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Asymmetric Impact of Exchange Rate on Trade Balance: How Do Country Characteristics Imply?

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Abstract

The study investigates the asymmetric impact of the exchange rate on aggregate trade balance of 45 countries taking account of country characteristics, including development, exchange rate system, openness, and export diversification. Employing non-linear autoregressive distributed lag (ARDL) methodology; the study comes to several findings. First, the exchange rate does have an asymmetric impact on aggregate trade balance across countries in both the short and long-run. However, either appreciation or depreciation shows a consistent superior effect on the trade balance in comparison with the other. Second, although results among country groups of development, exchange rate regime or openness are not obviously different, developed countries show the more powerful impact of exchange rate than developing countries on the average and insignificant effects of exchange rate on trade balance are found only in low openness countries. Finally, currency depreciation to improve trade balance widely works in higher diversified exporters but does not work in lower diversified exporters.

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1 INTRODUCTION

The effect of exchange rate changes on the trade balance has been demonstrated through the elasticity approach, Marshall-Lerner condition, and J-curve impact. Accordingly, domestic currency devaluation can be considered as one of the policy instruments to improve the balance trade. Complementary to the elasticity approach, the absorption approach stated that when the economy has not reached full employment, the devaluation policy can be useful under the Marshall-Lerner condition.

Many empirical studies have tested theories of elasticities and absorption. Most empirical studies in both developed and developing economies have shown that the Marshall-Lerner condition exists in the long run (ex. Bahmani-Oskooee [5]; Bahmani-Oskooee & Farhang [7]). Furthermore, the J-curve effect on the trade balance is demonstrated in studies of Wilson [36], Bahmani-Oskooee & Kara [10], Fang et al. [20], Pham [30]. However, several studies found that there is no relationship between exchange rate and trade balance in the long run (Wilson [36]), There also has no impact on exchange rate on trade balance only complies with J-curve effect in the long run but not in the short run (Bahmani-Oskooee & Brooks [6]; Huchet-Bourdon & Korinek [23]). It can be summarized that the impact of the exchange rate on trade balance varies upon the economies.

A common problem in most empirical studies is the assumption of symmetry. This assumption states that the impacts of exchange rate on trade balance when exchange rate increases or decreases are the same. Under this assumption, the linear regression model is employed; consequently, the result implies that the response of the trade balance to exchange depreciation is the same as its response to exchange rate appreciation. However, the behavior of exporters and importers is facing an increase in the exchange rate can differ from their behavior when the exchange rate decreases. In other words, the impact of the exchange rate on the trade balance is asymmetric like other financial indicators. Recent empirical studies such as Arize et al. [2], Bahmani-Oskooee & Fariditavana ([8], [9]), and Demian & Di-Mauro [16] have provided evidence of the asymmetric effect. However, these studies were limited in scope when they covered several economies with data of selected separated industries and trade partners. This study, therefore, aims to examine the impact of the exchange rate on trade balance under the assumption of asymmetry across countries with various economic status, exchange rate system, trade openness, and trade diversity. Within the larger scope, this study will provide a piece of obvious evidence about the systematic asymmetric impact of the exchange rate on the trade balance. The results of this study enhance prior knowledge in 2 main issues: (i) showing the systematic asymmetry of the impact of exchange rate on the trade balance, and (ii) comparing the different impact of exchange rate on trade balance among economies (developed countries versus developing countries, high open and diversified exporting countries versus their counterparts).

2 LITERATURE REVIEW

2.1 Theory of Impact of Exchange Rate on Trade Balance: Elasticity Approach and Absorption Approach

The impact of the exchange rate on trade balance has been concerned by both academy and policymakers for decades. Theoretically, the elasticity approach and absorption approach are prominent among several theories of this discipline. Regarding the elasticity approach, under the Marshall-Lerner condition, the J-curve effect can be used as the most appropriate visualization to describe the relationship. The main idea of the Marshall-Lerner condition and J-curve effect bases on the relative prices of domestic goods versus foreign goods. The nominal exchange rate, or exchange ratio of currencies, is adjusted according to the differences between the prices of domestic goods and foreign goods. Accordingly, the nominal exchange rate can be understood as the differences between the prices of domestic goods and foreign goods when they are calculated in the same currency (Edward [18]). Therefore, the Marshall-Lerner condition implies that real domestic currency devaluation (in fixed exchange rate system) or real domestic currency depreciation (in floating exchange rate system) can influence trade balance. For instance, under the assumption of an infinitely elastic supply curve, a domestic currency devaluation policy can help to improve trade balance when the sum of demand elasticity of importing and exporting goods being larger than 1.

An abundance of empirical studies on both developed and developing countries have confirmed the Marshall-Lerner condition. Despite many results, the majority of them have provided evidence of the existence of the Marshall-Lerner condition in the long run (Bahmani &Oskooee [5]; Bahmani, Oskooee & Farhang [7]). These empirical results imply two crucial issues: (i) a domestic currency devaluation policy only enhances trade balance in the long run, and (ii) demand for importing and exporting goods in the short run is less elastic than in the long run.

These issues can be explained by the J-curve effect, which was explored by Magee [27]. Magee [27] argued that a decrease in domestic currency value might lead to two main effects. (i) price effect, which causes a decrease in exporting price, an increase in importing price, and consequently, a worsening trade balance; and (ii) quantity effect, which causes an increase in exporting quantity, a decrease in importing quantity, and consequently, an improved trade balance. Both producers and consumers need time to adjust their quantity; therefore, price effect prevails over quantity effect, making trade balance worsening in the short run. On the other hand, the quantity effect tends to dominate in the long run and helps trade balance recover.

Complementarily, the absorption approach was developed in the 1950s in the studies of Harberger [22], and Laursen & Metzler [26]. This approach states that domestic currency devaluation can enhance trade balance only if the economy has not reached the full state of employment, where supply is over demand absorption. On the other hand, under full employment state, the devaluation cannot support the supply quantity; therefore, trade balance can be adjusted by a decrease in the absorption level. This approach suggests that the supply quantity should be controlled when considering the impact of the exchange rate on the trade balance. Imperfect substitute model, which was introduced by Goldstein & Khan [21], and Rose & Yellen [32], is proposed to solve this problem.

2.2 Empirical Studies on the Impact of Exchange Rate on Trade Balance: Symmetric versus Asymmetric Impact

Empirical studies on the impact of exchange rate on trade balance are diverse in term of (i) methodology, (ii) type of data on trade (aggregate data, bilateral data on trade, data of different industries), and (iii) scope (one country versus many countries).

