DUMLUPINAR ÜNİVERSİTESİ SOSYAL BİLİMLER DERGİSİ
DUMLUPINAR UNIVERSITY JOURNAL OF SOCIAL SCIENCES
E-ISSN: 2587-005X http://dergipark.gov.tr/dpusbe
Dumlupınar Üniversitesi Sosyal Bilimler Dergisi, 67, 271-280; 2021
DOI : 10.51290/dpusbe.835558

Araştırma Makalesi / Research Artıcle

INVESTIGATING THE ASYMMETRY IN TRADE BALANCE RESPONSE TO OIL PRICE CHANGES: EVIDENCE FROM CHINA

Ayşen SİVRİKAYA[1]

Abstract
Examining the relation between oil price changes and the trade balance is important for oil-importing countries to formulate policy solutions. This study contributes to the literature by examining the asymmetric effects of changes in oil prices on the trade balance of China, the world's largest crude oil importer. To this end, the Nonlinear Autoregressive Distributed Lag (NARDL) cointegration approach and Pesaran's Generalized Variance Decompositions technique are adopted. The results reveal that the trade balance responds asymmetrically to oil price changes in the long run, while the responses are symmetric in the short run. The Generalized Variance Decompositions results indicate that the trade balance is more sensitive to the oil price increases than to decreases. These results indicate that China should support energy-efficient systems to reduce its dependency on imported oil.
Keywords: Trade Balance, Oil Price, NARDL, China
JEL Codes: F1, Q43, C22

TİCARET DENGESİNİN PETROL FİYATLARINDAKİ DEĞİŞİKLİKLERE ASİMETRİK TEPKİSİ: ÇİN ÖRNEĞİ

Öz
Petrol fiyatlarındaki değişiklikler ile ticaret dengesi arasındaki ilişkinin incelenmesi, petrol ithal eden ülkelerde uygulanacak politikaların belirlenmesinde oldukça önemlidir. Bu çalışma, petrol fiyatlarındaki değişimlerin dünyanın en büyük ham petrol ithalatçısı olan Çin'in ticaret dengesi üzerindeki asimetrik etkilerini inceleyerek literatüre katkı sağlamaktadır. Bu amaçla, çalışmada Doğrusal Olmayan Dağıtılmış Gecikmeli Otoregresif eşbütünleşme yaklaşımı (NARDL) ve Pesaran'ın Genelleştirilmiş Varyans Ayrıştırma Yöntemi uygulanmaktadır. Elde edilen bulgular, uzun dönemde petrol fiyatı değişikliklerine karşı ticaret dengesinin asimetrik olarak tepki verdiğini, kısa dönemde ise tepkilerin simetrik olduğunu ortaya koymaktadır. Genelleştirilmiş Varyans Ayrıştırma Yöntemi sonuçları, ticaret dengesinin petrol fiyatı artışlarına, düşüşten daha duyarlı olduğunu göstermektedir. Bu sonuçlar, Çin'in ithal petrole bağımlılığını azaltmak için enerji-etkin sistemleri desteklemesi gerektiğini göstermektedir.
Anahtar Kelimeler: Ticaret Dengesi, Petrol Fiyatları, NARDL, Çin
JEL Kodları: F1, Q43, C22

[1] Assoc. Prof. Dr., Department of Economics, Hacettepe University, Turkey, ORCID*:* 0000-0003-2199-3593, aysens@hacettepe.edu.tr
Başvuru Tarihi (Received): 03.12.2020 **Kabul Tarihi** (Accepted): 27.01.2021

Introduction

The oil demand has been increasing in China in recent years as a result of the rapid industrialization, expansion of highways, and the increase in the number of privately owned motor vehicles. China is the second consumer of oil in the world ("International Energy Agency", 2020a). Even though China is one of the top producers of oil, it is also the world's largest crude oil importer ("International Energy Agency", 2020b). From 2009 to 2019, China's oil import dependency has risen from 50 % to 70 % ("O'Sullivan", 2019). It is expected that China's oil consumption is likely to increase further in the future, and the dependency on imported oil influences China's trade balance and makes it sensitive to the changes in oil prices.

After reaching a record level in 2007, China's trade surplus kept narrowing until recently, which was noted as 1.15 % in 2019. Because of the fall in oil prices due to the pandemic, it is expected that China's trade surplus is to be widened. Changes in oil prices affect the trade balance through two channels. First, a decrease in oil prices causes a fall in imports and lead to an improvement in the trade balance. Second, a decline in oil prices causes the exports of trading partner countries to fall and eventually results in a decrease in trade balance. It is important to identify which effect dominates in China's economy in order to suggest policy solutions towards increasing trade surplus and redesigning energy systems.

