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The Prominence of USD/CNY in China-EU and China-UK Trade*

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Abstract

Despite the dominance of the USD as a vehicle currency in non-US trade, most studies on the exchange rate-trade balance relationship ignore its importance. Some recent J-curve papers have proved that incorporating the role of USD as vehicle currency as a crucial determinant of trade balance can well reflect the reality of global trade and provide more detailed findings. Motivated by this new approach and by the fact that USD is substantially used in the trade between China and the EU and the UK, this paper scrutinizes how the vehicle currency USD and the bilateral exchange rates asymmetrically affect China's trade balance with each EU country and the UK. The results of NARDL estimation indicate that the USD models outperform the bilateral exchange rate (BER) models in terms of detecting significant long-run and short-run coefficients, which confirms the usefulness of the new approach. Also, this paper finds that the USD/CNY exchange rate cannot be neglected in China's trade with the EU and the UK, which can supplement China's policies on international trade and foreign exchange management.

Keywords: China, EU, Exchange Rate, J-curve, NARDL, UK, Vehicle Currency

JEL Classification Code: F10, F31, F40

1. Introduction

Being the world's second-largest economy as well as top exporter, China is usually spotlighted in global trade (The World Bank, 2020; UNCTAD, 2021). Namely, in 2008, China surpassed Germany to become the largest exporting country occupying around 9% of the world's total exports. Since then, China has always maintained the leading position, and the gap between China and the runner-up has been substantially widened. Specifically, in 2008, the gap between China and Germany (the runner-up) was only 0.1%. However, in 2020, while China held 14.7% of the global exports, the share of the US (the runner-up) was only 8.1%, and thus, the gap between them was 6.6% (UNCTAD, 2021). It can be inferred from the above-mentioned statistics that China performs very well in exportation, which strongly contributes to her huge trade balance surplus. In fact, China is the country with the highest trade balance surplus, and in contrast, the US has the largest trade balance deficit.

The relationship between China's exchange rate movement and huge trade balance surplus has been an interesting topic of numerous studies (Abbas et al., 2020). Most of them focus on the trade of China with the US, possibly because the US is the largest economy in the world and had long been the largest trading partner of China. Particularly, in the period 2000Q1–2018Q1, the US was the largest trading partner holding nearly 13.53% of China's total trade value. Moreover, the recent China-US trade war has drawn much attention of researchers to the connection between the USD/CNY exchange rate and the enormous trade balance surplus of China with the US. In fact, one of

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the notable disputes in the trade war is whether China has deliberately kept CNY undervalued against the USD to gain unfair competitiveness in exportation, and in 2019, China was labeled "currency manipulator" by the US (Liu & Woo, 2018; U.S. Department of the Treasury, 2019). A considerable number of studies reported advocating results: the depreciation of CNY against USD facilitated China's trade balance with the US (Bahmani-Oskooee & Wang, 2006; Wang et al., 2012; Bahmani-Oskooee et al., 2018; Hunter, 2019). Meanwhile, some other papers such as Wang et al. (2012) demonstrated no effect of CNY depreciation on China's trade balance with the US. Hence, controversy still exists and the role of the exchange rate USD/CNY in China-US trade will continue to be examined by many researchers.

Although the EU is now the largest trading partner of China (European Commission, 2021), the China-EU trade has not been investigated as much as the China-US trade. In the period 2000Q1–2018Q1, the EU was the second-largest trading partner of China, occupying roughly 13.33% of China's total trade value. Hence, compared to the share of the US in China's international trade (i.e., 13.53%), the gap between the EU and the US was not so considerable. Furthermore, since the first quarter of 2019, the EU has outperformed the US to become the largest trading partner of China. Therefore, the importance of the EU as the major trading partner of China is approximately comparable to the US, which is clearly depicted in Figure 1. Nevertheless, it seems that the existing literature has not given enough concentration on the role of the exchange rate in China-EU trade. In fact, even though a few studies such as Bahmani-Oskooee and Wang (2006), Wang et al. (2012), and Bahmani-Oskooee et al. (2018) covered the exchange rate-trade balance nexus in China's trade with some EU members (i.e., Belgium, France, Germany, Italy, the Netherlands, and Spain) as well as the UK, the whole China-EU trade has not been sufficiently investigated. Hence, this can be deemed an empirical research gap, given (i) the prominence of the EU as China's largest trading partner, (ii) the role of the EU as the potential alternative destination for China's exports in the circumstance of China-US trade war (Li et al., 2018), and (iii) the future long-term China-EU relationship focusing on the EU-China Investment Agreement (European Commission, 2021). Thus, a thorough analysis of China-EU trade is worth conducting.

The vast majority of existing studies overlooked the role of vehicle currency in the trade between non-US countries. This neglect not only fails to capture the real situation of global trade where USD is the dominant vehicle currency but also hinders meticulous findings (Boz et al., 2020; Bao & Le, 2021b). Yang and Gu (2016) was presumably the first research to recognize the importance of USD as a vehicle currency in the trade between China and Singapore. They discovered that USD had significant effects on China's exportation and importation with Singapore. Apart from Yang and Gu (2016), hardly any paper has raised the question: how does the vehicle currency USD impact China's trade balance with non-US partners? This question is very noticeable when China has long pegged CNY to USD, and the exchange rate USD/CNY is always at the center of China's international trade. Thus, besides the China-US trade which has been intensively examined by many studies, the exchange rate USD/CNY can also influence China's trade with other partners such as EU countries because USD has long been substantially employed as a vehicle currency by both China and the EU (Dobson & Masson, 2009; Ito & Chinn, 2014;

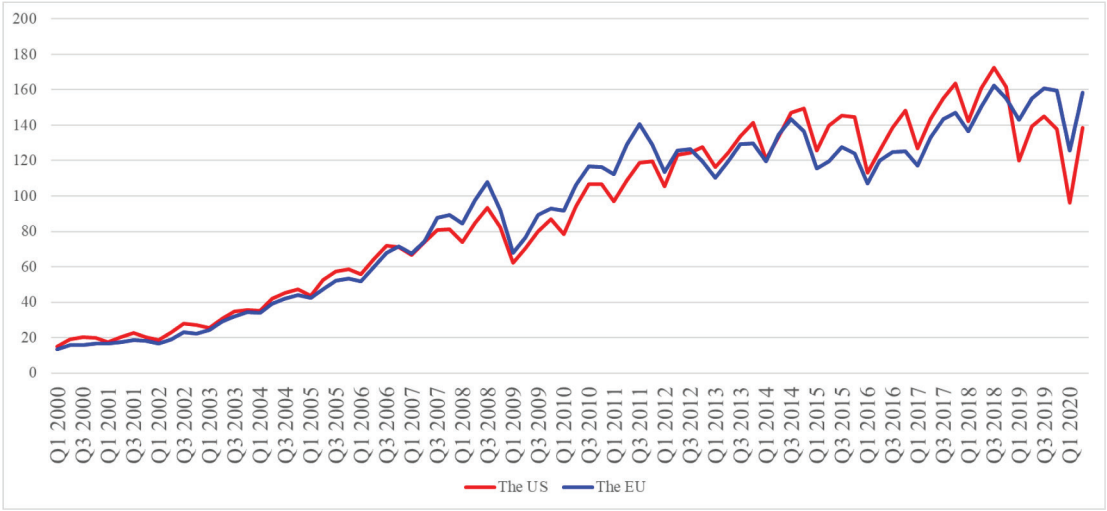

Figure 1: The Total Trade Value of China with the US and the EU (Billion USD)

Lai & Yu, 2015; Eurostat, 2021). Hence, investigating how USD/CNY affects China's trade balance with EU countries is a new approach, yet no research has focused on this issue.

The objective of this paper is to explore how the vehicle currency USD, reflected by the exchange rate USD/CNY, impacts China's trade balance with 27 EU members and the UK. In addition, the roles of bilateral exchange rates are also examined.