In terms of data and scope, the majority of empirical studies employed aggregate data of trade, which is calculated as the sum of total exports and total imports of the economy. Several studies applied data on bilateral trade or data in selected industries. They found evidence that the impact of the exchange rate on trade balance can be different upon trade partners and industries. This result starts with a trend of empirical studies using disaggregated data after 2010. However, due to the emerging demand of policymakers for understanding the overall impact of exchange rate on the trade balance, aggregate data for many economies is more valuable to consider in this study.

Regarding methodology, Auboin & Ruta [3] summarized and classified them into two categories: before and after 2000. Before 2000, empirical studies focused on examining the Marshall-Lerner condition by basic traditional regression such as ordinary least squares and co-integration. Meanwhile, studies after 2000 have taken attention on both Marshall-Lerner condition and J-curve effect thanks to the development of new quantitative models such as vector auto-regression, auto-regressive distributed lag (ARDL) models and co-integration for VAR.

Another interesting issue concerned by recent studies is symmetric versus asymmetric assumption. Symmetric assumption shows the same absolute value between the increasing and decreasing magnitudes of trade balance when the exchange rate changes. While many “traditional models” before 2010, under the symmetric assumption, found limited evidence of J-curve effect (Bahmani-Oskooee & Farhang [7]), the new approach under asymmetric assumption provides the better results (Arize et al. [2]; Sollis [35]; Bahmani-Oskooee & Fariditavana [8]; [9]). The scenarios of the asymmetric impact include: (i) an increase or a decrease in domestic currency value that influences trade balance in both different signs and magnitudes, (ii) a decrease in domestic currency value enhances trade balance but an increase in domestic currency does not affect trade balance, and (iii) an increase in domestic currency value makes trade balance worsen, but a decrease in domestic currency does not affect the trade balance. These scenarios can be explained by different expectations between exporters and importers when facing changes in the exchange rate. In the case of domestic currency devaluation, exporters may quickly reduce the inventories to meet the emerging demand; however, in the case of domestic currency appreciation, importers may find difficulties to increase inventories because of rigid production.

Demian & Di-Mauro [16] suggested further explanation. This study focused on the behavior of exporters, which can be classified into 2 strategies when the domestic currency decreases: (i) keeping the price constant and gaining more profit from the change of exchange rate, or (ii) decreasing the price further to achieve higher market share and profit. In the short run, exporters tend to select to keep the price and gaining more profit rather than taking time and cost to expand production and distribution channels. Consequently, the export quantity just increases slightly. On the contrary, when domestic currency decreases, exporters can (i) decrease the export quantity and international market share, or (ii) lower the price to keep the market share. In this circumstance, exporters are to reduce the export quantity rather than export prices because of the complexity in the pricing decision. Therefore, although exchange rate policy targets to adjust the export quantity (Bernard & Jensen [11]), the absolute change on exports when domestic currency increases are lower than the absolute change on exports when domestic currency decreases. Table 1 below represents the flow of empirical studies on this topic in the last two years. Across various data set in both country and industry scale, recent studies have a trend to apply a non-linear ARDL model and found the asymmetric impact of the exchange rate on the trade balance. Under this assumption, the J-curve effect was found in more cases, which might be good evidence for policymakers to adjust the exchange rate policy. Our study also applies non-linear ARDL in panel data of a large scale of countries to identify the systematic asymmetric impact of the exchange rate on the trade balance. Furthermore, we will compare the impact among country groups after the economic crisis of 2008.

3 METHODOLOGY

3.1 General Research Model and Data Specification

To test hypotheses on the asymmetric impact of the exchange rate on the trade balance, we employed the common model by Rose & Yellen [32] with some modifications (model 1):

$$\mathrm{TB}_{i,t} = \alpha_i + \beta_i \mathrm{ER}_{i,t} + \gamma_i \mathrm{IP}_{i,t} + \varepsilon_{i,t} \quad (1)$$

Where i represents the country, t represents time, TB is trade balance (ratio of exports to imports), ER is the exchange rate, and IP is an industrial index – the proxy variable for economic production capacity. α denotes constant. β, γ are coefficients: β reflects the elasticity effect, γ reflects absorption effect.

In this model, the impact of the exchange rate follows the elasticity approach, whereas the impact of the industrial index represents the absorption approach. In line with other empirical studies, we applied model (1) in log-log form, where the regression coefficient represents elasticity of an independent variable to the dependent variable.

Regarding the measurements, TB_i is calculated by the ratio of exports to imports, whereas trade balance is surplus when TB>1, deficit when TB<1, and balance when TB=1. This calculation does not follow the common practice of economic statistics. However, it is common in empirical research with the two main advantages: one is free of the measurement unit, which helps to compare across countries, and explains both nominal and real values (Bahmani-Oskooee [5]). Another is positive value, which can be used in the log-log model. Data of TB was extracted from International Financial Statistics database. ER_i is the real multilateral exchange rate of country i, which represents the competitive trade capacity of country i to the rest countries of the world. An increase in ER shows the appreciation of currency value of country i compare to the basket of other currencies, and vice versa. Data of the real exchange rate of almost countries is extracted from the Bank for International Settlements. IP_i is an industrial index, which was produced by the Asian Regional Integration Center and International Financial Statistics. We used this index because it is available in short-time frequency (monthly) in all selected economies.

Regarding the coefficient, β is the main elasticity effect that we will consider the asymmetric value in the next section. Whereas, γ, representing the impact of economic production on the trade balance, is different in theory as well as across empirical studies. The theory on the relationship between trade and production shows that: (i) higher production leads to a higher demand for imports of production inputs, and (ii) higher production help to promote exports. Therefore, γ is larger than 0 when the change in export is bigger than the change in import, and vice versa, γ is smaller than 0 when the change in export is smaller than the change in import.

We use monthly data from 45 countries selected from January 2009 to December 2016. We select this period to avoid an unstructured point of the crisis periods of 2008, which can make the resulting bias. Moreover, this is the updated period, which can be used to compare with the previous period in other empirical studies.

3.2 Non-linear ADRL Model

To explore the short-run and long-run impact of the exchange rate on the trade balance, ARDL bound approach developed by Pesaran et al. [29] was employed in a non-linear form.

