Open Economies Review (2019) 30: 343–373
https://doi.org/10.1007/s11079-018-9510-3

RESEARCH ARTICLE

Real Exchange Rates and the Balance of Trade: Does the J-curve Effect Really Hold?

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Published online: 28 August 2018

Abstract

In this paper, we re-examine the relationship between trade flows, real effective exchange rates, and incomes by using the bilateral trade flows of 33 countries that form more than two-thirds of total world trade. For each country, we consider the bilateral trade flows of the country under consideration vis-à-vis all other countries. The analysis reveals the fact that for most of the countries, a real depreciation of the home currency has favorable effects on the home country's trade balance in the long run. This long-run effect manifests itself in the short run for a small number of countries, indicating the fact that satisfying the Marshall-Lerner condition in the short run is more difficult. However, there is no evidence for the J-curve phenomenon, which suggests an initial deterioration in the trade balance in the short run following a depreciation.

Keywords Competitive devaluation · Marshall-Lerner condition · J-Curve · Panel data · Panel data cointegration · CCE estimator

JEL Classification C23 · F10 · F30

1 Introduction

In this paper, we re-examine the relationship between aggregate trade flows, real effective exchange rates, and incomes by using a panel of 33 countries. A key issue in this literature is the extent to which trade flows are responsive to real price changes, more specifically, whether currency depreciation improves the trade balance, i.e.,

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whether the well-known Marshall-Lerner (ML) condition, a condition that is typically considered to be a long-run phenomenon, holds. On the other hand, the J-curve hypothesis, introduced in the literature by Magee (1973), asserts that it is also possible for a depreciation to worsen the trade balance in the short run before contributing to its improvement in the long run (see Rose and Yellen 1989).[1]

Several studies have attempted to distinguish the short-run effects of depreciations from their long-run counterparts to assess the validity of the J-curve hypothesis. A comprehensive review of the literature is provided by Bahmani-Oskooee and Ratha (2004) and Bahmani-Oskooee and Hegerty (2010). In this context, the short-run and the long-run effects of currency depreciation on the trade balance have largely been investigated by two lines of research. The first line employs trade balance data at the aggregate level between one country and the rest of the world.[2] The second and relatively more recent line of research uses trade data at the bilateral level between one country and its major trading partners (see, among others, Bahmani-Oskooee and Wang (2006) and Bahmani-Oskooee et al. (2005), and the references cited in Bahmani-Oskooee and Hegerty (2010)). Rose and Yellen (1989) were among the first to note the merits of using bilateral disaggregated versus aggregated data. They argued that since using aggregate trade data leads to the so-called "aggregation bias problem", one would need to use trade data and the exchange rate at the bilateral level to test the J-curve hypothesis. Not only has this line of research not provided conclusive evidence for the J-Curve pattern, but it has also failed, in many cases, to support any long-run relation between the trade balance and the real exchange rate.[3]

In this paper, we reconsider this literature by using the bilateral trade flow data of 33 countries that form more than two-thirds of total world trade. We estimate the long- and short-run dynamics for each country separately by using a panel of its trading partners. Our estimations reveal the fact that the real depreciation of the home currency has favorable effects on the home country's trade balance in the long run;

[1]Hence, the J-curve is identified with the negative effect of depreciations on the trade balance in the short run, given that the ML condition is established. As emphasized in the literature (see, for example, Bahmani-Oskooee and Wang (2008) and Bahmani-Oskooee and Hegerty (2011) this definition of the J-curve, which is due to Rose and Yellen (1989), is somehow different from its traditional definition. When Magee (1973) first introduced the J-curve in the literature, he did not make a distinction between the short run and the long run. Hence, traditionally, the J-curve hypothesis is characterized as the negative effect(s) of devaluation on the trade balance, which is followed by positive effects.

[2]This empirical literature dates back to the pioneering study of Bahmani-Oskooee (1985).

[3]Bahmani-Oskooee and Wang (2008) have opened up a third line of empirical research in the J-curve literature. They argue that since the response of the trade balance of a country with respect to changes in the exchange rate between the country in question and one of its trading partners varies by commodity, using industry-level trade data and the real bilateral exchange rate would increase the benefits from employing disaggregate trade data. In a series of papers, although Bahmani-Oskooee and his co-authors (see Bahmani-Oskooee and Wang 2007; Bahmani-Oskooee and Hegerty 2011 among others) have shown that the use of industrial-level data provides more evidence in favor of the J-curve, the evidence still remains inconclusive. The more recent research in this area has focused on nonlinear reactions of trade balance to exchange rate changes. Bahmani-Oskooee and Fariditavana (2015), Bahmani-Oskooee and Fariditavana (2016), Bahmani-Oskooee et al. (2016), and Arize et al. (2017) among others, have shown that the effects of appreciation are different than those of depreciation, which supports the presence of asymmetric effects of real exchange rate changes on trade balance.

hence, the ML condition holds. On the other hand, our analysis does not support the J-curve hypothesis.