This paper can contribute to the literature from several perspectives. First, it applies a new approach that captures the importance of USD as a vehicle currency in China's bilateral trade with 27 EU members and the UK, which has not been covered by any study. In fact, this paper is also the first to scrutinize the trade between China and each of the EU countries and the UK. Second, this paper captures the facts that the EU is now China's largest trading partner, and the vehicle currency USD has been strongly used by China, the EU, and the UK. Third, by inspecting the nonlinear effects of USD/CNY on China's trade balance with all EU countries and the UK, the findings of this paper can provide useful information to supplement China's management of international trade and foreign exchange. Namely, the exchange rate USD/CNY not only impacts China's trade balance with the US but also with different partners. As China is likely to let CNY appreciate against USD in the near future (Yeung, 2020; Bloomberg, 2021), China's trade balance with the US may be reduced, but China's trade balance with other partners such as the EU countries and the UK can be enhanced. Also, in the current China-US trade war and the long-term China-EU relationship, the EU is considered a potential market that China can focus on to lower the reliance on the US. Consequently, knowing the positive as well as negative impacts of the USD/CNY exchange rate, especially when CNY appreciates against the USD, on China's bilateral trade balance with EU countries can be very helpful for policy-makers.

2. Literature Review

Since the introduction of the J-curve effect by Magee (1973), most studies have analyzed the direct linkage between exchange rate and trade balance instead of estimating the export and import functions to check the presence of Marshall-Lerner condition like many early papers did (Purwono et al., 2018). As China is among the top traders in the world, a large number of studies have been dedicated to China. Early papers examined the impacts of a real effective exchange rate on China's trade balance at an aggregate level. For instance, Brada et al. (1993), Weixian (1999), and Zhang (1999) reported that the depreciation of CNY facilitated China's total trade balance with the rest of the world. They assumed a linear connection between the exchange rate and the trade balance (i.e., the impact of a 1% depreciation of CNY on China's trade balance is similar to that of a 1% appreciation). Nevertheless, Bahmani-Oskooee and Fariditavana (2015) argued that the exchange rate could asymmetrically affect the trade balance. In fact, they reported that the asymmetric influences of exchange rate on trade balance were found in all countries in their sample including Canada, China, Japan, and the US. Moreover, they indicated that the NARDL method detected more significant results than the conventional ARDL method.

Besides the papers inspecting China's overall trade with the rest of the world, later studies focused on China's bilateral trade with main trading partners to enable more detailed findings as well as reduce aggregation bias. For example, Bahmani-Oskooee and Wang (2006) investigated the bilateral trade of China with 13 large trading partners including Australia, Belgium, Canada, France, Germany, Hong Kong, Italy, Japan, Netherlands, Singapore, Thailand, the UK, and the US over the 1983Q1–2002Q1 period by using ARDL and Johansen cointegration methods. They found that the depreciation of CNY against the currencies of Australia, France, and the US respectively stimulated China's trade balance with these countries. Moreover, for the trade balance of China with the partners from the EU (i.e., Belgium, Italy, and the Netherlands) and the UK, they reported no effects of bilateral exchange rates in the long run. Narayan (2006) relied on the ARDL approach and the monthly data between 1979M11 and 2002M9 to analyze China's trade balance with the US, which documented the positive impact of CNY depreciation in both the short run and long run. Wang et al. (2012) employed the FMOLS estimator and panel cointegration technique to examine the bilateral trade between China and 18 partners in the period 2005M8–2009M9. They demonstrated that CNY depreciation improved China's trade balance with Japan, the UK, and the US in the long run, but reduced China's trade balance with Brazil, Germany, Italy, the Netherlands, and Russia. Furthermore, their findings suggested that China might hinder CNY's appreciation to support her trade balance, especially with large partners such as the US and Japan. Noticeably, recognizing the limitation of studies assuming a linear connection between exchange rate and trade balance, Bahmani-Oskooee et al. (2018) used the strength of the NARDL method to examine the asymmetrical impacts of bilateral exchange rates on China's trade balance with 21 major partners from 2000Q1 to 2015Q4. They reported that the NARDL method was better than the ARDL counterpart in terms of detecting more significant results. Further, their findings indicated strong evidence for the nonlinear linkage between bilateral exchange rates and China's trade balance, especially in the short run. In addition, they documented that the depreciation of CNY encouraged China's trade balance with France, Spain, and the US in the long run, while the cases of the Netherlands and the UK showed no impact. Hunter (2019) applied the NARDL method and supported the J-curve effect in China's bilateral trade with Hong Kong, Japan, and the US over the

period 1986Q1–2014Q4, which reinforced the superiority of NARDL over the ARDL method in terms of providing more evidence for the J-curve phenomenon.

Virtually all the J-curve studies about the EU countries and the UK were devoted to their intra-regional trade or their trade with the US. Thus, the role of China as a major trading partner of the EU and the UK has been usually neglected. In fact, only a few published articles examined the trade of EU countries and the UK with respect to China. For instance, Bahmani-Oskooee and Zhang (2013) investigated the trade between the UK and China in 47 industries during 1978–2010 by the ARDL method. They discovered that the exchange rate between GBP and CNY had significant short-run effects on the UK's trade balance with China in the majority of industries. Moreover, in the long run, the depreciation of GBP against CNY fostered the UK's trade balance with China in only 7 industries. Besides, Bahmani-Oskooee and Zhang (2014) did not focus on the J-curve effect when they revisited the UK-China trade in the same 47 industries to investigate the role of exchange rate risk. Recently, recognizing the role of China as the third-largest trading partner of the UK, Bahmani-Oskooee and Karamelikli (2021) re-examined the trade between the UK and China in 68 industries from 2010M1 to 2018M12 by using both ARDL and NARDL methods. The results showed more significant short-run and long-run impacts of GBP/CNY on the UK's trade balance. Also, more J-curve cases were detected thanks to the NARDL method, thus confirming its superiority over the ARDL counterpart.

Most of the existing studies about the relationship between exchange rate and trade balance overlook the role of USD as the most used vehicle currency in global trade. For the case of China, Yang and Gu (2016) was presumably the first research to analyze the role of the USD as a vehicle currency in China's bilateral trade with Singapore. They documented that when SGD or CNY depreciates against the USD, China's exports were reduced in the period 1993M1–2013M12. Meanwhile, China's imports were also discouraged, but to a higher degree. Since the work of Yang and Gu (2016), it seems that no paper covering the role of USD as a vehicle currency in China's trade with her partners has been published. For the cases of other developing countries, some recent studies have acknowledged the importance of USD as the major vehicle currency. Namely, Bao and Le (2021a) disclosed that while the real effective exchange rate between the currencies of ASEAN (Association of Southeast Asian Nations) and the EU did not affect ASEAN's trade balance with the entire EU, the vehicle currency USD had significant long-run effects. In addition, Bao and Le (2021b) demonstrated that the vital role of USD as a vehicle currency should not be ignored when inspecting Vietnam's trade balance with the EU and the UK. Hence, they suggested that the neglect of USD as vehicle currency could be a reason preventing many studies from detecting significant results.

3. Research Methods and Materials

Many studies rely on the standard two-country model (Rose & Yellen, 1989; Bahmani-Oskooee, 1991; Iyke & Ho, 2018). This paper also employs the aforementioned model to examine the trade between China and the EU and the UK at a bilateral level:

$$\ln \mathrm{TB}_{i,t} = \alpha_i + \beta_i . \ln \mathrm{BER}_{i,t} + \gamma_i . \ln Y_t + \delta_i . \ln \mathrm{YF}_{i,t} + \varepsilon_{i,t} \quad (1)$$

In Equation 1, TB_i stands for the trade balance of China with respect to the i^{th} trading partner sorted in alphabetical order. BER_i denotes the bilateral exchange rate between CNY and the currency of the i^{th} trading partner; and the rise of BER_i indicates CNY depreciation. When $\beta_i > 0$, the depreciation of CNY fosters China's trade balance. Y and YF_i respectively symbolize the real incomes of China and the i^{th} trading partner.