Model (1) is transferred into linear ARDL model as following:

$$\Delta TB_{i,t} = a_i + b_i T + \sum_{j=1}^{p1} c_{i,j} \Delta TB_{i,t-j} +$$

$$+ \sum_{j=0}^{p2} d_{i,j} \Delta ER_{i,t-j} + \sum_{j=0}^{p3} e_{i,j} \Delta IP_{i,t-j} +$$

$$+\theta_{i,1}TB_{i,t-1} + \theta_{i,2}ER_{i,t-1} + \\ +\theta_{i,3}IP_{i,t-1} + \varepsilon_{i,t} \quad (2)$$

where Δ denotes first difference, T is trending factor, j denoted lag level.

In this model, ER is decomposed into increasing effect (appreciation - AP) and decreasing effect (depreciation – DE), where AP and DE are followed the form of sum of sections (Delatte & Lopez-Villavicencio [15]):

$$AP_t = \sum_{m=1}^{t} \Delta ER_m^+ = \sum_{m=1}^{t} \max(\Delta ER_m, 0) \quad (3)$$

$$DE_t = \sum_{m=1}^{t} \Delta ER_m^- = \sum_{m=1}^{t} \min(\Delta ER_m, 0) \quad (4)$$

Then, trade balance equation can be developed into asymmetric ARDL model as model (5) below:

$$\Delta TB_{i,t} = a_i + b_i T + \sum_{j=1}^{p1} c_{i,j} \Delta TB_{i,t-j} + \\ + \sum_{j=0}^{p21} d1_{i,j} \Delta AP_{i,t-j} + \sum_{j=0}^{p22} d2_{i,j} \Delta DE_{i,t-j} + \\ + \sum_{j=0}^{p3} e_{i,j} \Delta IP_{i,t-j} + \theta_{i,1} TB_{i,t-1} + \\ + \theta_{i,21} AP_{i,t-1} + \theta_{i,22} DE_{i,t-1} + \\ + \theta_{i,3} IP_{i,t-1} + \varepsilon_t \quad (5)$$

Shin, Yu & Greenwood-Nimmo [33] indicated that model (5) is a nonlinear ARDL model, which has similar test procedures as the original linear model. Therefore, we apply the same technique strategy of Pesaran et al. [29] to identify the short-run and long-run asymmetric impact of exchange rate appreciation and exchange rate depreciation on the trade balance. According to Pesaran et al. [29], these estimation and testing procedures of ARDL bound test can work with variables in I(0), I(1) or both I(0) and I(1).

Step 1, identify the ARDL specifications: (i) whether there is intercept a, (ii) whether there is trending factor T, (iii) number of lag levels *p1, p21, p22, p3* of ΔTB, ΔAP, ΔDE and ΔIP. We use T-ratio test to identify the existence of intercept a and trending factor T, and minimum Akaike information criteria to identify the appropriate number of lag levels for other variables.

Step 2, test the co-integration relationship by F-test: null hypothesis H_0 as no co-integration relationship between trade balance, exchange appreciation and exchange depreciation ($\theta_{i,1} = \theta_{i,21} = \theta_{i,22} = \theta_{i,3} = 0$); and H_1 as there is co-integration relationship between trade balance, exchange appreciation and exchange depreciation ($\theta_{i,1} \neq 0$, $\theta_{i,21} \neq 0$, $\theta_{i,22} \neq 0$, $\theta_{i,3} \neq 0$).

The critical values of the test include upper limit and lower limit. We employ the critical value reported by Narayan [28], which is more appropriate for small sample size. If the statistic value from result is larger than upper limit, H_0 is rejected and the co-integration relationship exists.

Step 3, estimate the long-run impact of AP, DE, and IP on TB, calculated by standardizing $\theta_{i,1}$, $\theta_{i,21}$, $\theta_{i,22}$ and $\theta_{i,3}$ with $\theta_{i,1}$. The coefficient of AP is expected to be negative because an increase in exchange rate (an appreciation in domestic currency value) makes trade balance worsen in the long run. Meanwhile, the coefficient of DE is also expected to be negative because of the negativity inside DE decomposition.

Therefore, symmetric or asymmetric impact of the exchange rate on the trade balance can be explored by comparing ratios of coefficients of AP and DE, namely $\theta_{i,21}/\theta_{i,1}$and $\theta_{i,22}/\theta_{i,1}$. If $\theta_{i,21}/\theta_{i,1} = \theta_{i,22}/\theta_{i,1}$, impact of the exchange rate on trade balance is symmetric. Otherwise, this impact is asymmetric as following scenarios: (i) $\theta_{i,21}/\theta_{i,1}$ is statistically significant but $\theta_{i,22}/\theta_{i,1}$is not significant, and vice versa; (ii) both $\theta_{i,21}/\theta_{i,1}$ and $\theta_{i,22}/\theta_{i,1}$are statistically significant but $\theta_{i,21}/\theta_{i,1} \neq \theta_{i,22}/\theta_{i,1}$.The Wald test in the form of F test is employed to test the null hypothesis of asymmetric issue in the long run.

Step 4, short run impact of the exchange rate on trade balance can be identified through error correction model (ECM) by Engle & Granger [19] (model 6):

$$\Delta TB_{i,t} = a_i + b_i T + \sum_{j=1}^{p1} c_{i,j} \Delta TB_{i,t-j} +$$

$$+ \sum_{j=0}^{p21} d1_{i,j} \Delta AP_{i,t-j} + \sum_{j=0}^{p22} d2_{i,j} \Delta DE_{i,t-j} +$$

$$+ \sum_{j=0}^{p3} e_{i,j} \Delta IP_{i,t-j} + \rho EC_{i,t-1} + \mu_{i,t}$$

where EC is error correction from long run equation of TB, AP, DE and IP in model (5). In this model, exchange rate has short-run asymmetric impact on trade balance when sum of coefficients of appreciation (AP) equals, but in negative sign, sum of coefficients of depreciation (DE), $\sum d1_j$=-$\sum d2_j$. Otherwise, this impact is asymmetric. We also use the Wald test for the null hypothesis of asymmetric impact in the short run.

J-curve effect can exist as partial or total effect (Bahmani-Oskooee & Farid-itavana [8], [9]). Partial J-curve effect happens when only 1 condition is satisfied while total effect exists when both below conditions are satisfied:

long-run impact of AP (θ_{21}/θ_1 <0) is statistically negative and short-run impact of AP is statistically positive ($\sum d1_j$ >0) or even not statistical, and long-run impact of DE is statistically negative (θ_{22}/θ_1<0) and short-run impact of DE is statistically positive ($\sum d2_j$ >0) or even not statistical.