Despite its importance, the literature on the relationship between oil price and the trade balance is very limited. Gruber and Kamin (2006) examined the effect of oil price on the U.S. economy and concluded that a decrease in the imported oil price would reduce the current account deficit. Schubert (2014) investigated the effects of oil price shocks for a small open economy and found evidence that a change in oil price, first, leads to a deterioration in trade balance and an improvement afterward. There are also several studies focusing on developing economies. Özlale and Pekkurnaz (2010) examined the relation between oil price and current account balance in Turkey using an SVAR model and showed that oil price has a significant effect on the current account in the short run. Undertaking a similar analysis for Nigeria, Chuku et al. (2011) reached a similar conclusion. In a recent study, Yalta and Yalta (2017) analyzed the effect of oil price on Turkey's current account balance using a rolling window analysis and found that the responses of the current account deficit to the changes in oil prices are time-varying. By using a computable general equilibrium model and by evaluating the sectoral effects, Zaouali (2007) found that oil prices have modest effects on the current account. Ballı et al. (2020) analyzed the effects of oil demand and supply shocks on the trade balance in China by using a time-varying parameter vector autoregression (TVP-VAR) model and found that the effects of these shocks on trade balance changed substantially and the effects were maximized, especially during the crisis.

To the extent of our knowledge, there are few studies examining the nexus between oil price and trade balance in China. Understanding the relation between China's trade balance and oil prices is especially important during the current macroeconomic environment in which oil prices fell sharply due to the Covid-19 pandemic and change in energy markets structure.

This study contributes to the literature by analyzing the effect of oil price change on China's trade balance by performing a nonlinear Autoregressive Distributed Lag framework (henceforth NARDL) introduced by Shin et al. (2014). The NARDL allows one to separate the effects of a decrease and an increase in the oil price on trade balance. By using quarterly data for the period 1998:1 and 2016:1, the findings suggest that change in oil prices have asymmetric impacts on trade balance in China.

The remainder of the paper is organized as follows. The next section gives a brief explanation of China's trade balance and oil price changes over the period under consideration. The third section describes the econometric methodology and the data sources. This is followed by the presentation of empirical results. The final section provides a conclusion.