The remainder of this paper is organized as follows. Section 2 outlines the model and the method used in its estimation. Section 3 describes the data and reports all of the results of our econometric analysis, as well as their interpretations. Section 4 concludes the paper.

2 The Model and Estimation Methods

We use a panel specification for the estimation of the trade balance model for each of the 33 countries. For each country, a panel trade balance model is estimated using the bilateral trade flows between the country and its trading partners. The classical workhorse trade balance model for country i, can be expressed as follows.[4]

$$\begin{aligned} b^i_{jt} &= \rho^i_j + \mu^i_j t + \alpha^i_j y^i_t + \beta^i_j e^i_{jt} + \gamma^i_j y_{jt} + u^i_{jt}, \\ t &= 1, 2, ..., T; \quad i, j = 1, ..., N; \quad i \neq j \end{aligned} \tag{1}$$

where N represents the number of countries and their trading partners included in our analysis, T is number of time periods, and t, as one of the regressors, is the common (cross-sectionally invariant) linear trend term. All variables are expressed in logarithms, and b^i_{jt} represents (the logarithm of) the balance of trade of country i vis-à-vis country j, defined as the ratio of nominal exports and imports of country i to and from country js at time t. Therefore, an improvement in the trade balance can be represented by an increase in b^i_{jt}, whereas a deterioration leads a decrease in its value. y^i_t refers to country i's income, whereas y^i_{jt} represents the income levels of country i's trade partners (country js), and e^i_{jt} denotes the real exchange rate of country i with respect to country j at time t. The real exchange rate is defined, in the usual manner, as the nominal exchange rate times the ratio of the foreign (j) and home (i) country price indices, where nominal exchange rates are expressed in units of domestic currency per unit US dollars. Hence, a decrease (increase) in the value of the real exchange rate indicates the appreciation (depreciation) of home country i's currency with respect to country j's currency. Therefore, the expected signs of the coefficient γ^i_j and β^i_j are positive, whereas a negative sign should be expected to be associated with α^i for all is.

Equation (1) provides us a framework to estimate γ^i_j and β^i_j for each country i separately by using appropriate panel data estimators. The parameters are allowed to vary over js, trading partners of country i to take into account cross-country (trade

[4]See, for example, Boyd et al. (2001), for a derivation of a similar equation from aggregate import and export functions. The model defines the trade balance as the ratio of exports to imports instead of its traditional one: the difference of exports from imports. The purpose of this re-definition is purely empirical. It makes possible to use an full logarithmic model. We also have estimated a semi-logarithmic model, in which the trade balance variable is defined in its traditional way as the difference between exports and imports whereas all the other variables are expressed in logarithms. The results of this estimation is provided in the Appendix A.3.

partner) heterogeneity. Allowing cross-country heterogeneity aims to capture the possible differences in the response of the trade balance of country i to the changes in the real exchange rates and incomes of its trading partners. Another important concern in our context is controlling for cross-sectional correlation, i.e., the interdependence across trading partners. It has been shown that this interdependence, i.e. the correlation across cross section units may have serious consequences if not accounted for.[5]

We account for these interdependence influences, or cross section correlation by using the common correlated effects (CCE) estimator of Pesaran (2006), which has become very popular in the empirical literature with a large number of applications. The approach has also been shown to work under very general conditions, including models with weak factors, dynamic models and even models with non-stationary data (see, for example, Chudik et al. 2011; Chudik and Pesaran 2013; Kapetanios et al. 2011; Persaran and Tosetti 2011; Pesaran et al. 2013).

To control for cross-sectional correlation, we incorporate the possible unobserved common effects into the model by using the error term, u^{i}_{jt}, for which the following multi-factor structure is assumed, for each i. Therefore, omitting the i subscripts for notational simplicity, we have the following:

$$u_{jt} = \lambda_j \mathbf{f}_t + \varepsilon_{jt}, \tag{2}$$

where $\mathbf{f}_t$ is an $m \times 1$ vector of the unobserved common factors common to all countries and ε_{jt} are the individual specific (idiosyncratic) errors.[6]

Given the parameter heterogeneity, to assess the overall effects of real exchange rates (of foreign incomes) on the trade balance of country i, we focus on the estimation of the average value of β_j (γ_j), namely, $E(\beta_j) = \beta$ ($E(\gamma_j) = \gamma$), assuming a random coefficient model, $\beta_j = \beta + \eta_j^1$ ($\gamma_j = \gamma + \eta_j^2$), for all i's, where $\eta_j^{1,2}$s are assumed to follow an i.i.d. process.