3.3 Classification of Country Characteristics

To examine whether exist different estimation results on this relationship relevant to country characteristics, studied countries are classified in terms of development, exchange rate regime, openness, and export diversification. Development classification relies on UNCTAD economic groups to divide countries into developed and developing groups as there is no least developed country in our sample. Annual Report on Exchange Arrangements and Exchange of IMF are relied on to classify countries into floating and pegged regimes. The floating government comprises floating and free-floating. While the pegged system includes the remaining, including other managed arrangements, pegged exchange rate within horizontal bands, craw-like settlement, crawling peg, stabilized arrangement, conventional peg, currency board, and no separate legal tender.

Regarding openness classification, a ratio of total trade to GDP of the World Bank is used to classify countries into high and low open countries. The benchmark for classification is the average trade-to-GDP ratio of all countries in the studied period. Top openness countries have a trade-to-GDP rate higher than average, and low openness countries have a trade-to-GDP ratio lower than average. In terms of export diversification, countries are classified into high and low diversified exporters dependent on exporting diversification index of IMF in 2009. The average index of all countries in 2009 is used as a benchmark, as the index has not been updated. High diversified exporters have index lower than average, and low diversified exporters have indexes higher than average. The expectation of how these country characteristics make different relationships between exchange rate and trade balance is theoretically and empirically are deficient. Nevertheless some studies indicated signals of differences. For example, Situ [34] corroborated trade balance in developed countries much suffers from exchange rate fluctuation than developing countries. In contrast, Romelli et al. [31] documented the exchange rate depreciation can improve trade balance and current account more strongly in a more open country.

Classifications of studied countries in terms of development, exchange rate regime, openness, and export diversification are summarized in Table 1. Column (2) displays there are 25 developed countries and 20 developing countries. Column (3) and (4) indicate there are 21 developed and 14 developing countries having floating regimes: four developed and six developing countries following the pegged system. In column (5) and (6), the calculated average trade-to-GDP ratio is 100, correspondingly, high openness countries include ten developed and seven developing countries, while low openness countries include the rest 15 developed and 13 developing countries. Calculated average export diversification index in column (7) and (8) is 2.22, based on which high diversified exporters include 14 developed and seven developing and low diversified exporters include 11 developed and 13 developing countries.

Table 1. Classification of development, exchange rate regime, trade openness and export diversification

(1)	Total (2)	Exchange rate regime		Openness (ratio of total trade to GDP)		Export diversification (Export diversification index)	
		Floating (3)	Pegged (4)	High (5)	Low (6)	High (7)	Low (8)
Developed countries	25	21	4	AT, BE, CY, CZ, ES, IE, LT, MT, NL, SG	CA, DK, FI, FR, DE, GR, IT, JP, KR, NO, PT, ES, SE, UK, US	AT, CZ, FR, DK, DE, GR, IT, LT, NL, PT, ES, SE, UK, US	CA, CY, EE, FI, IE, JP, KR, MT, NO, SG, BE
Developing countries	20	4	6	BG, HU, LV, MY, SI, TH, VN	BR, TR, RU, RO, PH, MX, IN, ID, HR, CO, CN, CL, PL	BG, HR, IN, LV, PL, SV, TU	BR, CL, CN, CO, HU, ID, MX, MY, PH, RO, RU, TH, VN

Source: Authors

4 ESTIMATION RESULTS

4.1 Long Run Estimation Results

As all variables are I(0) or I(1), they are appropriate to analyzed following the estimation and testing procedure of the ADRL bound test. Table 2 shows the results of the co-integration test and long-run estimation of developed countries and developing countries in the top and bottom panels, respectively. In table 3, column (6) and (7) presents ARDL specification; column (8) is F statistics of co-integration test; column (9), (10) and (11) are normalized long-run coefficients of AP, DE, and IP respectively. Although the F test results are failed to reject the null hypothesis in 38 countries, implying long-run relationship between TB and AP, DE, IP, long-run coefficients of AP and/ or DE are significant in 33 countries with various signs and magnitudes which can be categorized into three impact forms.

The first form involves significant expected negative impacts of appreciation and depreciation on trade balance including DK, EE, FA, JP, LT and CL, CO, VN.

The second form involves appreciation causes a significant expected negative impact the trade balance. At the same time, depreciation has (i) insignificant effect on the trade balance, including CA, TW, FI, DE, IE, US, and MY, RU, SI or (ii) significant positive impact on trade balance which is found in AT, KR, SG, ES. Primarily, this result is found only in floating exchange rate countries, except for RU, suggesting exchange rate movement toward whatever directions could deteriorate trade balance because risk aversion exporters would reduce production against exchange changes. Fang et al. [20] analyzed the decremental influence of depreciation on the trade balance is due to the dominant impact of exchange rate risk against improvement impact of currency depreciation.

The third form involves depreciation causes a significant expected negative impact on the trade balance. However, appreciation has (i) insignificant impact on trade balance found in CY, SE, UK and BG, LV, PL, TR, or (ii) significant positive impact on trade balance found in IT and ID, MX. Contrary to the inference under the second form, this impact form intimates exchange rate movement toward all directions is not harmful to trade balance. De Gauwe [14] explained the extent to which risk-aversion producers are influenced by exchange depends on the level of aversion. When exchange rate changes, if low-risk-aversion producers will decrease production due to lower marginal profit, high-risk-aversion producers will suppose the worst case and increase production as the trade-off for a decrease in expected revenue per one unit. Broll, Jack & Wing-Keung [12] also corroborated that the impact of exchange rate risk on trade depends on the elasticity of risk aversion.

Results of diagnostic tests in Table 3 also confirming for the existence of long-run relationships as all error correction terms in column (3), except for FI, IT, SE, CN, and CO, are significantly negative and vary from -1 to 0. DW, LM, reset, cusum and cusumsq tests in columns (5) to (9) also indicate all estimation models, except for FI, GR, BE, IT, PT, CO, MX are well-behaved. Correspondingly, we will focus our analysis on countries with significant negative error correction terms and a well-behaved model.

Among the three forms of exchange rate impact on the trade balance, the second and third forms affirm asymmetric characteristics of this relationship. Regarding the first form, appreciation and depreciation have opposite effects at different sizes in all countries, also implying asymmetry. For instance, appreciation and depreciation harm Japan's trade balance at 1.048 and 0.766, respectively; these figures in the case of Chile are 2.045 and 1.386, respectively.

There is no consistent evidence for the superior impact of appreciation or depreciation on trade balance. For instance, under the first impact form, appreciation shows stronger impact than depreciation in DK, FR, KR, LT, SG, VN and weaker impact than depreciation in AT, EE, JP, ES, CL, ID. As the results of Demian & Di-Mauro [16] and Arize et al. [2] are also opposite, this result could support neither one. However, on average, impact of appreciation is stronger than that of depreciation across countries.