To evaluate the short-run and long-run asymmetric effects of exchange rates, we transform Equation 1 into error correction form following the NARDL method of Shin et al. (2014):

$$\begin{aligned}\Delta \ln \mathrm{TB}_{i,t} = {} & c_i + \sum_{j=1}^{p_{1,i}} \left(\pi_{i,j} . \Delta \ln \mathrm{TB}_{i,t-j} \right) \\ & + \sum_{k=0}^{p_{2,i}} \left(\beta_{i,k}^{+} . \Delta \mathrm{POS\_BER}_{i,t-k} \right) \\ & + \sum_{l=0}^{p_{3,i}} \left(\beta_{i,l}^{-} . \Delta \mathrm{NEG\_BER}_{i,t-l} \right) \\ & + \sum_{m=0}^{p_{4,i}} \left(\rho_{i,m} . \Delta \ln Y_{t-m} \right) \\ & + \sum_{n=0}^{p_{5,i}} \left(\rho_{i,m} . \Delta \ln \mathrm{YF}_{i,t-n} \right) + \lambda_i . \ln \mathrm{TB}_{i,t-1} \\ & + \phi_i^{+} . \mathrm{POS\_BER}_{i,t-1} + \phi_i^{-} . \mathrm{NEG\_BER}_{i,t-1} \\ & + \kappa_i . \ln Y_{t-1} + \mu_i . \ln \mathrm{YF}_{i,t-1} + e_{i,t}\end{aligned} \quad (2)$$

In Equation 2, the subscript i denotes each country in the EU and the UK sorted in alphabetical order. The variable POS_BER indicates the depreciation of CNY, and NEG_BER represents the appreciation of CNY. Their impacts on China's trade balance can be different from each other in both the short run and long run. Following Shin et al. (2014), we show the construction of POS_BER and NEG_BER:

$$\mathrm{POS\_BER}_{i,t} = \sum_{g=1}^{t} \max(\Delta \ln \mathrm{BER}_{i,g}, 0) \quad (3)$$

$$\mathrm{NEG\_BER}_{i,t} = \sum_{g=1}^{t} \min(\Delta \ln \mathrm{BER}_{i,g}, 0) \quad (4)$$

Shin et al. (2014) documented that the partial sums of positive and negative changes in Equations 3 and 4 can be treated as normal variables, and thus Equation 2 can be estimated in the same way as the conventional

ARDL approach of Pesaran et al. (2001). Accordingly, NARDL has all advantages of the ARDL method. Namely, it enables the mixture of both I(1) and I(0) processes, which makes unit-root testing unnecessary due to the fact that almost all macroeconomic variables are stationary at first-difference or level (Bahmani-Oskooee & Aftab, 2018; Bahmani-Oskooee & Nasir, 2019). In addition, it allows the estimation of both short-run and long-run coefficients in a single equation (Ahmed et al., 2021). Before assessing the long-run impacts of the independent variables on the dependent one, cointegration must be checked by the bound test provided by Pesaran et al. (2001). Specifically, the null hypothesis (H0: $\lambda_i = \phi_i^+ = \phi_i^- = \kappa_i = \eta_i = 0$) indicating the absence of cointegration is supported if the *F*-statistic is smaller than the lower bound associated with I(0) variables. When it is greater than the upper bound connected with *I*(1) variables, the alternative hypothesis (H1: $\lambda_i \neq \phi_i^+ \neq \phi_i^- \neq \kappa_i \neq \eta_i \neq 0$) denoting the presence of cointegration is supported. In case the *F*-statistic lies between the two bounds, there is no clear conclusion (Phong et al., 2018). Further, to affirm that the estimation results are reliable, we will respectively check for autocorrelation, heteroskedasticity, and wrong functional form by Breusch-Godfrey, Breusch-Pagan, and Ramsey RESET tests. Besides, the Cumulative Sum of Recursive Residuals (CUSUM) and Cumulative Sum of Square of Recursive Residuals (CUSUMSQ) tests will also be conducted to ensure the stability of coefficients.

Next, following Bao and Le (2021a, 2021b), we introduce the vehicle currency model to examine the role of the vehicle currency exchange rate:

$$\ln TB_{i,t} = \alpha_i' + \beta_i'.\ln USD_t + \gamma_i'.\ln Y_t + \delta_i'.\ln \mathrm{YF}_{i,t} + \varepsilon_{i,t}' \quad (5)$$

in which USD_t is the real exchange rate USD/CNY, and the increase of this variable signifies CNY depreciation against USD. Again, when $\beta_i' > 0$, CNY depreciation stimulates China's trade balance.

Equation 5 is converted into error correction form as follows:

$$\begin{aligned}\Delta \ln \mathrm{TB}_{i,t} = {} & c_i' + \sum_{j=1}^{q_{1,i}} \left(\pi_{i,j}'.\Delta \ln \mathrm{TB}_{i,t-j}\right) + \sum_{k=0}^{q_{2,i}} \left(\beta_{i,k}'^{+}.\Delta \mathrm{POS}_{\mathrm{USD}_{t-k}}\right) \\ & + \sum_{l=0}^{q_{3,i}} \left(\beta_{i,k}'^{-}.\Delta \mathrm{NEG}_{\mathrm{USD}_{t-l}}\right) + \sum_{m=0}^{q_{4,i}} \left(\rho_{i,m}'.\Delta \ln Y_{t-m}\right) \\ & + \sum_{n=0}^{q_{5,i}} \left(\omega_{i,n}'.\Delta \ln \mathrm{YF}_{i,t-n}\right) + \lambda_i'.\ln \mathrm{TB}_{i,t-1} \\ & + \phi_i'^{+}.\mathrm{POS}_{\mathrm{USD}_{t-1}} + \phi_i'^{-}.\mathrm{NEG\_USD}_{t-1} \\ & + \kappa_i'.\ln Y_{t-1} + \eta_i'.\ln \mathrm{YF}_{i,t-1} + e_{i,t}'\end{aligned} \quad (6)$$

where the variables (denoting the depreciation of CNY against USD) and (denoting the appreciation of CNY against USD) are computed as:

$$\mathrm{POS\_USD}_t = \sum_{g=1}^{t} \max(\Delta \ln \mathrm{USD}_g, 0) \quad (7)$$

$$\mathrm{NEG\_USD}_t = \sum_{g=1}^{t} \min(\Delta \ln \mathrm{USD}_g, 0) \quad (8)$$

The procedure for estimating Equation 6 is exactly the same as Equation 2. Particularly, the bound test is used for identifying the occurrence of cointegration. After the cointegration is verified, the short-run and long-run coefficients can be estimated simultaneously. Then, similar diagnostic tests are implemented to ensure the trustworthiness of the results.

This paper employs quarterly data from 2000Q1 to 2018Q1. The sources include the two common datasets provided by IMF (i.e., Direction of Trade Statistics, and International Financial Statistics) as well as Eurostat.

4. Results and Discussion

The main estimation results of Equation 2 (referred to as "bilateral exchange rate" model, denoted by "BER") and Equation 6 (referred to as "vehicle currency exchange rate" model, denoted as "USD") are displayed in the Appendix section. It can be observed that all models connected with all trading partners of China are free from autocorrelation and heteroskedasticity, as evidenced by the insignificance of Breusch-Godfrey and Breusch-Pagan tests. Moreover, based on the Ramsey RESET tests, most cases do not have misspecification errors except the BER models of Bulgaria, Romania, and Slovenia as well as the USD models of Bulgaria and Slovakia.

Regarding the BER models, we can observe the J-curve effect caused by the depreciation of CNY in 7 cases (i.e., Estonia, Finland, Ireland, Luxembourg, the Netherlands, Romania, and the UK) because the short-run coefficients of POS variables are negative or insignificant and the long-run ones are positive (Rose & Yellen, 1989; Bahmani-Oskooee & Fariditavana, 2016). Regarding the USD models, the J-curve phenomenon is witnessed in 3 trading partners: Denmark, France, and Hungary. Obviously, incorporating the role of USD as a vehicle currency helps to identify additional evidence of the J-curve effect (Bao & Le, 2021b).