The CCE estimation of Eq. (1) is based on OLS regressions in which the cross-sectional averages of all variables, including the regressand, are included as additional variables to approximate the unknown common factors. In CCE estimation, although the observed common factors, i.e., the intercept, time trend and y_t are included explicitly, the unobserved common factors, $\mathbf{f}_t$ are approximated by cross-sectional averages, $\overline{b}_t$, $\overline{e}_t$ and $\overline{y}_t$.

In this paper, the mean value of β_j and γ_j are estimated by the pooled (identical slopes) version of the CCE (CCEP) estimator of Pesaran (2006). CCEP, as a pooled estimator, is preferable when the individual slope coefficients are in fact the same so that the efficiency gains from pooling observations over the cross-section units can be achieved. Since we assumed, at least in the long run, a homogeneous response

[5] As a result, the analysis of panel data sets with large time series and cross-sectional dimensions has started to assume that the individual units of the data sets are interdependent, and advancements in this branch of the literature have recently been surveyed by Sarafidis and Wansbeek (2012) and Chudik and Pesaran (2013).

[6] They are assumed to be distributed independent of y_t (country i's income income), y_{jt} (country i's trading partners incomes), e_{jt}, and $\mathbf{f}_t$ and allowed to be serially correlated over time. However, the common factors $\mathbf{f}_t$ can possibly be correlated with y_t, y_{jt}, and e_{jt}.

of the real exchange rate to the trade balance across countries, we simply adopt the CCEP estimator to achieve this efficiency. An alternative would be to adopt the mean group CCE estimator (CCEMG),[7] which is a simple average of the β_j and γ_js, i.e., individual CCE estimators, over js. Naturally, CCEMG should be used when the individual slope coefficients are thought to be different across cross-section units (hence, the overall effects can only be captured by averaging individual cases). We use CCEMG estimators when we estimate short-run effects, which are assumed to be different across trading partners.

As shown by Kapetanios et al. (2011), CCE estimators are consistent regardless of whether $\mathbf{f}_t$ is I(0) or I(1), given that u_{jt} is stationary[8] and the number of unobserved factors is a fixed number. For each country i in our data set, we also test whether u_{jt} in (1) is stationary , which is accomplished by using cross-sectionally augmented panel unit root (CIPS) tests. The CIPS test, due to Pesaran (2007), is also valid when the series are cross-sectionally dependent, as with CCE estimators. The CIPS test follows the CCE approach and eliminates the cross-sectional dependence by augmenting the ADF (CADF) regressions with cross-sectional averages in an approach similar to CCE estimators.

The short-run dynamics is modeled by the following panel error correction model. For each country i, we have the following:

$$\Delta b_{j,t} = \mu_j + \sum_{l=0}^{z} \kappa_j^l \Delta y_{t-l} + \sum_{l=1}^{s} \varphi_j^{b,l} \Delta b_{j,t-l} + \sum_{l=0}^{q} \varphi_j^{e,l} \Delta e_{j,t-l} + \sum_{l=0}^{p} \varphi_j^{y,l} \Delta y_{j,t-l} + \phi_j \hat{u}_{j,t-1} + \xi_{j,t}, \tag{3}$$

where $\hat{u}_{j,t-1}$ is the estimated residuals of (1). Δ, as usual, refers to the first-difference operator, and the coefficient ϕ_j provides a measure of the speed of adjustment of the trade balance to deviations from the long-run equilibrium described in (1).

3 Data

The data used in this paper are disaggregated (bilateral) trade data for a total of 33 countries. We use the bilateral trade flows of each of these 33 countries to obtain their bilateral trade statistics vis-à-vis their trading partners, which are accepted to consist of the remaining 32 countries in our data set. Table 1 illustrates the share of the bilateral trade flows of the 32 trading partners in the total trade of each country. As shown by the table, these shares vary between 64 to 94 and substantially cover the bulk of the

[7] We report the results associated with CCEMG estimators in Appendix A.2.

[8] Which implies that, in the case where $\mathbf{f}_t$ contains unit root processes, b_t, y_{jt}, e_{jt}, observed factor and $\mathbf{f}_t$ must be cointegrated. However, as shown by Kapetanios et al. (2011), the results on the estimators of β_j and γ_js hold even if the factor loading λ_j is zero (or weak in the sense of Chudik et al. (2011), and it is not necessary for b_t, y_{jt}, e_{jt}, observed factors and $\mathbf{f}_t$ to be cointegrated. What is required is that the idiosyncratic errors u_{jt} are stationary.