The high asymmetric impact in three forms can explain for the exchange rate and trade balance across countries. First, long-run currency appreciation is one of the determinants of persistent trade balance deficit or cause to worsen trade balance such as the US, UK. Second, persistent trade balance surplus or upward trade balances are partly driven by currency depreciation. For example, HU, CY, PL have a downward exchange rate, thanks to which trade surplus in HU is maintained during the studied period, the trade balance in CY and PL are gradually improved, especially, trade balance in PL has turned to surplus since 2013. Third, depreciation is not always an effective solution to improve the trade balance in all cases because reduction can have either a positive or insignificant impact on the trade balance, such as the cases of MT, NO, CA, and IE. While currency depreciates in the long run, the trade balance is persistently deficit in MT and NO because depreciation has a positive impact on trade balance. CA and IE also have a downward exchange rate and the trade balance as exchange rates do not have a significant effect in these countries.

Besides, most countries show the significant negative impact of output on the trade balance, implying an increase in income can deteriorate trade balance due to higher demand for imports. There are seven countries, including IE, NO, BG, CL, CO, HU, and PH showing the significant positive impact of output on the trade balance, implying improvement of trade balance due to higher income.

4.2 Impact of Exchange Rate on Trade Balance: Country Characteristics

In table 3, column (3), (4) and (5) respectively display characteristics of exchange rate regime, openness, and export diversification following our classifications. Between developing and developed countries, the impact of the exchange rate on trade balance on average is more potent in the former than the latter, reflecting demand elasticity is higher in developed countries than in developing countries. However, the result of the more substantial impact of the exchange rate on trade balance is not consistent across individual developed countries; in other words, not all developed countries show the more significant effect of this relationship than developing countries do.

In comparison between pegged and floating countries, we could not find an apparent different result. IMF (2004) also argued the impact of the exchange rate on trade flows does not depend on either pegged or floating as the pegged does not mean a lower overall exchange rate fluctuation than the floating.

Similarly, we could not find a different result in the comparison between high and low openness countries, which is contrary to Romelli et al. [31]. Nonetheless, countries showing the insignificant impact of the exchange rate (both appreciation and depreciation) on trade balance are all low trade openness, including LT, BR, HR, HU, IN, PH, RO. The explanation for this result can rely on low elasticity demand for imports and exports of low openness countries.

In terms of export diversification, there is a noticeable difference between the high and the low. Under depreciation, countries showing the trade balance improvement are all in the top group, including CY, DK, EE, FR, DE, JP, LT, UK, BG, CL, ID, LV, PL, TR, VN. In contrast,, countries showing trade balance deterioration are mostly less diversified exporters, including KR, IR, LT, NL, NO, SG, ES. The reason is when the exchange rate decreases, countries with diversified export gain more from a large variety of products. In contrast, countries with less diversified export can only concentrate on some products to get a limited increase in quantity. Alemu & Jin-sang [1] also documented an insignificant impact on the trade balance of depreciation in a full sample, including small and unstable economies, and significant improvement of trade balance due to reduction is an example of the intense competitive manufacturing sector. IMF (2006) also argued the value of exports depends crucial on the nature of a country's predominant export.

4.3 Short Run Estimation Results

Short-run estimation results are presented in Table 4, in which only the short-run impacts of exchange rate are displayed for simplicity. In table 5, columns (3) to (14) show lagged has implications of the exchange rate in order 0 to 11, respectively; column (15) are total significant coefficients of lagged the exchange rate. Like the long-run impact, the short-run effect of the exchange rate on the trade balance is different in terms of the sign, magnitude, and order among countries. Either appreciation or depreciation influence the trade balance in IE, NL, ES, US, BR, BG and DK, DE, HR, VN, undeniably affirming asymmetric relationship in the short-run. Both appreciation and depreciation influence on trade balance in 19 countries, including AT, CA, CY, CZ, EE, JP, KR, LT, MT, NO, SG, UK and ID, LV, RO, RU, SI, TH, TR. However, the magnitudes of the total short-run impacts of appreciation and depreciation are unbalanced in all countries, also indicating the asymmetric effect of the exchange rate on trade balance.

Based on the long-run and short-run impacts of the exchange rate on the trade balance, perfect J- curve effect is found in four countries, including DK, FR, JP, CL, VN and partial J curve effect is found in 22 countries, including AT, CA, CY, EE, DE, IE, KR, NL, SG, ES, UK, US and MY, PL, RU, SI, TR.

5 CONCLUSIONS AND RECOMMENDATIONS

By using non-linear ADRL in the form of bound testing approach, this study separately investigates the impacts of appreciation and depreciation on aggregate the trade balance of 45 countries, which are classified in terms of development, exchange rate regime, trade openness and export diversification to compare results based on characteristics.

The study confirms exchange rate does have an asymmetric impact on aggregate trade balance across countries in both the short and long-run. This result is consistent with the asymmetric impact of the exchange rate on the disaggregate trade balance in previous studies. However, the study argues either appreciation or depreciation shows consistent superior impact on the trade balance in comparison with the other. However, the effect of appreciation is more reliable than that of reduction on average, which is supportive to the analysis of Demian & Di-Mauro [16]. Besides, the impact of exchange rate on the trade balance also follows a J-curve pattern, mostly in partial form. Only five countries are displaying the perfect J-curve effect.

Although results among country groups of development, exchange rate regime or openness are not obviously different, developed countries show a higher impact than developing countries on the average and insignificant impacts of exchange rate on trade balance are found only in low openness countries. Meanwhile, high and low export diversification creates exciting differences in the effect of depreciation. Currency depreciation to improve trade balance works in more top diversified exporters but does not work in lower diversified exporters.

Besides, the study also indicates output has both positive and negative impacts on trade balance across countries, in which most countries show the former impact form.

The results derived in this study have some obvious implications for policymakers. First, policymakers should no longer have the same assessments on the responses of trade balance under influences of appreciation and depreciation. Second, the ways exchange rate impacts on trade balance are variable across countries, exchange rate management to trade balance should rely on conditions of each country rather than copy from others. Third, when depreciation is under consideration as a solution for trade balance improvement, it should be done based on thorough prudential analysis. On the one hand, the reduction does not always improve the trade balance, especially in countries with less diversification of export products. On the other hand, currency depreciation influences different currency depreciation influences on other aspects of the economy, for instance foreign debt. Fourth, exchange rate fluctuation should be reduced in countries that show both appreciation and depreciation has a detrimental impact on the trade balance.