When the depreciation of domestic currency positively affected the trade balance in the long run, the Marshall-Lerner condition is supported (Rose & Yellen, 1989; Bahmani-Oskooee & Wang, 2006). To check the Marshall-Lerner condition in the bilateral trade between China and each of the EU countries and the UK, we summarize the long-run impacts of the BER as well as USD models in Table 1. Concerning the BER models, the Marshall-Lerner

condition is supported in 12 cases where CNY depreciation fosters China's trade balance (i.e., Austria, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Luxembourg, Netherlands, and the UK). Concerning the USD models, 4 trading partners are associated with the Marshall-Lerner condition: Denmark, France, Greece, and Hungary. Remarkably, the trade of China with Denmark, France, and Hungary exhibits the presence of Marshall-Lerner condition regardless of whether bilateral exchange rate or vehicle currency exchange rate is used.

To supplement the results in Table 1 and further scrutinize the long-run impacts of bilateral as well as vehicle currency exchange rates on China's trade balance, we report the share of each EU country as well as the UK in trading with China from 2000Q1 to 2018Q1 in Table 2.

Combining Tables 1 and 2, we notice that, in the BER models, the depreciation of CNY boosts China's trade balance with 12 partners accounting for 78.71% of China's total trade with the EU and the UK in the period 2000Q1–2018Q1. Additionally, excluding the UK, all 4 largest trading partners of China in the EU (i.e., Germany, Netherlands, France, and Italy) are Eurozone members which employ EUR as their official currency. Thus, the depreciation of CNY against EUR enhances China's trade balance with those countries, especially Germany – the largest trading partner of China in the EU accounting for 28.43% of the total trade. Nevertheless, in the USD models, the depreciation of CNY against the vehicle currency USD only facilitates China's trade balance with Denmark, France, Greece, and Hungary, which comprises only 13.37% of China's total trade with the EU and the UK. Furthermore, it is remarkable that the appreciation of CNY against USD favorably affects China's trade balance with 15 partners (i.e., Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Lithuania, Luxembourg, Netherlands, Poland, Romania, Spain, Sweden, and the UK) whose total trade share is

Table 1: Summary of Exchange Rates' Long-Run Impacts

	BER Models	**USD Models**
CNY depreciation fosters China's trade balance	Austria, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Luxembourg, Netherlands, UK	Denmark, France, Greece, Hungary
CNY appreciation fosters China's trade balance	Belgium, Croatia, Denmark, France, Ireland, Italy, Latvia, Netherlands, Portugal, Spain	Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Lithuania, Luxembourg, Netherlands, Poland, Romania, Spain, Sweden, UK
CNY depreciation lowers China's trade balance	Belgium, Croatia, Czechia, Latvia, Malta, Poland	Austria, Croatia, Czechia, Ireland, Italy, Luxembourg, Netherlands, Poland, Portugal, Slovenia, Sweden
CNY appreciation lowers China's trade balance	Austria, Greece, Malta, UK	Czechia, Estonia, Latvia, Malta, Slovenia

Notes: The list does not include the countries associated with misspecification problems.

Table 2: The Share of Each Partner in China's Total Trade with the EU and the UK

Partners	**%**	**Partners**	**%**	**Partners**	**%**	**Partners**	**%**
Germany	28.43	Poland	2.55	Austria	1.27	Slovenia	0.35
Netherlands	12.19	Sweden	2.48	Romania	0.84	Bulgaria	0.31
UK	11.90	Finland	1.95	Greece	0.83	Croatia	0.26
France	9.20	Denmark	1.74	Slovakia	0.80	Lithuania	0.25
Italy	8.36	Czechia	1.65	Portugal	0.72	Estonia	0.20
Spain	4.88	Hungary	1.60	Luxembourg	0.45	Latvia	0.20
Belgium	4.56	Ireland	1.42	Malta	0.44	Cyprus	0.17

Source: Authors' calculation from the dataset Direction of Trade Statistics provided by IMF.

Table 3: The Number of Significant Coefficients of Exchange Rates

	BER Models	USD Models
Long-run	21	25
Short-run	24	23
Both long-run and short-run	21	23

Notes: The models with misspecification problems are excluded.

around 91.20%. To sum up the results in Tables 1 and 2, when EUR is used as an invoicing currency, CNY depreciation against EUR is favorable to China because 78.71% of trade with the EU and the UK is improved. In contrast, when USD is used as a vehicle currency, CNY appreciation against USD is beneficial to China as 91.20% of the trade with the EU and the UK is facilitated. Obviously, China's trade balance reacts distinctively when different currencies are used in trading with the EU and the UK.

The importance of USD as vehicle currency and its usefulness in estimating the exchange rate-trade balance nexus under the NARDL framework is shown in Table 3. It can be observed that the USD models outperform the BER counterparts when more significant long-run coefficients of exchange rates are documented. Specifically, the USD models of 25 out of 28 trading partners have significant long-run coefficients of either POS or NEG variables, whereas those of BER models are 21. Thus, incorporating the role of USD as a vehicle currency not only reflects the reality of global trade but also enables more significant results, which is analogous to the findings of Bao and Le (2021a, 2021b) for the trade of ASEAN and Vietnam with the EU and the UK. Also, the USD models are better in terms of having more cases with concurrently significant long-run and short-run coefficients of exchange rates, which is also in line with Bao and Le (2021a, 2021b). Consequently, the crucial role of USD as a vehicle currency should not be neglected in exchange rate-trade balance research.

5. Conclusion

This paper inspects how the vehicle currency USD, reflected by the exchange rate USD/CNY, asymmetrically influences China's bilateral trade balance with 27 countries in the EU as well as the UK. In addition, the roles of bilateral exchange rates are also examined. The findings show that USD/CNY has significant long-run impacts on the trade between China and 25 out of 28 partners. Moreover, the USD models also outperform the BER models in detecting the cases with significant coefficients in both the short run and the long run. Therefore, the results of this paper confirm the importance of USD as a vehicle currency in China-EU and China-UK trade. Thus, the incorporation of the vehicle currency USD in exchange rate-trade balance analyses is very useful and meaningful, which is similar to the findings of Bao and Le (2021a, 2021b).

The trade balance of China with each EU country and the UK can react distinctively to different currencies. For instance, when bilateral exchange rates are employed, the depreciation of CNY improves China's trade balance with 12 partners (Austria, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Luxembourg, the Netherlands, and the UK). However, when the vehicle currency exchange rate (USD/CNY) is used, the appreciation of CNY against USD foster China's trade balance with 15 partners (Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Lithuania, Luxembourg, Netherlands, Poland, Romania, Spain, Sweden, and the UK). Remarkably, the aforementioned 15 partners together account for 91.20% of the trade value between China and the whole EU-28 in the period 2000Q1–2018Q1. In addition, some of them such as Germany, the Netherlands, the UK, France, Italy, Spain, and Belgium are the major trading partners of China. In the long-term relationship between China and the EU, China's policy-makers can consider focusing on the EU's as well as the UK's markets to decrease the reliance on the US. If China would like to let CNY appreciate against USD faster to support domestic consumption (Yeung, 2020), China-EU and China-UK trade seems to be facilitated.