Table 1 Countries and trading partners' share in their total trade

Country	Parters' share (%)
UNITED STATES	82
UNITED KINGDOM	79
AUSTRIA	86
BELGIUM	86
FRANCE	79
GERMANY	80
ITALY	76
NETHERLANDS	84
NORWAY	85
SWEDEN	79
SWITZERLAND	86
CANADA	93
JAPAN	79
CHINA	64
FINLAND	72
SPAIN	77
TURKEY	64
AUSTRALIA	83
NEW ZEALAND	85
SOUTH AFRICA	67
ARGENTINA	78
BRAZIL	77
CHILE	80
MEXICO	94
PERU	81
SAUDI ARABIA	84
INDIA	65
INDONESIA	88
KOREA, REPUBLIC OF	79
MALAYSIA	87
PHILIPPINES	83
SINGAPORE	83
THAILAND	80

bilateral trade flows for each of the countries in our data sets. On the other hand, the total bilateral trade flows among the 33 countries considered in this study form almost two-thirds of total world trade. The bilateral trade flows of each countries are taken from Direction of Trade Statistics published by the IMF. The sources of all of the countries included in the analysis for the output, prices and exchanges rates are International Financial Statistics and the data set supplied by the University of Cambridge, Centre for Financial Analysis & Policy, GVAR toolbox website (http://www.cfap.jbs.

cam.ac.uk/research/gvartoolbox/), which is also used by Pesaran et al. (2009). We employ quarterly data covering the period of 1981q1-2010q2 for all countries.

4 Results of the Econometric Analysis

Following the estimation procedure in Holly et al. (2010), we first test the time series properties of the variables in the analysis by using CIPS unit root tests. Then, we estimate the parameters of the long-run relationship in (1) using CCE estimators and obtain the residuals. Finally, after checking the stationarity of these residual by using CIPS panel unit root tests, we estimate the parameters of the panel error correction Eq. (4) utilizing CCE estimators once again.

For each country i, the time series properties of b_{jt}, y_{jt}, e_{jt} are analyzed by using CIPS panel unit root tests, and in the case of y_t standard time series, ADF tests are used.[9] Overall, the same conclusion emerges from the CIPS test results for all 33 countries in our analysis. They convincingly indicate that although the unit root hypothesis cannot be rejected for all of the real output (either in panel or time series unit root tests), the results for the trade balance and real effective exchange rates are not unambiguous and exhibit variations across countries, and the underlying lags used CADF regressions. This result is not surprising from an economic perspective, considering that the hypothesis of a unit root in both the trade balance and the real exchange rate is a matter of debate. On the other hand, as noted above, since CCE estimators are robust to the mixed time series properties of the underlying regressors, this result does not constitute a concern for the econometric procedure used in this study (see Kapetanios et al. 2011).[10]

4.1 Estimation of the Long-run Response of the Trade Balance

Table 2 displays the CCEP estimation results of the long-run trade balance Eq. (1) for the 33 countries; we report the coefficient estimates of the real exchange rate and income together with their t statistics.[11] As shown by the table, in 25 countries, with the exception of the Belgium, Norway, Switzerland, Canada, South Africa, Argentina, Saudi Arabia, and Philippines the real exchange rate appear to have significant long run effects on the trade balance. In 23 of them, with the exception of Mexico and Peru, the real depreciation of the domestic currency leads to an improvement in the trade balance in the long run, supporting the validity of Marshall-Lerner condition. For most of the countries, the results indicate an improvement in the trade

[9]To capture the trend in real outputs, we run the CADF regressions with linear trends only. However, for the real exchange rate and trade balance, since the presence of the trend is not as apparent as it is for the real output, we prefer to run the CADF regressions, both with and without the linear trend, i.e., the intercept only.

[10]To save space, we do not report the results of the unit root tests for these 4 variables for all 33 countries in our sample. They are available upon request.

[11]To save space, the coefficient estimates of the observed factors and cross-sectional averages, which vary across trading partners of the country, are not reported. They are available upon request.