Analysis in this studied may be criticized due to some limitations. We ignore foreign demand in the trade balance function of each country as world output is not available at the monthly frequency, and it is complicated to calculate a weighted output of all foreign trade partners for each country. How country characteristics derive differences in the impact of exchange rate on the trade balance is figured out by comparison estimation results among sample groups but not by estimation themselves due to the natural limitation of time series model and unavailable proxies for these characteristics at high frequency. Also,, the study uses a simple benchmark for classifications of country characteristics as there is no criterion to classify countries into high and low openness or high and low diversified exporters.

Table 2. Results of cointegration test and normalized long-run coefficients

	Country	Exchange rate	Openness	Export diversification	ADRL specification		F statistics	Normalized long-run coefficients		
					Lag	Constant (C)/ Trend (T)		AP	DE	IP
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Developed countries										
1	AT	F (emu)	101	1.6	2,7,10,9	C, T	9.046***	-1.685***	1.170***	-0.752***
2	BE	F(emu)	159		1,3,1,8	C	14.038***	0.298	-0.138	0.282***
3	CA	F	62	2.0	8,10,10,4	C, T	8.762***	-0.345***	0.139	2.838
4	CY	F (emu)	114	1.9	7,11,11,9	C, T	5.118**	-0.697	-8.557***	-1.770***
5	CZ	F	144	1.9	12,12,11,12		3.777**	0.215	-0.052	-0.005
6	DK	P	99	1.8	12,0,7,6	C, T	6.353***	-0.519***	-0.538***	0.026
7	EE	P	155	1.7	3,9,2,8	C	4.710**	-1.048**	-0.837*	0.075
8	FI	F (emu)	76	2.0	12,10,11,10	C, T	10.250***	-2.010**	0.132	-0.483**
9	FR	F (emu)	58	1.6	1,1,0,2	C	22.034***	-0.393*	-0.464***	-0.826***
10	DE	F (emu)	83	1.6	1,0,0,2	C	19.770***	0.153	-0.252**	-0.351***
11	GR	F (emu)	59	1.8	7,5,12,5	C	8.278***	13.613	8.179	9.379
12	IE	F (emu)	198	3.3	9,2,0,11	C	8.488***	-1.261***	-0.204	0.333***
13	IT	F (emu)	54	1.5	12,11,11,12	C	6.212***	0.505***	-0.187*	-1.224***
14	JP	F	32	2.1	5,1,12,5		4.481**	-1.048*	-0.766*	0.011
15	KR	F	96	2.4	3,3,8,0	C, T	6.094***	-1.489*	1.803***	-0.056
16	LT	P	147	1.8	3,9,10,12	C	2.689	-4.463***	-4.476***	-0.631**
17	MT	F (emu)	300	3.9	7,11,12,7	C, T	5.477***	12.001***	-2.776	1.809
18	NL	F (emu)	146	1.4	1,2,0,0	C, T	11.411	-0.189	0.487***	0.103
19	NO	F	68	3.4	12,2,8,10		3.399**	2.843***	2.494***	0.045*
20	PT	F (emu)	74	1.6	5,0,0,6		2.943	8.912	6.77	-0.041
21	SG	F	358	2.7	2,2,4,0	C, T	7.420***	-1.125***	1.599***	0.073
22	ES	F (emu)	59	1.7	3,12,0,2	C, T	7.261***	-8.076***	2.023**	-1.468***
23	SE	F	86	1.7	2,7,0,3	C, T	19.503***	0.586	-0.328*	-0.019
24	UK	F	59	1.8	12,12,4,5	C, T	5.104**	0.188	-0.290***	-0.288**
25	US	F	29	1.5	3,1,4,3	C, T	4.935**	-0.702**	-0.055	-0.122
Developing countries										
26	BR	F	24	2.3	12,3,0,1	C	6.087***	-0.357	0.060	-2.243***
27	BG	P	119	1.9	1,2,0,3	C, T	14.368***	0.927	-0.769*	0.650***
28	CL	F	69	3.4	5,0,3,0		3.314*	-2.045***	-1.386***	0.106***
29	CN	P	49	2.0	12,3,0,2	C	3.435	0.756***	0.324	-0.514***
30	CO	F	37	3.0	4,11,12,12	C	12.280***	-1.650***	-0.471***	2.360***
31	HR	P	86	1.7	3,0,7,0	C	2.527	0.025	0.900	-0.010
32	HU	F	165	2.3	1,9,0,6	C	14.786***	-0.133	-0.112	0.140*

33	IN	F	46	2.2	1,0,0,0		4.422**	0.153	-0.063	-0.098***
34	ID	F	49	1.9	12,4,2,12	C, T	8.888***	1.403***	-0.452*	0.094
35	LV	P	115	1.7	1,1,10,7	C	20.627***	-0.253	-1.050**	-0.428***
36	MY	F	146	2.7		C	6.016***	-0.495**	-0.207	-0.284*
37	MX	F	66	2.4	3,2,2,2	C, T	5.316	0.228***	-0.175*	0.019
38	PH	F	65	3.3	3,0,0,0	C	2.409	-1.022	-0.413	0.651*
39	PL	F	89	1.7	1,0,0,5	C, T	15.504***	0.141	-0.264**	-0.859***
40	RO	F	78	2.0	11,10,1,4	C, T	3.708	1.809***	-0.249	-0.731
41	RU	P	48	3.4	10,9,11,6	C, T	11.603***	-0.823*	-0.323	0.576
42	SI	F (emu)	138	2.0	3,6,8,9	C, T	9.607***	-1.372**	-0.293	-0.614***
43	TH	F	130	2.0	4,9,2,8	C, T	4.040*	65.791	-17.423	0.5900
44	TR	F	49	1.8	10,3,8,12	C	4.718**	0.147	-0.663**	-1.893***
45	VN	P	163	2.5	1,0,9,0		10.525***	-0.248***	-1.321***	-0.053***