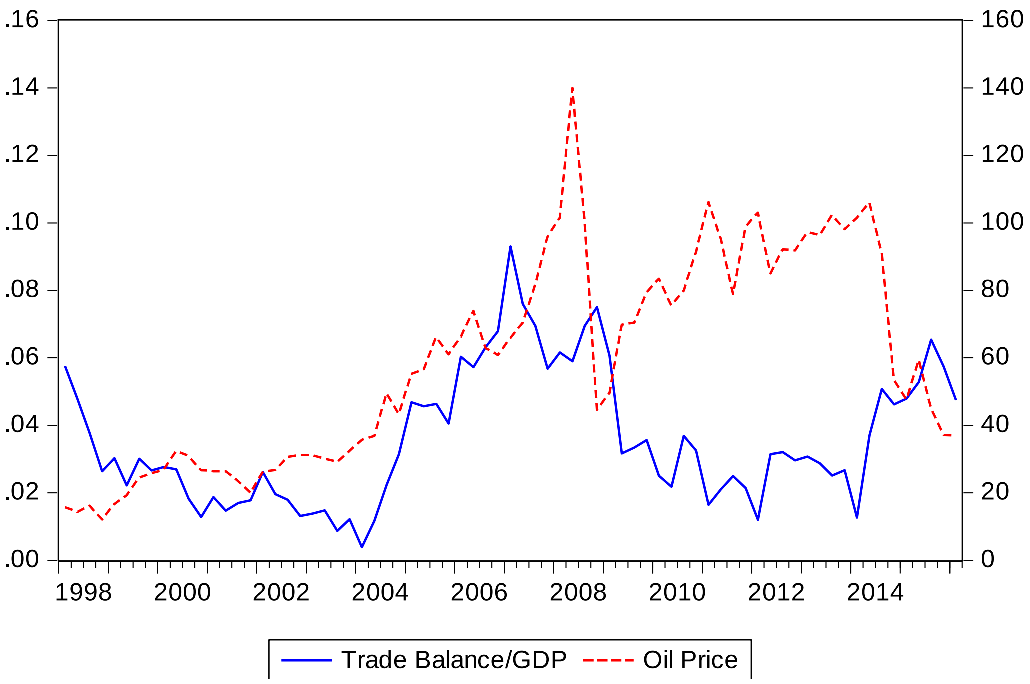
1. China's Trade Balance and Oil Price

In this section, the trends in the trade balance of China, as well as changes in oil prices are presented. Figure 1 illustrates China's trade balance to GDP ratio and indicates that the surplus was at its lowest levels before 2004. After China's membership to the World Trade Organization in 2001, China's trade surplus kept rising and reached a record level in 2007 as 8.68 % of GDP. Nevertheless, the great trade breakdown in 2008-2009 influenced China's trade balance negatively and the trade surplus decreased substantially to 4.31 % of GDP in 2009. The ratio of the trade balance to GDP has been around 1-2 percent in recent years.

Oil prices have always been volatile, as shown in Figure 1. After a peak in 2008, prices decreased drastically due to economic activity contraction driven by the global financial crises. After the recovery in world demand, oil prices began to increase again. However, an excess of oil production in 2014 caused oil prices to decrease.

The figure also illustrates that China's trade balance's response to an increase and a decrease in oil prices may be different. Therefore, in the next section, we aim to analyze this asymmetric relationship between trade balance and oil prices.

Figure 1: *China's Trade Balance and Oil Price*



2. Econometric Methodology and Data

The majority of the previous studies have applied techniques for testing the relationship between oil price and the trade balance based on the assumption that the trade balance responds symmetrically to the changes in oil price. However, the responses may be asymmetric. This study applies the NARDL cointegration approach, introduced in Shin et al. (2014). This approach allows one to separately examine the effects of a decrease and increase in the oil prices on the trade balance.

We use the model given in Eq. 1.

$$\ln TB_t = \alpha_0 + \alpha_1 \ln Y_t^{China} + \alpha_2 \ln Y_t^{OECD} + \alpha_3 \ln REX_t + \alpha_4 \mathrm{POZ}_t + \alpha_5 \mathrm{NEG}_t + \varepsilon_t \quad (1)$$

In here, ln represents the natural logarithm. We use quarterly data covering the period 1998:1-2016:1. TB is the real trade balance of China. Y_t^{China} and Y_t^{OECD} denote China's and the OECD countries' real GDPs, respectively. TB and Y_t^{China} are acquired from the National Bureau of Statistics of China while Y_t^{OECD} from OECD Statistics. REX is the real effective exchange rate between China and OECD, obtained from IMF-International Financial Statistics (IFS). Oil prices data is sourced to the Energy Information Administration (EIA) of the U.S. Department of Energy (DoE). All series are seasonally adjusted using the TRAMO/SEATS procedure.

The oil price changes are decomposed as positive and negative changes as follows:

$$\begin{aligned} \mathrm{POZ}_t &= \sum_{j=1}^{t} \Delta \ln OIL_t^{+} = \sum_{j=1}^{t} \max(\ln OIL_{i,j}, 0) \\ NEG_t &= \sum_{j=1}^{t} \Delta \ln OIL_t^{-} = \sum_{j=1}^{t} \min(\ln OIL_{i,j}, 0) \end{aligned} \quad (2)$$

The estimates of α_1 and α_2 are expected to have either a positive or negative sign. If higher economic growth increases imports, α_1 can be positive. However, in case that the higher growth is because of an increase in the production of substitute goods, imports fall, hence, α_1 is negative. The sign of α_2 is subject to a similar approach from outside of the country. The estimate of α_3 is expected to have a positive sign for the evidence validating the J-curve hypothesis. J-curve hypothesis postulates that a country's trade balance worsens in a short time after a currency depreciation but improves in the long-run.

The long run bilateral trade model is extended to the NARDL model as in Eq.3:

$$\begin{aligned} \Delta \ln TB_t = \alpha &+ \sum_{j=1}^{p1} \beta_j \Delta \ln TB_{t-j} + \sum_{j=0}^{p2} \gamma_j \Delta \ln Y_{t-j}^{China} + \sum_{j=0}^{p3} \delta_j \Delta \ln Y_{t-j}^{OECD} \\ &+ \sum_{j=0}^{p4} \pi_j^{+} \Delta \ln REX_{t-j} + \sum_{j=0}^{p5} \theta_j^{+} \Delta \mathrm{POZ}_t + \sum_{j=0}^{p6} \theta_j^{-} \Delta \mathrm{NEG}_t \\ &+ \mu_1 \ln Y_{t-1}^{China} + \mu_2 \ln Y_{t-1}^{OECD} + \mu_3 \ln REX_{i,t-1} + \mu_4 \mathrm{POZ}_{t-1} + \mu_5 NEG_{t-1} + \epsilon_t \end{aligned} \quad (3)$$