Table 2 The long-run trade balance equation estimation results

Country	e_t	t−stat	y_t	t−stat
UNITED STATES	**0.698**	**3.534**	**0.421**	**6.925**
UNITED KINGDOM	**0.570**	**1.666**	−0.198	−1.083
AUSTRIA	**1.066**	**2.910**	**1.024**	**4.668**
BELGIUM	0.196	1.186	**0.541**	**10.175**
FRANCE	**0.937**	**4.181**	**0.524**	**8.162**
GERMANY	**1.331**	**5.922**	**0.438**	**6.690**
ITALY	**2.169**	**8.370**	**0.587**	**8.770**
NETHERLANDS	**1.098**	**5.082**	**0.467**	**6.272**
NORWAY	0.419	1.293	**0.597**	**3.819**
SWEDEN	**1.637**	**3.073**	**0.660**	**5.651**
SWITZERLAND	0.208	0.731	**0.527**	**5.517**
CANADA	−0.621	−1.167	**0.293**	**3.015**
JAPAN	**1.189**	**6.092**	**0.441**	**6.405**
CHINA	**2.388**	**3.837**	**0.821**	**4.346**
FINLAND	**1.940**	**3.428**	**0.597**	**3.936**
SPAIN	**0.849**	**2.895**	**0.662**	**7.262**
TURKEY	**6.406**	**4.534**	0.367	0.678
AUSTRALIA	**1.587**	**6.315**	**0.352**	**4.140**
NEW ZEALAND	**1.751**	**3.980**	**0.581**	**2.763**
SOUTH AFRICA	−1.540	−0.932	**1.316**	**2.610**
ARGENTINA	−0.042	−0.039	**0.814**	**2.546**
BRAZIL	**1.476**	**3.168**	**−0.414**	**−2.322**
CHILE	**3.096**	**4.035**	**1.069**	**4.461**
MEXICO	**−2.103**	**−2.731**	**0.802**	**3.693**
PERU	**−2.334**	**−1.691**	**0.946**	**2.895**
SAUDI ARABIA	1.770	1.537	**1.327**	**2.878**
INDIA	**2.632**	**3.870**	0.054	0.228
INDONESIA	**3.133**	**2.331**	0.589	1.337
KOREA, REPUBLIC OF	**1.762**	**3.079**	**0.561**	**3.108**
MALAYSIA	**1.260**	**1.840**	0.215	1.119
PHILIPPINES	−0.749	−0.991	**1.897**	**6.043**
SINGAPORE	**0.544**	**1.798**	**0.519**	**4.857**
THAILAND	**3.374**	**3.478**	**0.734**	**2.032**

Embolden items refer to the significance at %10 percent level. The standard errors of t statistics are computed based on Newey-West type variance estimator of Equation (74) in Pesaran (2006)

balance of more than 1 percent as a result of 1 percent real depreciation. Only in the US, UK, France, Spain, and Singapore this impact on the trade balance appear to be less than 1 percent. Large improvements that are greater than 3 percent are observed in Chile, Indonesia, Thailand and Turkey.

To test the stationarity of the residuals of the long-run trade balance equation, for each country, we compute the CIPS panel unit root test statistics for the estimated residuals, computed as:

$$\hat{u}_{j,t} = b_{j,t} - \hat{\rho}_j - \hat{\mu}_j t - \hat{\alpha}_j y_t - \hat{\beta} e_{j,t} - \hat{\gamma} y_{j,t} \tag{4}$$