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Appendix

	***i* = Austria**		***i* = Belgium**		***i* = Bulgaria**		***i* = Croatia**	
	BER	**USD**	**BER**	**USD**	**BER**	**USD**	**BER**	**USD**
Long Run								
POS	0.45**	−4.10***	−0.73***	−1.68	−1.22*	−1.44	−3.34**	−10.08***
NEG	−0.36**	0.36	1.28***	3.03**	−3.79***	5.44***	2.49***	−2.29
ln *Y*	−1.32***	−1.81***	−2.02***	−1.28**	−2.82***	−0.75	3.78***	−0.25
ln YF	4.47***	2.87**	17.88***	9.71***	12.65***	7.79***	−2.67	1.89
Short Run								
ΔPOS_t	0.47*	1.92	−0.80	−1.00	−3.47	−2.76	−1.73	−10.85
ΔPOS_{t-1}		6.30***	1.36		−2.81	3.04	−0.82	12.23
ΔPOS_{t-2}		4.30**	3.21**		−5.14**	6.46	4.64	26.91**
ΔPOS_{t-3}		3.60*	1.59		−6.98***	2.05	7.65**	24.63**
ΔPOS_{t-4}			2.31*		−8.95***		5.03	
ΔPOS_{t-5}			2.18*		−3.68*			
ΔPOS_{t-6}			2.79**					
ΔPOS_{t-7}			1.20					
ΔNEG_t	−0.38**	0.37	0.26	−0.84	−3.05	7.86	2.94***	−19.55**
ΔNEG_{t-1}			−1.76**	2.84*	8.87***	1.05		

	***i* = Austria**		***i* = Belgium**		***i* = Bulgaria**		***i* = Croatia**	
	BER	**USD**	**BER**	**USD**	**BER**	**USD**	**BER**	**USD**
ΔNEG_{t-2}			−3.33***	−2.20	5.25**			
ΔNEG_{t-3}			−4.82***	−4.09**	5.14**			
ΔNEG_{t-4}			−2.63**					
ΔNEG_{t-5}			−1.06					
ΔNEG_{t-6}			−2.75***					
ΔNEG_{t-7}			−1.83**					
ΔlnY_{t}	−0.14	−0.41	−2.07	−0.30	8.04	0.45	−8.31	3.07
ΔlnY_{t-1}	1.10***	6.04***	6.67***		6.42		1.67	8.21
ΔlnY_{t-2}	0.65***	3.81*	4.31		17.36***		0.79	5.40
ΔlnY_{t-3}		5.45**	−6.58**		14.93***		2.80	10.33*
ΔlnY_{t-4}		5.59***	−5.86*		6.66		14.41**	10.99
ΔlnY_{t-5}		0.70*	−10.7**		11.99*			
ΔlnY_{t-6}		2.38	−9.72***					
$\Delta lnYF_{t}$	−4.75*	−7.40**	16.04*	2.42	23.58***	10.39	−3.16	−4.69
$\Delta lnYF_{t-1}$			−28.01**	−5.55	−17.82**			−5.14*
$\Delta lnYF_{t-2}$			−34.38***		−9.75			
$\Delta lnYF_{t-3}$			−16.40**		−26.87***			
$\Delta lnYF_{t-4}$			2.40					
$\Delta lnYF_{t-5}$			−8.10					
$\Delta lnYF_{t-6}$			−6.31					
Constant	−10.69***	−1.01	−183.6***	−20.58**	−95.97***	−35.54***	0.10	−3.61
Bound test	9.41***	9.23***	4.57**	8.06***	9.30***	4.93***	8.56***	6.24***
Adj–R^2	0.57	0.55	0.62	0.52	0.58	0.47	0.57	0.59
Breusch−Godfrey	0.94	0.88	0.26	0.18	0.21	0.63	1.25	0.37
Breusch−Pagan	1.51	1.12	1.04	1.62	1.16	1.49	1.18	1.34
Ramsey RESET	2.39	2.25	2.52	0.76	6.78***	7.79***	2.52	1.19
CUSUM	S	S	S	S	U	S	S	S
CUSUMSQ	S	S	S	S	S	U	U	S

	***i* = Austria**		***i* = Belgium**		***i* = Bulgaria**		***i* = Croatia**	
	BER	**USD**	**BER**	**USD**	**BER**	**USD**	**BER**	**USD**
	***i* = Cyprus**		***i* = Czechia**		***i* = Denmark**		***i* = Estonia**	
	BER	**USD**	**BER**	**USD**	**BER**	**USD**	**BER**	**USD**
Long Run								
POS	−0.66	−2.14	−1.74**	−4.17***	1.31***	3.27***	0.38**	−2.52
NEG	−0.15	−0.25	−0.78	−3.06***	1.15*	1.90**	0.76	−11.5***
ln*Y*	−2.49**	−2.40**	1.56**	−2.71***	3.57***	4.07***	−0.78	−4.86***
lnYF	6.31***	5.63***	3.86**	7.34***	8.18***	4.21***	−0.41	0.99
Short Run								
ΔPOS_t	−0.50	−1.67	0.17	−2.83***	0.99	−1.07	0.31	−3.83
ΔPOS_{t-1}			0.74		1.30*	−5.85***	0.07	−11.80*
ΔPOS_{t-2}			0.14		1.97**	−5.60***	−0.32**	
ΔPOS_{t-3}			0.89*		2.21***	−6.46***		
ΔNEG_t	−0.11	−0.19	−0.45	3.40**	1.19*	3.90*	1.13	7.84
ΔNEG_{t-1}				5.17***	−0.66	2.09		
ΔNEG_{t-2}					−0.78	1.71		
ΔNEG_{t-3}					−1.17*	2.79*		
ΔNEG_{t-4}					1.49**	−1.17		
ΔNEG_{t-5}					0.50	2.79		
ΔNEG_{t-6}					0.10	3.25*		
ΔNEG_{t-7}					−0.63	1.74		
$\Delta \ln Y_t$	−1.89**	−1.88**	0.91**	−0.21	−4.90***	−0.89	−11.51**	−2.69***
$\Delta \ln Y_{t-1}$				1.03	−4.38**	−7.61***	2.63	3.15**
$\Delta \ln Y_{t-2}$					−8.10***	−7.28***	0.71	
$\Delta \ln Y_{t-3}$					−4.62**	−5.44***	−3.39	
$\Delta \ln Y_{t-4}$					−6.89***		10.76*	
$\Delta \ln Y_{t-5}$					−8.02***			
$\Delta \ln Y_{t-6}$					−4.34**			
$\Delta \ln Y_{t-7}$					−5.55***			

	***i* = Austria**		***i* = Belgium**		***i* = Bulgaria**		***i* = Croatia**	
	BER	**USD**	**BER**	**USD**	**BER**	**USD**	**BER**	**USD**
$\Delta \ln YF_t$	2.32	2.28	0.34	1.03	7.77***	3.90**	4.74*	4.76**
$\Delta \ln YF_{t-1}$					−6.35**	−4.94**	−2.28	−1.74
$\Delta \ln YF_{t-2}$					−2.68	−1.51	−4.02	
$\Delta \ln YF_{t-3}$					0.51	−1.21	−2.23*	
$\Delta \ln YF_{t-4}$					2.20	0.47	−4.54*	
$\Delta \ln YF_{t-5}$					−2.00	0.15	−6.20	
$\Delta \ln YF_{t-6}$					−3.68**	0.01	−4.66*	
$\Delta \ln YF_{t-7}$						3.49***		
Constant	−9.83	−7.88	−12.04***	−11.09***	−65.41***	−48.36***	17.63***	15.66***
Bound test	7.40***	7.49***	12.74***	12.90***	8.25***	12.40***	9.60***	6.96***
Adj–R^2	0.40	0.41	0.52	0.59	0.70	0.77	0.65	0.58
Breusch−Godfrey	0.20	0.08	0.44	0.32	0.23	0.07	0.11	0.15
Breusch−Pagan	1.31	0.76	1.28	1.69	0.67	0.74	1.53	1.17
Ramsey RESET	0.02	0.79	0.05	2.21	0.45	1.60	1.07	0.43
CUSUM	S	S	S	S	S	S	S	S
CUSUMSQ	U	U	S	U	S	S	U	S
	***i* = Finland**		***i* = France**		***i* = Germany**		***i* = Greece**	
	BER	**USD**	**BER**	**USD**	**BER**	**USD**	**BER**	**USD**
Long Run								
POS	2.17***	2.10	0.60**	1.80*	2.81**	0.22	0.48	2.61**
NEG	0.70	10.31***	2.65***	6.68***	0.44	4.17***	−2.15***	0.42
ln*Y*	3.27***	8.64***	1.00***	3.46***	−1.71*	1.59***	−1.78***	−0.29
lnYF	3.21*	−0.55	9.74***	−13.17***	2.41	0.07	4.77***	1.95***
Short Run								
ΔPOS_t	−2.12**	1.50	1.94***	0.91	0.84**	0.09	0.73	2.05**
ΔPOS_{t-1}	−0.20		3.99***		−0.97***		−0.003	
ΔPOS_{t-2}	1.11		2.70***		0.13			
ΔPOS_{t-3}	−0.84		2.29***		−0.82***			
ΔPOS_{t-4}	−1.50*		2.03***					
ΔPOS_{t-5}			1.40**					