The Bounds Testing Procedure (henceforth, BTP) is applied to the NARDL models to test for the existence of a long run cointegrating relationship among variables. BTP relies on the assumption that the regressors are either integrated of order zero or one and uses Wald or F-statistics to test the null hypothesis of no cointegration, which is given by $\mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5 = 0$ in Eq. 3. The critical values are tabulated for the lower bound and the upper bound by Pesaran et al. (2001) given the number of regressors and conventional significance levels. In case the computed F statistic is smaller than the related lower bound, the null hypothesis cannot be rejected. If it is between lower and upper bounds, the finding is inconclusive for the existence of cointegration. As long as the computed statistic is bigger than the upper bound, the decision can be made in favor of cointegration.

We, then, investigate whether or not the responses of the trade balance to oil price changes are asymmetric in the short run. For this, we test the null hypothesis of $\sum_{j=0}^{p5} \theta_j^{+} = \sum_{j=0}^{p6} \theta_j^{-}$ in Eq. 3, as proposed in Shin et al. (2014). We use a similar approach to investigate the long run asymmetry. In particular, the estimates of Eq. 1 are used for the null hypothesis of $\alpha_4 = \alpha_5$.

We use the error correction model given in Eq. 4 to capture the short run and long run dynamics. In case all the variables in level are integrated of order one, their first differences are used in the error correction model. Error correction term (EC) is the estimated residuals of the long run trade model given in Eq. 1. If a cointegration exists between the variables, the residual of the long run model becomes a stationary variable. Therefore, the ordinary least square method can perform well to estimate the error correction model. EC in Eq. 4 measures the adjustment speed of the long run equilibrium in each period. It is supposed to be significant and negative for disequilibrium to dissipate.

$$\begin{aligned}\Delta \ln TB_t = \alpha + \beta\Delta \ln TB_{t-j} + \gamma\Delta \ln Y_{t-j}^{China} + \delta\Delta \ln Y_{t-j}^{OECD} + \pi\,\Delta \ln REX_{t-j} \\ + \theta^{-}\Delta\mathrm{NEG}_t + \theta^{+}\Delta\mathrm{POZ}_t + \varphi EC_{t-1} + \epsilon_t\end{aligned} \tag{4}$$

It also is insightful to find the size and order impact of shocks in oil prices, income, and exchange rates on the trade balance of China. A shock in one of these variables will have an impact on any other variable in Eq. 3, and vice versa. Technically, the importance of a variable in the determination of a variation in another variable is usually sensitive to the order of the variables entering a VAR system. However, the generalized approach of Pesaran and Shin (1998) overcome the ordering problem. Thus, we will be utilizing this approach to calculate variance decomposition for innovations in oil prices, income, and exchange rates on China's trade balance.

3. Empirical Results

This study investigates the long run and short run relationship between oil price and the trade balance for the case of China. To start, we focus on the long run relationship between them and apply BTP to the NARDL model given in Eq. 3. However, the orders of the integration of the time series used in the long run trade model given in Eq. 1 must be identified since BTP can be applied if the series or their first difference series are stationary. For this, we use the Augmented Dickey-Fuller Unit Root Test (ADF). The results show that all series are either I(0) or I(1).

Table 1: *ADF Unit Root Tests Results*

Variables	Level	In first difference
$\ln TB_t$	-1.385	-10.551***
$\ln Y_t^{China}$	-0.093	-4.283***
$\ln Y_t^{OECD}$	-1.478	-4.168***
$\ln REX_t$	0.416	-5.616***
POZ_t	-6.772***	
NEG_t	-9.158***	

*Notes: TB is the real trade balance of China. Y_t^{China} and Y_t^{OECD} denote China's and the OECD countries' real GDPs, respectively. REX is the real effective exchange rate between China and OECD. The oil price changes are decomposed as positive and negative changes and they are defined as POZ and NEG, respectively. We use the natural logarithm (ln) of the variables. The regression models for the ADF tests include an intercept. *, **, and *** denote significance levels at 10%, 5%, and 1%, respectively.*