Table 3 CIPS tests for $\hat{u}_{jt}$

	CADF(0)	CADF(1)	CADF(2)	CADF(3)	CADF(4)
UNITED STATES	**−4.726**	**−3.957**	**−2.840**	−2.224	−2.441
UNITED KINGDOM	**−4.185**	**−3.336**	**−2.673**	−2.301	−2.424
AUSTRIA	**−3.708**	**−2.606**	**−2.129**	−1.690	−1.758
BELGIUM	**−4.495**	**−3.713**	**−2.750**	−2.293	−2.488
FRANCE	**−4.583**	**−3.470**	**−2.703**	−2.233	−2.243
GERMANY	**−4.284**	**−3.290**	**−2.818**	−2.201	−2.490
ITALY	**−4.207**	**−2.818**	**−2.350**	−1.761	−2.183
NETHERLANDS	**−4.670**	**−3.663**	**−2.772**	−2.354	−2.373
NORWAY	**−5.123**	**−3.647**	**−2.989**	−2.570	−2.520
SWEDEN	**−4.905**	**−3.734**	**−3.044**	−2.343	−2.561
SWITZERLAND	**−4.792**	**−3.627**	**−2.875**	−2.383	−2.245
CANADA	**−4.844**	**−3.814**	**−2.967**	−2.412	−2.519
JAPAN	**−4.098**	**−3.236**	**−2.667**	−2.073	−2.343
CHINA	**−3.977**	**−3.304**	**−2.836**	−2.572	**−2.725**
FINLAND	**−5.057**	**−3.766**	**−2.781**	−2.234	−2.314
SPAIN	**−5.164**	**−3.885**	**−2.933**	−2.544	−2.726
TURKEY	**−5.742**	**−4.148**	**−3.354**	**−3.059**	**−2.948**
AUSTRALIA	**−5.361**	**−3.963**	**−3.112**	**−2.594**	−2.491
NEW ZEALAND	**−5.724**	**−4.476**	**−3.320**	**−2.622**	−2.588
SOUTH AFRICA	**−5.579**	**−4.369**	**−3.705**	**−3.353**	**−3.213**
ARGENTINA	**−5.242**	**−4.160**	**−3.300**	**−2.798**	**−2.856**
BRAZIL	**−5.811**	**−4.518**	**−3.701**	**−3.192**	**−3.099**
CHILE	**−5.995**	**−4.317**	**−3.470**	**−2.973**	**−2.996**
MEXICO	**−4.439**	**−3.404**	**−2.734**	**−2.601**	**−2.600**
PERU	**−5.346**	**−4.064**	**−3.201**	**−2.941**	**−2.758**
SAUDI ARABIA	**−4.945**	**−3.698**	**−3.326**	**−2.974**	**−2.847**
INDIA	**−5.787**	**−4.246**	**−3.132**	−2.455	−2.372
INDONESIA	**−4.688**	**−3.386**	**−2.756**	−2.424	−2.227
KOREA, REPUBLIC OF	**−4.458**	**−3.271**	**−2.759**	−2.402	−2.402
MALAYSIA	**−4.421**	**−3.514**	**−3.000**	−2.583	**−2.606**
PHILIPPINES	**−5.156**	**−3.818**	**−3.193**	**−2.929**	**−2.928**
SINGAPORE	**−4.545**	**−3.470**	**−2.876**	−2.487	−2.435
THAILAND	**−4.828**	**−3.955**	**−3.169**	**−2.938**	**−2.854**

Embolden items refer to the significance at %10 percent level

Table 4 Cointegration test results

Country	Westerlund test			Banerjee-Silvestre test				
	Test Statistic	P-Value	Robust P-value	No Break	1 Break- M. 2	1 Break- M. 5	2 Breaks- M. 2	2 Breaks– M. 5
UNITED STATES	**−5.109**	**0.003**	**0.000**	**−8.254**	**−6.026**	**−3.926**	**−7.331**	0.110
UNITED KINGDOM	**−5.468**	**0.001**	**0.000**	**−5.741**	**−3.815**	**−4.182**	**−7.091**	**−5.566**
AUSTRIA	−1.352	0.881	0.900	**−5.938**	**−3.632**	**−1.758**	**−4.721**	−0.858
BELGIUM	**−5.338**	**0.001**	**0.000**	**−4.306**	**−2.905**	**−2.555**	**−4.908**	**−2.647**
FRANCE	**−4.827**	**0.006**	**0.010**	**−5.160**	**−5.575**	−0.934	**−5.058**	**−3.465**
GERMANY	−3.543	0.126	0.120	−0.274	−0.790	**−2.469**	0.955	−1.965
ITALY	**−7.553**	**0.000**	**0.000**	**−8.428**	**−4.268**	**−2.367**	**−6.478**	**−2.891**
NETHERLANDS	**−6.752**	**0.000**	**0.000**	**−2.287**	**−5.512**	**−3.327**	**−5.050**	**−4.359**
NORWAY	**−4.124**	**0.039**	**0.060**	**−7.741**	**−7.663**	**−3.010**	**−8.187**	**−2.386**
SWEDEN	−1.869	0.736	0.860	**−2.929**	**−3.215**	**−2.089**	**−2.968**	**−2.386**
SWITZERLAND	**−5.609**	**0.000**	**0.000**	**−4.138**	**−2.930**	**−4.409**	**−3.416**	−1.015
CANADA	**−3.713**	**0.092**	0.140	**−6.160**	**−5.999**	**−2.964**	**−4.171**	**−3.100**
JAPAN	−3.134	0.238	0.360	**−4.366**	**−3.941**	**−4.342**	**−3.483**	**−3.532**
CHINA	**−7.083**	**0.000**	**0.000**	−1.815	−1.860	−0.963	−4.013	0.853
FINLAND	**−5.469**	**0.001**	**0.000**	**−2.600**	**−2.980**	**−2.152**	**−3.590**	**−4.102**
SPAIN	**−4.280**	**0.027**	**0.030**	−1.467	**−2.784**	−1.321	**−3.051**	**−3.308**
TURKEY	**−5.269**	**0.001**	**0.000**	**−4.446**	**−3.164**	**−4.707**	**−5.199**	**−2.559**
AUSTRALIA	−3.445	0.149	0.230	**−4.580**	**−2.344**	**−2.139**	**−3.360**	**−1.331**
NEW ZEALAND	**−7.469**	**0.000**	**0.000**	**−5.617**	**−2.973**	**−3.930**	**−4.562**	**−2.302**
SOUTH AFRICA	**−4.049**	**0.046**	**0.040**	**−3.710**	**−3.753**	**−2.228**	**−3.546**	**−2.368**
ARGENTINA	**−5.960**	**0.000**	**0.000**	**−5.021**	**−6.731**	**−2.664**	**−5.699**	−1.328