	i = Austria		*i* = Belgium		*i* = Bulgaria		*i* = Croatia	
	BER	**USD**	**BER**	**USD**	**BER**	**USD**	**BER**	**USD**
ΔPOS_{t-6}			1.71***					
ΔPOS_{t-7}			0.66					
ΔNEG_{t}	1.73**	2.79	0.15	−4.42***	−1.17***	0.69	−1.55	0.33
ΔNEG_{t-1}	0.58	−6.08**	−2.90***	−6.12***	0.48	0.70	1.33	
ΔNEG_{t-2}	−1.25	−8.28***	−2.76***	−4.17*	−0.69**	−0.67	3.32***	
ΔNEG_{t-3}	−1.29		−0.62	−3.17**		−1.63*		
ΔNEG_{t-4}			−0.39	−1.34		−1.50*		
ΔNEG_{t-5}			−0.70*	−3.13**				
ΔNEG_{t-6}			−1.79***					
$\Delta \ln Y_{t}$		−4.54**	2.91**	4.26***	0.38***	0.49***	−6.02***	−2.22***
$\Delta \ln Y_{t-1}$		−4.49*	−2.47**	0.17	0.62***		−4.64**	−2.02**
$\Delta \ln Y_{t-2}$		−9.82***	−2.16**	−0.69	0.35***		−3.23*	
$\Delta \ln Y_{t-3}$		−8.95***	−4.56***	−2.61*			−3.21*	
$\Delta \ln Y_{t-4}$		−1.72	−6.95***	−6.03***				
$\Delta \ln Y_{t-5}$		−6.39***	−2.88**	−3.66**				
$\Delta \ln Y_{t-6}$			−2.04	−2.12				
$\Delta \ln YF_{t}$	−2.29	−0.39	8.96**	−6.65**	0.54	0.02	3.70**	2.14**
$\Delta \ln YF_{t-1}$	1.28		−8.53**					2.25
$\Delta \ln YF_{t-2}$	−5.27***							
$\Delta \ln YF_{t-3}$	−4.25**							
$\Delta \ln YF_{t-4}$	−1.183							
$\Delta \ln YF_{t-5}$	−6.65***							
Constant	15.66***	−16.85***	−45.89***	24.81**	0.19	−1.59	−14.71***	−2.23
Bound test	6.96***	6.53***	7.22***	4.25**	5.11***	5.26***	4.47**	7.36***
Adj–R^2	0.58	0.63	0.84	0.61	0.69	0.57	0.54	0.44
Breusch−Godfrey	0.15	0.00	0.43	0.04	0.00	0.00	0.15	2.03
Breusch−Pagan	1.17	0.83	0.68	1.09	0.85	1.52	1.09	1.47
Ramsey RESET	0.43	1.26	0.43	0.79	2.19	0.00	2.20	0.16
CUSUM	S	S	S	S	S	S	S	S
CUSUMSQ	S	S	S	S	S	S	S	S

	i = Austria		*i* = Belgium		*i* = Bulgaria		*i* = Croatia	
	BER	USD	BER	USD	BER	USD	BER	USD
	i = Hungary		*i* = Ireland		*i* = Italy		*i* = Latvia	
	BER	USD	BER	USD	BER	USD	BER	USD
Long Run								
POS	2.13***	2.88***	4.41***	−5.33*	0.79**	−1.97**	−10.3***	4.53
NEG	−0.13	−0.60	1.44**	26.97***	1.59***	2.03*	1.83***	−14.45**
ln*Y*	4.86**	0.92***	−2.11**	−0.25	1.96***	1.33***	8.01***	3.64
lnYF	13.30	1.11	−1.73**	−5.19**	12.08***	5.37***	0.53	5.52***
Short Run								
ΔPOS_t	6.04***	−0.39	−0.20	−4.68*	0.46	0.39	−4.13	14.82**
ΔPOS_{t-1}	−0.63	−6.59**	−0.09		1.07**		11.14***	6.80
ΔPOS_{t-2}	0.42		−1.95**		1.79***		5.01	5.51
ΔPOS_{t-3}	4.12*		−3.08***		1.03**			−6.52
ΔPOS_{t-4}	2.51		−0.98		1.01*			3.32
ΔPOS_{t-5}	6.03**				1.68***			
ΔPOS_{t-6}	7.56**							
ΔPOS_{t-7}	3.10							
ΔPOS_{t-8}	4.46**							
ΔPOS_{t-9}	3.27**							
ΔNEG_t	−2.86	2.51	0.91	1.71	−0.003	0.20	2.73***	−8.36
ΔNEG_{t-1}	2.93*	8.22**	−0.47	−21.74***	−1.88***			15.41
ΔNEG_{t-2}	−0.76	1.78	1.29*	−21.49***	−2.05***			4.76
ΔNEG_{t-3}	−2.49	4.29	2.20***	−14.22**	−2.26***			13.31
ΔNEG_{t-4}	−0.26	4.37		−14.02***	0.13			20.35**
ΔNEG_{t-5}	−1.21			−9.64**	−0.89*			
ΔNEG_{t-6}	−2.70			−4.57*	−0.36			
ΔNEG_{t-7}	0.18				0.51			
ΔNEG_{t-8}	−1.32							
$\Delta \ln Y_t$	−12.36**	−5.31	0.28	−2.31	−0.75	0.17	−0.47	7.46
$\Delta \ln Y_{t-1}$	−20.34**	−10.71***	0.29	−6.63*	−2.11		−1.08	5.04
$\Delta \ln Y_{t-2}$	−16.58**	−4.96*		−5.73	−8.44***		−11.47**	6.69
$\Delta \ln Y_{t-3}$	−21.18**	−4.62*		−10.39**	−8.95***		−11.88**	9.15