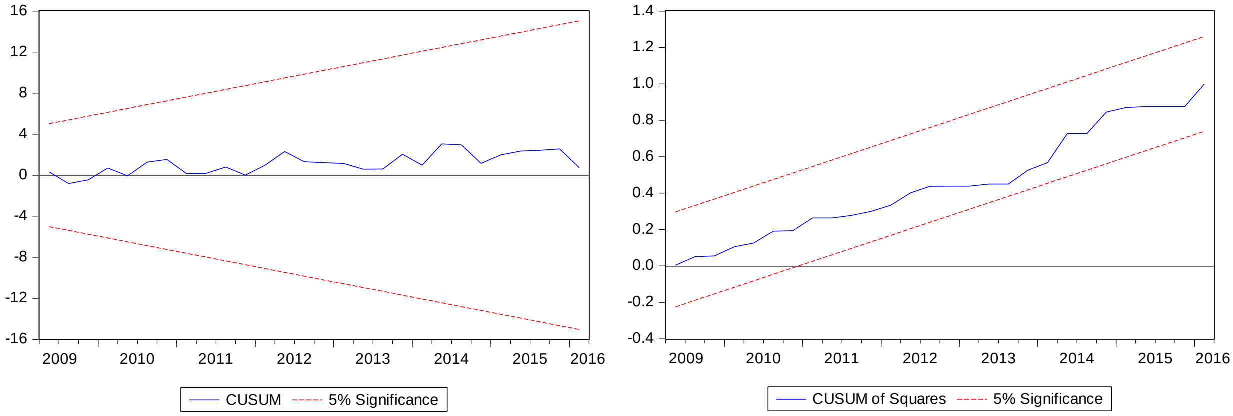
Next, the NARDL model is estimated by imposing a maximum of six lags on each first differenced variable. Panel A of Table 2 reports the estimation results of the optimal NARDL model. The diagnostic statistics of the estimated NARDL model are given in Panel B of Table 2. The estimated coefficients of the NARDL models are stable according to the results of $CUSUM$ and $CUSUM^2$ tests, whose plots are given in Figure 2. Breusch-Godfrey Serial Correlation LM statistic is insignificant. That is, the estimated residuals are not auto-correlated. We also apply the ARCH LM test to investigate whether or not the residuals are heteroscedastic. The null hypothesis of no ARCH effect up to order 1 cannot be rejected. This result suggests that the residuals are not heteroscedastic. To report the goodness of fit, the Adj. R^2 statistic is also given in the table.

Table 2: *NARDL Model Estimates and F-stat for BTP*

Panel A							
Lags (j)	**0**	**1**	**2**	**3**	**4**	**5**	**6**
$\Delta \ln TB_t$		-0.432**	-0.013	-0.192			
$\Delta \ln Y_{t-j}^{China}$	6.879	-19.039***	-8.012	1.713	-10.388**	-6.745	
$\Delta \ln Y_{t-j}^{OECD}$	7.178	-5.0382	25.299	2.320	11.572	56.151***	-38.926***
$\Delta \ln REX_{t-j}$	-0.301	4.818	18.208	-1.264	9.452**	0.939	12.092***
ΔPOZ_{t-j}	3.185***	1.942	2.312***	3.979***	2.445***		
ΔNEG_{t-j}	-2.140***	-0.152	1.002	-2.140			
$\ln TB_t$		-0.285					
$\ln Y_{t-j}^{China}$		1.568					
$\ln Y_{t-j}^{OECD}$		-1.972					
$\ln REX_{t-j}$		-8.288					
POZ_{t-j}		1.262					
NEG_{t-j}		-2.264					
Panel B							
Diagnostic Statistics:	$CUSUM$	$CUSUM^2$	**LM Test**	**ARCH(1)**	**Adj. R^2**		
	Stable	Stable	1.360	0.395	0.525		
F-stat:	3.50						

*Notes: TB is the real trade balance of China. Y_t^{China} and Y_t^{OECD} denote China's and the OECD countries' real GDPs, respectively. REX is the real effective exchange rate between China and OECD. The oil price changes are decomposed as positive and negative changes and they are defined as POZ and NEG, respectively. We use the natural logarithm (ln) of the variables. Δ represents the first difference of a variable. The optimal lag in the NARDL model is selected using the Akaike Information Criterion. *, ** and *** denote significance at 10%, 5%, and 1% levels, respectively.*

Figure 2: *$CUSUM$ and $CUSUM^2$ Tests for The NARDL Model*



After verifying the order of the series and estimating the NARL model, we can carry on BTP to investigate the long run relationship between oil price changes and trade balance. BTP uses the familiar F-test to test the null hypothesis of no cointegration. The NARDL model in this study has five exogenous variables, namely lnY_t^{China}, lnY_t^{OECD}, $lnREX$, POZ, and NEG. We incorporate an unrestricted intercept into the model. According to the table given in Pesaran et al. (2001), the critical values are 2.26 and 3.35 for such a model at 10 % significance level. The null hypothesis of no cointegration can be rejected when the computed F-stat exceeds the upper bound. Since its value is 3.50, it is concluded that the variables under investigation are cointegrated.