Table 4 (continued)

Country	Westerlund test			Banerjee-Silvestre test				
	Test Statistic	P-Value	Robust P-value	No Break	1 Break- M. 2	1 Break- M. 5	2 Breaks- M. 2	2 Breaks– M. 5
BRAZIL	**−4.499**	**0.015**	**0.020**	**−7.525**	**−7.595**	**−5.246**	**−7.053**	**−2.887**
CHILE	**−7.836**	**0.000**	**0.000**	**−3.719**	**−4.184**	−1.156	**−4.443**	**−3.434**
MEXICO	**−4.684**	**0.009**	**0.020**	**−2.452**	**−2.573**	**−3.679**	−0.988	−1.173
PERU	−3.444	0.149	0.180	**−3.619**	**−4.856**	1.493	**−5.261**	**−2.869**
SAUDI ARABIA	−3.035	0.272	0.270	**−3.510**	**−3.393**	**−2.749**	**−3.470**	**−2.617**
INDIA	**−4.719**	**0.008**	**0.010**	**−5.239**	**−3.271**	**−3.757**	**−3.399**	**−7.844**
INDONESIA	**−4.700**	**0.009**	**0.000**	**−5.320**	**−5.513**	−1.463	**−5.468**	**−4.214**
KOREA, REPUBLIC OF	−2.744	0.383	0.510	**−3.788**	**−3.368**	**−7.278**	**−6.195**	**−2.923**
MALAYSIA	**−6.493**	**0.000**	**0.000**	**−6.142**	**−3.950**	−2.057	**−3.881**	**−3.183**
PHILIPPINES	**−5.132**	**0.002**	**0.010**	**−4.558**	**−5.360**	1.459	**−4.281**	−0.926
SINGAPORE	**−3.975**	**0.054**	0.120	**−4.008**	**−5.269**	**−3.023**	**−4.814**	**−3.762**
THAILAND	**−7.345**	**0.000**	**0.000**	−0.854	−0.025	−0.322	−0.822	−1.287

Embolden items refer to that cointegration cannot be rejected at %5 percent level. Robust p-value in Westerlund test refers to bootstrap tests. In Banerjee-Silvestre test M.2 and M.5 denote the model 2 and model 5 in Banerjee and Carrion-i Silvestre (2015)

where $\hat{\rho}_j = T^{-1}\sum_{t=1}^{T}(b_{j,t} - \hat{\mu}_j t - \hat{\alpha}_j y_t - \hat{\beta} e_{j,t} - \hat{\gamma} y_{j,t})$ and $\hat{\beta}$ and $\hat{\gamma}$ are CCEP estimators. We calculate the CADF statistics up to the 4th order.

As shown by the table, using the CIPS %10 critical value[12], we conclude in favor of the stationarity of $\hat{u}_{jt}$ for all countries up to lag 3, whereas the majority of these countries' tests statistics indicate the presence of unit roots at the 3th- and 4th-order lag (Table 3).

We proceed by testing the presence of cointegration by using 2 different panel cointegration tests. The first test is due to Westerlund (2007) where cross-section dependence is taken into consideration through a bootstrap version of the test (see Persyn and Westerlund 2008). The second one is developed (Banerjee and Carrion-i Silvestre 2015) and has the property of controlling both cross section dependence and structural breaks. The results are illustrated in Table 4. While Banerjee-Silvestre test indicate the presence of cointegration for most of the countries except a few cases, Westerlund test confirm these results only for some countries, but still does so for more than the majority of them.