F: floating; P: pegged

***, **, * denote significant level at 1%, 5% and 10% respectively

Source: Authors' calculation

Table 3. Results of diagnostic tests

	Country	ECt-1	R-adjusted	DW	LM (4)	RESET	CUSUM	CUSUMSQ
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Developed countries								
1	AT	-0.950***	0.570	1.837	0.333	0.017	S	S
2	BE	-0.800***	0.584	1.958	0.234	5.350**	S	S
3	CA	-0.873***	0.695	1.920	0.083	0.508	S	S
4	CY	-0.765***	0.645	1.705	0.950	0.711	S	S
5	CZ	-0.652***	0.842	2.109	1.767	2.595	S	S
6	DK	-0.645***	0.471	1.979	2.138	0.066	S	S
7	EE	-0.763***	0.500	1.951	1.396	0.037	S	S
8	FI	-2.229***	0.582	1.787	3.148**	4.335**	S	S
9	FA	-0.960***	0.409	2.030	0.297	0.003	S	S
10	DE	-0.932***	0.517	2.062	1.452	2.366	S	S
11	GR	-0.197***	0.799	2.038	2.132*	3.606*	S	S
12	IE	-0.732***	0.584	2.143	0.702	1.465	S	S
13	IT	-5.095***	0.938	2.268	1.668	3.445*	S	S
14	JP	-0.141***	0.903	2.013	0.23	0.223	S	S
15	KR	-0.490***	0.815	2.026	0.679	0.393	S	S
16	LT	-0.534***	0.436	1.985	0.167	1.431	S	S
17	MT	-0.911***	0.355	2.004	0.726	2.023	S	S
18	NL	-0.784***	0.421	1.844	0.838	0.047	S	S
19	NO	-0.716***	0.821	2.092	1.423	0.205	S	S
20	PT	-0.088***	0.908	2.084	0.339	15.410***	S	S
21	SG	-0.892***	0.36	1.928	0.682	0.16	S	S
22	ES	-0.764***	0.870	2.29	1.229	0.096	S	S
23	SE	-1.437***	0.638	1.916	0.742	1.138	US	S
24	UK	-0.786***	0.485	2.176	1.016	0.028	S	S
25	US	-0.654***	0.407	2.087	0.47	0.492	S	S
Developing countries								
26	BR	-0.751***	0.636	1.880	0.975	1.906	S	S
27	BG	-0.859***	0.721	1.925	0.648	1.908	S	S

28	CL	-0.365***	0.720	1.853	0.109	1.756	S	S
29	CN	-1.140***	0.581	1.807	0.617	0.222	S	S
30	CO	-1.537***	0.913	2.085	0.687	5.598**	S	S
31	HR	-0.520**	0.102	2.032	0.562	0.014	S	S
32	HU	-0.821***	0.478	1.986	0.693	1.418	S	S
33	IN	-0.320***	0.510	2.133	0.421	0.050	S	S
34	ID	-0.867***	0.823	1.490	1.108	0.831	S	S
35	LV	-0.950***	0.631	1.885	0.532	0.305	S	S
36	MY	-0.672***	0.627	2.013	0.809	0.258	S	S
37	MX	-0.783***	0.342	1.895	0.685	5.276**	S	S
38	PH	-0.329***	0.468	1.958	0.828	1.152	S	S
39	PL	-0.946***	0.839	2.011	0.404	0.132	S	S
40	RO	-0.528***	0.778	2.034	0.874	0.07	S	S
41	RU	-0.890***	0.803	2.143	0.841	0.362	S	S
42	SI	-0.756***	0.718	2.098	0.869	0.008	S	S
43	TH	-0.037***	0.635	2.084	1.095	0.002	S	S
44	TR	-0.784***	0.755	2.090	0.478	0.569	S	S
45	VN	-0.723***	0.788	2.049	0.178	0.292	S	S

S: stable; US: unstable

***, **, * denote significant level at 1%, 5% v膝10% respectively

Source: Authors' calculation

Table 4. Results of short-run impact of exchange rate and output on trade balance

No	Co	Lagged of 蛸ER												Total impact
		0	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	-11	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Developed countries														
1	AT	Partial J curve effect												
	AP	0.073	0.479	1.324*	-0.044	1.736**	0.440	1.932***						4.992
	DE	0.935	0.282	-1.618**	0.735	-1.031*	-0.681	-1.559**	-1.702***	1.390**	-2.095***			-6.615
2	BE													
	AP	-1.238**	-0.827	-1.313***										2.551
	DE	0.959*												0.959
3	CA	Partial J curve effect												
	AP	-0.334	-1.423***	0.702*	0.720*	0.235	0.213	0.569*	0.692*	1.683***	0.691**			3.634
	DE	0.433	-0.535*	0.704**	-0.258	0.207	0.250	0.237	-0.248	-0.704**	0.752**			0.217
4	CY	Partial J curve effect												
	AP	9.555	-4.075	7.747	-3.570	5.631	5.582	-1.446	-4.612	-10.352*	-9.364	6.932		-10.352
	DE	-10.191**	10.473**	8.259	25.772***	0.442	8.419*	16.391***	-3.837	22.319***	5.478	21.589***		94.772
5	CZ													
	AP	0.080	-0.340	-0.338	0.420	0.627**	0.371	-0.471	-0.317	-0.182	0.998***	-0.29	0.466*	2.091
	DE	-0.434*	0.168	-0.124	-0.454*	-0.427*	-0.441*	-0.076	-0.318	-0.148	-0.709***	-0.610***		-3.075
6	DK	Complete J curve effect												
	AP													
	DE	0.566	1.425*	1.649**	1.934***	0.473	2.313***	2.122***						9.443
7	EE	Partial J curve effect												
	AP	-0.700	-1.280	0.912	-0.646	1.755*	0.079	0.844	2.064**	1.735*				5.554
	DE	-3.712***	2.446											-3.712
8	FI	Partial J curve effect												
	AP	2.129	4.688***	1.250	-0.265	2.436*	5.556***	2.477*	1.682	3.580***	4.087***			22.824
	DE	-3.114***	-1.461	1.655	-1.543	-2.841**	1.035	0.455	-0.941	-3.075**	-1.772	3.559***		-5.471
9	FR	Complete J curve effect												
	AP	0.782												
	DE													
10	DE	Partial J curve effect												
	AP													
	DE													
11	GR													
	AP	2.363	0.464	-3.254**	-1.343	-5.317***								8.571
	DE	-4.714***	-0.937	-3.907**	0.907	-5.119***	-2.870*	-7.004***	-2.177	-0.516	-5.181***	-1.023	-3.944**	-32.739
12	IE	Partial J curve effect												
	AP	0.916	2.129***											2.129
	DE													
13	IT	Partial J curve effect												
	AP	0.666	-3.624***	-3.167***	-2.335*	-3.530***	-4.060***	-3.483***	-1.286	-1.561	-0.211	1.715		-20.219
	DE	1.314**	1.574*	0.76	0.989	1.334	0.527	0.696	0.263	0.529	-0.342	-2.374***		0.514
14	JP	Complete J curve effect												
	AP	0.570*												0.570
	DE	0.437*	0.637**	0.530*	-0.249	-0.325	0.440*	0.497	0.315	0.326	0.101	0.695***		2.739
15	KR	Partial J curve effect												
	AP	0.547	1.346***											1.346
	DE	-0.144	-1.550***	-0.994***	-0.166	-1.255***	-0.576	-0.213	-0.886**					-3.691
16	LT													
	AP	0.075	-0.648	-0.507	4.070***	-2.436*	2.749*	-2.731**	4.781***	2.182*				8.615
	DE	-0.567	3.049**	4.545**	-2.867*	3.924**	3.338**	-0.249	2.761*	-5.219***	3.318***			12.849
17	MT													
	AP	1.633	-8.884	-16.868***	-6.726	-19.740***	-12.128**	-13.288***	-8.232*	-15.943***	-17.391***	-12.360**		-115.95

