is significant at 1% (except import model significant at 5%) and supports the equation cointegration. Next, the Error Correction Model (ECM) has a negative sign and is significant implying the long-run causality running from independent variables to the dependent variable. In other words, the real exchange rate has impacted import and export volumes in the long run. Besides that, Breusch-Godfrey Serial Correlation LM test indicates there is no serial correlation (except the export model in ARDL); Breusch-Pagan-Godfrey test shows heteroskedasticity did not accompany the export model. Normality test indicates the residuals are normally distributed on all of the models. Cumulative sum of the recursive residuals (CUSUM) and CUSUM of squares test (CUSUMQ) are added to check the stability. The results express parameters stability at CUSUM and CUSUMQ (except the import model in the ARDL).

Although the import model in linearity has the disadvantages of heteroskedasticity and CUMSUMQ, the rest of the requirements are satisfied. As a result, this model is still considered being good. The other models are good, and the best model is the export model in the NARDL; it satisfies all the gauges of tests.

To summarize, the exchange rate has a slight impact on trade balance, and the J curve exists between Vietnam and the U.S. The diagnostic checks show that the four models are good.

Table 6: Diagnostic Statistics

	F-bound Test	ECM_{t-1}	Serial Correlation	Heteroskedasticity	Normality	CUSUM	CUSUMQ
Part 1: Diagnostic Statistics Export and Import in ARDL Model							
Export model	5.752***	–0.17***	–	+	+	+	+
Import model	2.677**	–0.144***	+	–	+	+	–
Part 2: Diagnostic Statistics Export and Import in NARDL Model							
Export model	13.08***	–0.68***	+	+	+	+	+
Import model	4.28***	–0.44***	+	–	+	+	+

Note: ***, ** indicate significant at 1% and 5% levels respectively; +: Good; –: Bad.

The exchange rate is asymmetric in both the short term and long term. NARDL supports the minor impact of the exchange rate on exports. This result is similar to Khachatryan and Grigoryan (2020) in their research in Armenia, a developing country like Vietnam. Finally, the trade war had a vital impact on the trade balance between Vietnam and the U.S.

5. Conclusion

The U.S economy plays a vital role for the rest of the world, mainly for export–led growth countries like Vietnam. Vietnam's government profoundly understand the consequence if U.S government labels it a currency manipulater. This paper proves that the main reason why the trade surplus of Vietnam increases in recent times is because of the trade war between the U.S and China. As a result, the Biden administration should remove Vietnam from the country's list of currency manipulators.

Using the time-series data from 2010:1 to 2020:9, this paper also discovers the J curve, which is one of the most exciting topics in international economics, which takes place between two countries, reaching the same conclusion as Trinh (2014). However, there is a minor impact of the exchange rate on trade balance. This result suggests that Vietnamese policymakers should design suitable policy to stimulate exports. Besides, Vietnam's government should prioritize fiscal policy for increasing the added value of the export products. The customs should pay more attention to the enterprises victims of the faking C/O. Finally, the nonlinear models support the asymmetric relationship in short run and long run for exports and imports.

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