As a next step, the estimates of the NARDL model are utilized to investigate whether the trade balance responds differently to a decrease or increase in oil price. We establish the null hypothesis of symmetry as the equality of the sum of the coefficients of positive oil price changes and the sum of the coefficients of negative oil price changes in the NARDL models. The rejection of the null hypothesis indicates asymmetric responses of the trade balance to oil price changes in the short run. To test the null hypothesis, we apply the Wald test, whose statistic is 1.688 and insignificant. This finding suggests that there is no asymmetry in the short run.

Once we establish the cointegration relationship among the variables, we estimate the long run trade model. Panel A of Table 3 presents its coefficient estimates. First of all, the coefficient of OECD countries' GDP is positive and significant, as expected. On the other hand, the coefficient of China's GDP is positive but insignificant. The coefficient of the reel effective exchange rate on the trade balance is positive but insignificant. This finding is inconclusive for the validity of the J-curve hypothesis.

Table 3: *The Long Run Trade Model and Error Correction Model Estimates*

Panel A: Long run trade model		**Panel B: Error correction model estimates**	
Variable	**Coefficient**	**Variable**	**Coefficient**
Constant	-124.428	**Constant**	-0.029
$\ln \boldsymbol{Y_t^{China}}$	0.271	$\Delta \ln \boldsymbol{Y_t^{China}}$	1.871
$\ln \boldsymbol{Y_t^{OECD}}$	7.328***	$\Delta \ln \boldsymbol{Y_t^{OECD}}$	0.808
$\ln \boldsymbol{REX_t}$	0.477	$\Delta \ln \boldsymbol{REX_t}$	0.005
$\boldsymbol{POZ_t}$	1.773**	$\Delta \boldsymbol{POZ_t}$	1.145***
$\boldsymbol{NEG_t}$	-1.643***	$\Delta \boldsymbol{NEG_t}$	-0.786**
		$\boldsymbol{ECT_{t-1}}$	-0.320***
Adj. $\boldsymbol{R^2}$	**0.745**	**Adj.** $\boldsymbol{R^2}$	0.274

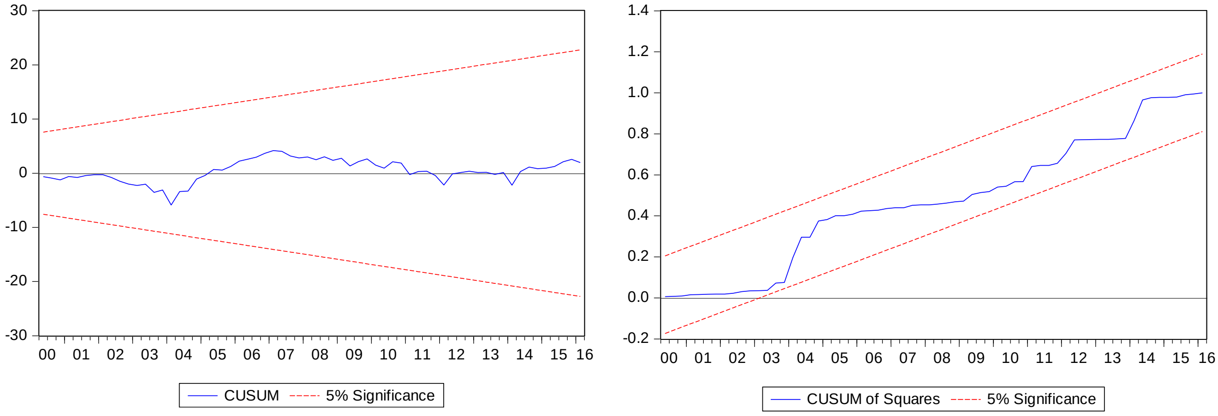
*Notes: TB is the real trade balance of China. Y_t^{China} and Y_t^{OECD} denote China's and the OECD countries' real GDPs, respectively. REX is the real effective exchange rate between China and OECD. The oil price changes are decomposed as positive and negative changes and they are defined as POZ and NEG, respectively. We use the natural logarithm ($\ln$) of the variables. Δ represents the first difference of a variable. ECT is the error correction term of the estimated error correction model. *, ** and *** denote significance at 10%, 5%, and 1% levels, respectively.*