	***i* = Austria**		***i* = Belgium**		***i* = Bulgaria**		***i* = Croatia**	
	BER	**USD**	**BER**	**USD**	**BER**	**USD**	**BER**	**USD**
$\Delta \ln Y_{t-4}$	−21.28**	−0.36		−7.39**	−10.36***		1.62	
$\Delta \ln Y_{t-5}$	−37.90***	4.63**		−3.75	−10.54***		−6.56	
$\Delta \ln Y_{t-6}$	−26.67**			−5.11**	−3.42*		6.42	
$\Delta \ln Y_{t-7}$	−22.52**				−2.57		10.84**	
$\Delta \ln Y_{t-8}$	−12.78							
$\Delta \ln Y_{t-9}$	4.40							
$\Delta \ln YF_{t}$	14.16**	2.62	1.04*	−0.35	9.42***	1.54	0.80	4.14
$\Delta \ln YF_{t-1}$	−14.85**		1.77**	3.49**	−3.24			
$\Delta \ln YF_{t-2}$	−19.73**		3.08***	4.14***	−2.23			
$\Delta \ln YF_{t-3}$	−8.52		2.32***	1.80	4.95			
$\Delta \ln YF_{t-4}$	−2.83		2.64***	3.13***	5.28			
$\Delta \ln YF_{t-5}$	7.14		2.37***	2.94***	−2.22			
$\Delta \ln YF_{t-6}$	0.44			0.97	3.63			
$\Delta \ln YF_{t-7}$	0.58			2.46***	−7.79***			
$\Delta \ln YF_{t-8}$	−2.43							
$\Delta \ln YF_{t-9}$	−11.83**							
Constant	−212.4***	−10.34	10.48***	26.14**	−62.10***	−10.45**	−57.1***	−47.49***
Bound test	5.52***	7.81***	7.25***	8.29***	5.47***	3.47*	5.81***	3.92**
Adj – R^2	0.83	0.62	0.58	0.73	0.74	0.26	0.56	0.55
Breusch−Godfrey	1.52	0.25	0.14	0.00	0.52	0.66	0.57	0.16
Breusch−Pagan	1.72	1.18	1.37	0.52	0.46	0.57	1.50	1.37
Ramsey RESET	1.59	1.00	1.91	1.29	0.58	0.01	0.20	0.20
CUSUM	S	S	S	S	S	S	S	S
CUSUMSQ	U	S	S	S	S	S	U	U
	***i* = Lithuania**		***i* = Luxembourg**		***i* = Malta**		***i* = Netherlands**	
	BER	**USD**	**BER**	**USD**	**BER**	**USD**	**BER**	**USD**
Long Run								
POS	−0.05	0.98	13.22***	−19.48**	−4.13**	−0.03	0.90***	−1.51***
NEG	1.27	4.97**	1.41	30.98***	−0.55*	−0.88**	0.84***	3.85***
ln*Y*	−2.78**	5.72***	−2.41*	−2.78	−12.32***	0.07	−0.00	1.52***
lnYF	9.34***	3.53***	14.05***	−3.19	−17.85***	−0.12	0.84	2.57***

	i = Austria		*i* = Belgium		*i* = Bulgaria		*i* = Croatia	
	BER	**USD**	**BER**	**USD**	**BER**	**USD**	**BER**	**USD**
Short Run								
ΔPOS_t	−0.54*	8.68*	1.92	−6.84	−2.91	0.35	−0.27	−1.50***
ΔPOS_{t-1}	−0.29	2.92	−11.06***	3.13	−2.73	−7.38***	−1.26*	
ΔPOS_{t-2}	−0.64**	−6.61	−8.53**	−0.43				
ΔPOS_{t-3}		6.58	−4.70	−11.16				
ΔPOS_{t-4}		5.04	−6.85**	−12.61				
ΔPOS_{t-5}		−10.99	−9.11***	−32.54**				
ΔPOS_{t-6}		−7.05	−5.63**	−25.23**				
ΔPOS_{t-7}		14.65*	−3.12	−14.76				
ΔNEG_t	−2.18	5.43**	−1.13	3.44	−2.24***	−0.81**	−0.79	3.82***
ΔNEG_{t-1}	−2.07		−5.37*	−31.6***	−1.76**		−0.39	
ΔNEG_{t-2}	−3.78**		−5.10	−30.6***	−2.60***		−0.92	
ΔNEG_{t-3}	−5.61***		−3.80	−31.5***	−2.53***		−1.67***	
ΔNEG_{t-4}	−4.87***		2.63	−23.1***	−2.99***			
ΔNEG_{t-5}			−0.65	−7.99	−3.61***			
ΔNEG_{t-6}			−5.25*	−20.3***	−2.47**			
ΔNEG_{t-7}					−0.88*	3.04***		
$\Delta \ln Y_t$	−8.20***	−3.35	−16.02**	1.03	3.23		0.56***	0.87***
$\Delta \ln Y_{t-1}$	−7.56***	−7.00**	−12.46**	3.69*	27.67***		0.54***	
$\Delta \ln Y_{t-2}$			−10.23	5.85***	35.14***			
$\Delta \ln Y_{t-3}$			−24.68***		28.85***			
$\Delta \ln Y_{t-4}$			−9.10		21.25**			
$\Delta \ln Y_{t-5}$			−11.59		11.61			
$\Delta \ln Y_{t-6}$			−14.40*					
$\Delta lnYF_t$	7.92***	3.18*	6.81	−12.4***	−1.02	−0.87	0.81	−0.77
$\Delta lnYF_{t-1}$	4.91***	2.17	−10.60*	−11.55*	22.27***	−4.49		−4.52
$\Delta lnYF_{t-2}$	−1.96	−2.22	−12.76**	−13.34**	21.22***	6.31*		
$\Delta lnYF_{t-3}$	−3.28*	−3.61*	−13.19**	−10.71*	12.84**	−2.54		
$\Delta lnYF_{t-4}$	−4.63***	−3.01*	−9.95*	−14.36**	13.25**	6.01*		
$\Delta lnYF_{t-5}$		0.16	0.005	−17.0***	7.24			
$\Delta lnYF_{t-6}$		−2.55*	−7.95	−19.9***	6.53*			

	***i* = Austria**		***i* = Belgium**		***i* = Bulgaria**		***i* = Croatia**	
	BER	**USD**	**BER**	**USD**	**BER**	**USD**	**BER**	**USD**
$\Delta \ln YF_{t-7}$		3.18***	−10.03**	−9.64*				
Constant	−12.18***	−39.52***	−57.70	41.39	252.0***	2.64	0.48	−14.6***
Bound test	7.68***	4.78***	4.96***	8.62***	7.72***	10.14***	7.00***	15.34***
Adj–R^2	0.75	0.70	0.69	0.69	0.75	0.70	0.62	0.62
Breusch−Godfrey	0.53	0.11	0.02	0.59	0.18	1.38	0.11	0.02
Breusch−Pagan	1.24	0.78	0.95	0.70	1.26	1.31	1.41	0.54
Ramsey RESET	1.93	0.00	1.94	0.24	1.34	2.70	2.65	0.00
CUSUM	*S*	*S*	*S*	*S*	*S*	*S*	*S*	*S*
CUSUMSQ	*S*	*S*	*S*	*S*	*S*	*U*	*S*	*S*
	***i* = Poland**		***i* = Portugal**		***i* = Romania**		***i* = Slovakia**	
	BER	**USD**	**BER**	**USD**	**BER**	**USD**	**BER**	**USD**
Long Run								
POS	−1.23**	−3.22**	−0.42	−6.61***	8.71**	20.62	0.19	−7.01
NEG	0.24	4.77***	1.43*	6.99	5.63**	29.63***	−0.74	−4.85**
ln*Y*	1.20	−1.31	0.93	3.10*	−9.64**	5.94	−11.12***	−9.09***
lnYF	1.53	10.64***	6.42*	15.3***	−3.79	6.30*	24.15***	9.50***
Short Run								
ΔPOS_t	−3.07***	−0.14	−0.49	−4.46	2.21	−8.60	−0.01	1.81
ΔPOS_{t-1}	−1.11	6.80***	−1.07	4.75	−7.69***	−16.45*	−0.18	
ΔPOS_{t-2}	−1.46	7.40***	0.21	7.49*	−8.84***	−14.18	−0.29	
ΔPOS_{t-3}	−1.92*		−2.27**	−1.00	−4.34*	−16.70	−0.77***	
ΔPOS_{t-4}	−2.53**				−7.86***	−3.95	−0.81**	
ΔPOS_{t-5}						−3.49	−0.41	
ΔPOS_{t-6}						−18.80*	−0.30	
ΔPOS_{t-7}						−20.31		
ΔNEG_t	0.50	−3.84*	0.52*	−0.22	0.38	9.12	−1.58	−0.59
ΔNEG_{t-1}	1.37*	−5.26*		3.22	−4.76**	−7.49	0.72	8.61*
ΔNEG_{t-2}		−1.61		−1.54	−4.71***	−12.38*	−2.22	
ΔNEG_{t-3}		−9.64***		−2.27	−5.28***	−13.24*	0.57	
ΔNEG_{t-4}		1.44			−2.31	−15.48**	0.40	
ΔNEG_{t-5}		5.17**			−5.64***	−6.35	−2.21	