	DE	-3.884	2.146	6.803**	1.139	6.421*	-1.388	1.94	-4.352	6.513*	4.399	6.152*	7.172**	33.060
18	NL	Partial J curve effect												
	AP	-0.400	0.966**											0.966
	DE													
19	NO													
	AP	3.433**	-4.877***											-1.444
	DE	-1.518	1.42	-1.151	-3.801***	5.087***	-5.590***	1.946	-3.732***					-8.036
20	PT													
	AP													
	DE													
21	SG	Partial J curve effect												
	AP	0.403	1.486*											1.486*
	DE	-1.101	0.144	-0.921	-1.713*									-1.713
22	ES	Partial J curve effect												
	AP	-0.552	4.609***	3.861***	4.714***	3.881***	2.486***	3.969***	3.276***	3.165***	2.839***	1.581*	2.698***	37.085
	DE													
23	SE	Partial J curve effect												
	AP	1.489***	-0.753***	0.237	0.075	-0.485*	-0.207	-1.177***						-0.926
	DE													
24	UK	Partial J curve effect												
	AP	-0.361	-1.039	-0.605	0.294	-0.362	-0.012	-0.948**	-0.286	-0.452	-0.695*	-0.738*	0.458	-2.381
	DE	-0.125	1.399**	0.845	0.898*									2.297
25	US	Partial J curve effect												
	AP	0.513												
	DE	-0.474	-0.120	-1.137***	-0.879**									-2.016
Developing countries														
26	BR													
	AP	0.844	2.056***	1.722**										3.778
	DE													
27	BG	Partial J curve effect												
	AP	2.298**	-2.677**											-0.379
	DE													
28	CL	Complete J curve effect												
	AP													
	DE	-1.062**	1.334**	0.882*										1.154
29	CN													
	AP	2.788***	-2.087**	-1.595										0.701
	DE													
30	CO	Partial J curve effect												
	AP	-2.646***	1.399*	-0.197	0.706	-2.180***	-0.981	-1.945**	0.011	-2.120**	-0.456	-2.401***		-9.893
	DE	0.806	2.230***	1.830***	3.059***	3.547***	4.054***	2.531***	1.830***	2.189***	1.411**	2.130***	1.246**	26.157
31	HR													
	AP													
	DE	-0.165	-0.562	-0.413	-0.693	-0.38	-0.101	-1.198**						-1.198
32	HU													
	AP	0.210	0.211	0.250	0.466***	0.590***	0.299***	-0.084	0.165	0.464***				1.819
	DE													
33	IN													
	AP													
	DE													
34	ID													
	AP	0.820	-1.517**	-1.096**	0.023									-2.613
	DE	-1.888***	0.658											-1.888
35	LV													
	AP	-2.586**												-2.586
	DE	0.593	-1.245	-1.662*	-1.157	1.331	-2.224**	-0.09	0.457	-2.465***	1.07			-6.351
36	MY	Partial J curve effect												

	AP													
	DE													
37	MX	Partial J curve effect												
	AP	0.277	-0.157											
	DE	0.045	0.334**											0.334
38	PH													
	AP													
	DE													
39	PL	Partial J curve effect												
	AP													
	DE													
40	RO													
	AP	0.240	-0.859*	-0.483	0.11	-0.803**	1.164***	0.09	-0.162	-0.429	-0.895**			-1.393
	DE	0.851*												0.851
41	RU	Partial J curve effect												
	AP	0.234	0.986***	2.061***	1.140***	0.872***	0.904***	0.617**	0.251	1.125***				7.705
	DE	0.575***	0.143	-0.814***	0.115	0.458*	-0.189	0.396*	0.717***	-0.102	0.545**	0.763***		2.640
42	SI	Partial J curve effect												
	AP	-1.295	0.126	2.200**	0.529	1.364	2.755**							4.955
	DE	-0.145	3.042***	0.523	2.108***	-0.496	-0.237	2.529***	-0.935					7.679
43	TH													
	AP	-0.278	-3.095**	-1.96	2.071									-3.095
	DE	2.099*	1.779*											3.878
44	TR	Partial J curve effect												
	AP	0.462	0.725	1.221**										1.221
	DE	-0.944	0.166	-1.088*	1.308**	0.905**	1.008**	-0.214	0.850*					2.983
45	VN	Complete J curve effect												
	AP													
	DE	0.389	0.529	1.086	1.217*	0.879	-0.878	3.023***	1.13	1.069				4.240

***, **, * denote significant level at 1%, 5% v膝10% respectively
Source: Authors' calculation

Appendix. Selected countries and name code

	Developed countries			Emerging and developing countries	
No.	Name	Code	No.	Name	Code
1	Austria	AT	26	Brazil	BR
2	Belgium	BE	27	Bulgaria	BG
3	Canada	CA	28	Chile	CL
4	Cyprus	CY	29	China	CN
5	Czech Republic	CZ	30	Colombia	CO
6	Denmark	DK	31	Croatia	HR
7	Estonia	EE	32	Hungary	HU
8	Finland	FI	33	India	IN
9	France	FR	34	Indonesia	ID
10	Germany	DE	35	Latvia	LV
11	Greece	GR	36	Malaysia	MY
12	Ireland	IE	37	Mexico	MX
13	Italy	IT	38	Philippines	PH
14	Japan	JP	39	Poland	PL
15	Korea	KR	40	Romania	RO
16	Lithuania	LT	41	Russia	RU
17	Malta	MT	42	Slovenia	SI
18	Netherlands	NL	43	Thailand	TH
19	Norway	NO	44	Turkey	TR
20	Portugal	PT	45	Vietnam	VN
21	Singapore	SG	46		
22	Spain	ES	47		
23	Sweden	SE			
24	United Kingdom	UK			
25	United States	US			

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