As can be seen in Table 3, the coefficients of positive and negative oil price changes are significant and have opposite signs. Particularly, an increase in oil prices has a positive effect on the trade balance while a decrease in oil price has a negative effect on it. In other words, the changes in oil price affect the trade balance in the same way. But the magnitude is greater in the case of an increase. This may be because imports volume can be cut when the oil price gets higher but it cannot be increased when the oil price decreases. This can happen when the production capacity is limited to an extent. We also want to statically examine whether trade balance responds asymmetrically to positive and negative changes in the oil prices in the long run. For this purpose, we use the Wald test, whose result (9.272^{***}) shows that there is a long run asymmetry.

We, then, estimate the error correction model, using the differenced variables and the lagged residual obtained from the long run trade model. The parameter estimates can be seen in Panel B of Table 3. The estimated coefficient of error correction term is negative and significant, indicating the convergence to long run equilibrium. The value of the error correction term implies that 32 % of a deviation from a long run equilibrium can be adjusted after one quarter. The coefficients of an increase and a decrease in the oil price are significant and have opposite signs. Thus, as in the long run, increasing and decreasing oil price changes affect the trade balance in the same way.

We conduct several diagnostic tests to make sure that the error correction model does not suffer from the problems of parameter instability, autocorrelation, and heteroscedasticity. Given in Figure 3, the results of $CUSUM$ and $CUSUM^2$ tests suggest parameter stability. With the value of 0.780, the Breusch-Godfrey Serial Correlation LM statistic is insignificant, indicating that there is no autocorrelation in the estimated residuals. LM statistics of the ARCH test is 0.649, which implies that there is no ARCH effect in the residuals.

Figure 3: *$CUSUM$ and $CUSUM^2$ Tests for the Error Correction Model*



The shocks in exchange rates, oil prices, national and OECD countries' GDP may also generate variations in the trade balance of China. The impacts are calculated by utilizing the generalized variance decomposition technique and the results are tabulated in Table 4. The findings indicate that the initial impact of negative oil prices on the trade balance is higher than any other variables in the VAR system. This finding is consistent with Killian et al. (2009), who estimated that oil price changes explain 89 percent of the fluctuations in the current account for oil-exporting countries. The percentage is lower for the case of oil-importing countries.

After the initial impact, the positive values of oil price changes take the lead and accounts for 7.7 % of variation in trade balance while the negative values account for 4.3 % of variation. Even though there is a limited increase in the impact of negative values, the positive values of oil price changes account for the 11 % variation in the sixth horizon and remain unchanged afterward.

Table 4: *Generalized Variance Decomposition Results*

Horizon	$\Delta \ln TB$	$\Delta \ln Y^{China}$	$\Delta \ln Y^{OECD}$	$\Delta \ln REX$	ΔPOZ	ΔNEG
0	1.0000	0.0001	0.0033	0.0086	0.0125	0.0369
1	0.9300	0.0046	0.0032	0.0275	0.0740	0.0437
2	0.8945	0.0047	0.0162	0.0302	0.1041	0.0541
3	0.8829	0.0057	0.0174	0.0299	0.1070	0.0550
4	0.8783	0.0059	0.0177	0.0298	0.1097	0.0547
5	0.8757	0.0059	0.0181	0.0300	0.1097	0.0554
6	0.8748	0.0061	0.0181	0.0299	0.1100	0.0554
7	0.8743	0.0061	0.0181	0.0300	0.1100	0.0555
8	0.8741	0.0061	0.0181	0.0300	0.1101	0.0555
9	0.8741	0.0061	0.0181	0.0300	0.1101	0.0556
10	0.8740	0.0061	0.0181	0.0300	0.1101	0.0556

Note: TB is the real trade balance of China. Y_t^{China} and Y_t^{OECD} denote China's and the OECD countries' real GDPs, respectively. REX is the real effective exchange rate between China and OECD. The oil price changes are decomposed as positive and negative changes and they are defined as POZ and NEG, respectively. We use the natural logarithm ($\ln$) of the variables. Δ represents the first difference of a variable.