	***i* = Austria**		***i* = Belgium**		***i* = Bulgaria**		***i* = Croatia**	
	BER	**USD**	**BER**	**USD**	**BER**	**USD**	**BER**	**USD**
ΔNEG_{t-6}		3.20			−2.70*	21.30**	1.21	
ΔNEG_{t-7}					−1.87		1.92	
$\Delta \ln Y_t$	1.82	−1.50	−0.62	−4.89**	7.42	−15.59*	6.64	7.19
$\Delta \ln Y_{t-1}$	2.99		−1.99***	−7.06**	5.54	−27.23***	6.44	10.94*
$\Delta \ln Y_{t-2}$	7.25			−4.02	5.76	−19.01*	6.06	13.43***
$\Delta \ln Y_{t-3}$	4.74*			−4.32*	12.37***	−21.62**	−5.10	4.36
$\Delta \ln Y_{t-4}$	7.81**						−14.04**	−2.72
$\Delta \ln Y_{t-5}$	3.51						−5.58	1.95
$\Delta \ln Y_{t-6}$	2.12						−11.61*	−8.01**
$\Delta \ln YF_t$	−7.63***	−1.89	−0.40	4.43	0.12	5.16	11.62**	3.54
$\Delta \ln YF_{t-1}$	−12.97***	−12.55***	5.14**	4.76*	5.89**	−1.42	−14.20**	−9.93***
$\Delta \ln YF_{t-2}$	−18.58***	−13.99***		−0.58	4.65	−14.04***	−2.67	
$\Delta \ln YF_{t-3}$	−11.97***	−10.26***		2.40		−3.56	−15.28**	
$\Delta \ln YF_{t-4}$	−9.12***	−4.51**				−13.26***	−18.17**	
$\Delta \ln YF_{t-5}$	−4.93*	−4.31**				−10.18**	−13.40*	
$\Delta \ln YF_{t-6}$						0.27	−11.83**	
$\Delta \ln YF_{t-7}$						−6.90**		
Constant	−20.83**	−45.38***	−11.16*	−39.35***	60.47**	−34.82*	−44.20***	2.91
Bound test	6.20***	17.08***	3.79**	3.22*	10.92***	8.21***	5.10***	6.97***
Adj–R^2	0.68	0.75	0.33	0.35	0.55	0.52	0.67	0.66
Breusch−Godfrey	0.62	1.57	2.27	0.00	0.00	1.53	0.61	0.07
Breusch−Pagan	1.39	1.21	0.50	0.96	1.43	1.19	0.68	1.36
Ramsey RESET	1.37	1.39	0.00	0.47	6.37**	2.09	0.86	6.31***
CUSUM	S	S	S	S	S	S	S	S
CUSUMSQ	S	U	U	U	U	S	S	S
	***i* = Slovenia**		***i* = Spain**		***i* = Sweden**		***i* = UK**	
	BER	**USD**	**BER**	**USD**	**BER**	**USD**	**BER**	**USD**
Long Run								
POS	0.09***	−8.23***	0.44	−1.22	4.84	−7.99***	2.82***	−0.98
NEG	−0.09	−2.08*	1.66**	4.83***	0.95	5.89***	−1.30***	4.33***

	i = Austria		*i* = Belgium		*i* = Bulgaria		*i* = Croatia	
	BER	**USD**	**BER**	**USD**	**BER**	**USD**	**BER**	**USD**
ln*Y*	−0.20	−4.70***	1.23	1.91***	−2.09	0.40	−0.035	1.86***
lnYF	−0.00	−0.43	−1.71	0.90	−4.46	−0.40	7.02***	0.46
Short Run								
ΔPOS_t	0.07**	2.65	0.12	−0.70	0.69	2.17	0.42	−0.61
ΔPOS_{t-1}	−0.12***	21.03***			−0.90**	26.62**	−1.10*	
ΔPOS_{t-2}	−0.13***	15.46***			−0.47	25.21**		
ΔPOS_{t-3}	−0.13***	3.50			0.49	23.65**		
ΔPOS_{t-4}	−0.06	2.90			−1.57***	15.30*		
ΔPOS_{t-5}		−4.32				10.68*		
ΔPOS_{t-6}		−0.82				8.68*		
ΔPOS_{t-7}		−7.26				6.24		
ΔPOS_{t-8}						−3.98		
ΔNEG_t	−1.75**	−5.67*	−0.30	1.47	−0.59	0.33	−0.64	2.69***
ΔNEG_{t-1}	0.95	−0.96	0.41	0.25		−18.83***		
ΔNEG_{t-2}	−1.42**	−6.92	−0.72*	−2.01		−20.36***		
ΔNEG_{t-3}	−0.71	−7.38*		−3.43***		−17.91**		
ΔNEG_{t-4}	−1.20*	−9.81**		−0.39		−10.23*		
ΔNEG_{t-5}	0.83	−7.87**		−2.97**		−13.28**		
ΔNEG_{t-6}	−2.04***					−10.88**		
ΔNEG_{t-7}						−6.24*		
$\Delta \ln Y_t$	−1.60	10.50***	−0.86*	−1.79	0.30*	4.24	0.49***	0.56***
$\Delta \ln Y_{t-1}$	−6.29**	22.39***	−0.46*	−1.98	0.20	8.03**	0.58***	
$\Delta \ln Y_{t-2}$	6.81***	32.62***	−0.62	−3.66***	−0.27	11.32**		
$\Delta \ln Y_{t-3}$	−2.84	29.29***		−3.31**		14.29**		
$\Delta \ln Y_{t-4}$	6.39**	25.39***		−1.76		6.43		
$\Delta \ln Y_{t-5}$	13.12***	22.03***		−2.29*		8.25		
$\Delta \ln Y_{t-6}$	0.20	9.99*				4.80		
$\Delta \ln Y_{t-7}$	8.21***	11.63**				1.87		
$\Delta \ln Y_{t-8}$						6.21**		
$\Delta \ln YF_t$	5.12**	−5.79*	5.53***	5.57***	−0.77	−10.41**	−0.08	−7.22**

	***i* = Austria**		***i* = Belgium**		***i* = Bulgaria**		***i* = Croatia**	
	BER	**USD**	**BER**	**USD**	**BER**	**USD**	**BER**	**USD**
$\Delta \ln YF_{t-1}$	2.13	−8.11**	2.78**	4.54***	5.28***	−4.19	−6.44*	−5.12*
$\Delta \ln YF_{t-2}$		−8.67***			0.02	−4.09	−3.82	
$\Delta \ln YF_{t-3}$		−12.54***			3.00	−5.58	−3.71	
$\Delta \ln YF_{t-4}$		−7.05**			−4.27**	−9.93**		
$\Delta \ln YF_{t-5}$		−2.77				−8.42**		
$\Delta \ln YF_{t-5}$		−2.78				−8.89**		
$\Delta \ln YF_{t-7}$		−3.97**				−3.52		
$\Delta \ln YF_{t-8}$						−5.85*		
Constant	9.82**	60.50***	1.79	−5.04	3.79	12.60	−27.32***	−3.72
Bound test	8.80***	13.93***	3.95**	6.27***	2.33	3.28*	5.89***	9.69***
Adj – R^2	0.74	0.74	0.45	0.55	0.51	0.77	0.72	0.73
Breusch−Godfrey	0.45	0.27	1.22	1.02	0.72	0.06	1.68	0.00
Breusch−Pagan	0.66	0.79	1.51	1.03	1.37	0.59	1.16	1.03
Ramsey RESET	9.10***	0.00	1.14	1.05	0.58	1.45	1.27	0.87
CUSUM	S	S	S	S	S	S	S	S
CUSUMSQ	S	S	S	S	S	S	S	S

Note: The levels of significance 1%, 5%, and 10% are symbolized by ***, **, and *. The *F* statistics of bound test and diagnostic test including Breusch-Godfrey, Breusch-Pagan, and Ramsey RESET are reported. Results of CUSUM and CUSUMSQ tests are either Stable (*S*) or Unstable (*U*).