4. Conclusion

China's imported oil dependency has been increasing in recent years, putting a pressure on its trade balance. Therefore, it is worth analyzing the effect of oil prices on China's trade balance. This paper contributes to the literature by examining the asymmetric effects of changes in oil prices on the trade balance of China. We use the nonlinear ARDL framework, which enables us to separately examine the responses of the trade balance to an increase and decrease in oil prices. The results indicate that the trade balance responds asymmetrically to the changes in oil price in the long run, while there is no asymmetry in the short run. This finding has several implications. First of all, China should redesign its energy policies especially related with renewable energy sources. Moreover, China should support energy efficient systems in order to reduce its oil demand.

On the other hand, variance decomposition analyses indicate that both positive and negative changes in oil prices are important in the variation of the trade balance. However, the trade balance is more sensitive to the oil price increases than to decreases, as the positive values account for more variation in the trade balance than any other variables in the VAR system. One interesting finding is that oil prices might be a more efficient balancing factor in trade balance than national and developed countries' income innovations. Investment in domestic energy resources, including renewables such as wind and solar, would have a balancing effect on the trade balance, since China is a key actor in the international energy market, not only as a producer but also as a major importer. Therefore, China's policymakers should closely follow the innovation in oil prices.

References

Ballı, E., Atık, A. N., & Nugent, J. B. (2020). Time-varying impact of oil shocks on trade balances: evidence using the TVP-VAR model. *Energy*, 119377. https://doi.org/10.1016/j.energy.2020.119377

Chuku, A., Usenobong, A., Ndifreke, R., & Ekpeno, L. (2011). Oil price shocks and the dynamics of the current account balances in Nigeria. *OPEC Energy Review, 35 (2)*, 119–139. https://doi.org/10.1111/j.1753-0237.2011.00186.x

Gruber J. W., & Kamin, S. B. (2007). Explaining the global pattern of current account imbalances. *J. Int. Money Finance, 26*, 500–522. https://doi.org/10.1016/j.jimonfin.2007.03.003

International Energy Agency, 2020a. (2020, 9th December) Retrieved from https://www.eia.gov/tools/faqs/faq.php?id=709&t=6

International Energy Agency, 2020b. (2020, 9th December) Retrieved from https://www.eia.gov/todayinenergy/detail.php?id=43216#:~:text=China%20remains%20the%20world's%20top,crude%20oil%20imports%20in%202019

Killian L., Repucci A., & Spatafora, N. (2009). Oil shocks and external balances. *J. Int. Econ, 77*, 181–194. https://doi.org/10.1016/j.jinteco.2009.01.001

Özlale U., Pekkurnaz D. (2010). Oil prices and current account: A structural analysis for the Turkish economy. *Energy Policy, 38*, 4489–4496. https://doi.org/10.1016/j.enpol.2010.03.082

Pesaran, M. H., & Shin, Y. (1998). Generalized impulse response analysis in linear multivariate models. *Economics Letters*, *58*, 17-29. https://doi.org/10.1016/S0165-1765(97)00214-0

Pesaran, M. H., Shin, Y., & Smit, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics, 16,* 289-326. https://doi.org/10.1002/jae.616

Schubert, S. F. (2014). Dynamic effects of oil price shocks and their impact on the current account. *Macroecon Dyn, 18*, 316–337. https://doi.org/10.1017/S1365100512000405

Shin, Y, Yu, B, & Greenwood-Nimmo, M. (2014). Modelling asymmetric cointegration and dynamic multipliers in a nonlinear ARDL framework. In W. Horrace & R. Sickles (Eds.), *The Festschrift in Honor of Peter Schmidt.: Econometric Methods and Applications* (pp. 281-314). New York: Springer. https://doi.org/10.1007/978-1-4899-8008-3__9

O'Sullivan, S. (2019). China: Growing import volumes of LNG highlight China's rising energy import dependency. Oxford Institute for Energy Studies. Retrieved from https://www.oxfordenergy.org/wpcms/wp-content/uploads/2019/06/China-growing-import-volumes-of-LNG-highlight-China%E2%80%99s-rising-energy-import-dependency.pdf

Yalta, A. Y., & Yalta, A. T. (2017). Dependency on imported oil and its effects on current account. *Energy Sources, Part B: Economics, Planning, and Policy, 12(10)*, 859-867. https://doi.org/10.1080/15567249.2017.1315753

Zaouali, S. 2007. Impact of higher oil prices on the Chinese economy. *OPEC Rev., 31*, 191–214. https://doi.org/10.1111/j.1468-0076.2007.00183.x