4.2 Panel Error Correction Model

Having established the stationarity of the long-run residuals $\hat{u}_{jt}$, we estimate the panel error correction model in (4), setting $p = q = s = 1$.[13] Unlike the estimation of the long-run equation, when we estimate the short-run dynamics, we use CCEMG instead of CCEP estimators. Hence, although we expect a homogenous response of the trade balance across countries with regard to the long run, the same should not be expected for short-run responses. Since CCEMG estimators do not assume this homogeneity, we prefer to employ them in the estimation of the short-term effects. Table 5 presents the estimation results of panel error correction Eq. (5) for each country. We find evidence in favor of a significant positive relationship between exchange rate depreciation and the trade balance for 7 out of 33 countries in the short run. These countries include the United States, Germany, Italy, Switzerland, Spain, Philippines, Thailand. For all countries, the error correction coefficient (ϕ) estimates have the correct sign and are significant. They vary in the range of -0.19 to -0.45, indicating the fact that, once disturbed, only 19-45 percent of the disequilibrium is corrected each quarter, which implies a relatively slow convergence to disequilibrium, with half-lives ranging from 3.5 to 1.5 quarters.[14] On the other hand, except South Africa, because the short-run coefficients with negative signs do not appear to be significant in any of these countries, we could not find any support in favor of the J-curve hypothesis . As noted above, the J-curve hypothesis requires that deteriorating effects

[12]Table II(b) in Pesaran (2007) of -2.08 CADF equations contain an intercept only.

[13]In all cases, 1 lag has appeared to be sufficient to capture all short-run effects. In other words, allowing more lags does not alter the results presented here.

[14]The half-lives are computed according to the following formula: $-\frac{ln(2)}{ln(1+\phi)}$

Table 5 The short-run trade balance equation estimation results

	Δb_{t-1}	t-stat	Δe_t	t-stat	Δe_{t-1}	t-stat	Δy_t	t-stat	Δy_{t-1}	t-stat	$\hat{u}_{t-1}$	t−stat
UNITED STATES	**−0.089**	**−3.109**	−0.091	−0.903	**0.334**	**1.854**	0.498	1.330	**0.997**	**2.663**	**−0.337**	**−8.443**
UNITED KINGDOM	**−0.170**	**−7.192**	−0.134	−1.545	0.046	0.537	0.348	0.917	**1.098**	**2.447**	**−0.255**	**−8.235**
AUSTRIA	**−0.261**	**−12.289**	−0.119	−0.911	0.008	0.049	0.975	1.403	0.930	1.439	**−0.193**	**−6.924**
BELGIUM	**−0.110**	**−4.144**	0.190	1.314	0.121	0.848	**0.621**	**2.016**	**1.118**	**3.835**	**−0.292**	**−8.437**
FRANCE	**−0.165**	**−8.975**	0.214	1.400	0.068	0.533	**1.061**	**4.246**	**1.000**	**3.453**	**−0.297**	**−11.977**
GERMANY	**−0.192**	**−8.210**	**0.182**	**1.735**	0.000	−0.003	**1.194**	**4.103**	**1.233**	**6.050**	**−0.243**	**−10.057**
ITALY	**−0.298**	**−9.370**	**0.233**	**2.684**	**0.323**	**3.567**	**1.967**	**5.064**	**1.362**	**3.708**	**−0.208**	**−11.939**
NETHERLANDS	**−0.151**	**−6.786**	0.123	0.964	−0.044	−0.346	**1.156**	**3.862**	**0.792**	**2.121**	**−0.288**	**−11.146**
NORWAY	**−0.237**	**−9.990**	−0.422	−1.547	0.094	0.510	**1.817**	**2.261**	−0.454	−0.432	**−0.328**	**−9.261**
SWEDEN	**−0.211**	**−7.046**	0.261	1.416	0.046	0.363	**1.353**	**3.042**	0.342	0.412	**−0.296**	**−7.601**
SWITZERLAND	**−0.178**	**−6.671**	**0.326**	**1.822**	−0.003	−0.007	0.128	0.203	**1.466**	**3.012**	**−0.305**	**−10.779**
CANADA	**−0.163**	**−7.023**	0.127	0.666	−0.043	−0.182	0.580	0.967	**1.278**	**2.009**	**−0.335**	**−9.384**
JAPAN	**−0.123**	**−5.744**	0.071	0.948	0.014	0.138	**1.423**	**5.154**	**1.352**	**6.697**	**−0.249**	**−9.965**
CHINA	**−0.142**	**−5.061**	−0.029	−0.129	0.315	1.323	−0.432	−0.338	−0.183	−0.154	**−0.238**	**−9.454**
FINLAND	**−0.178**	**−6.470**	−0.185	−0.861	−0.302	−0.846	**2.691**	**3.408**	1.042	1.339	**−0.324**	**−10.690**
SPAIN	**−0.145**	**−5.820**	**0.538**	**2.169**	−0.540	−0.866	**1.750**	**2.371**	**1.343**	**1.844**	**−0.365**	**−11.673**
TURKEY	**−0.193**	**−7.247**	0.176	0.416	−0.234	−0.278	2.497	1.163	−2.474	−1.160	**−0.364**	**−11.944**
AUSTRALIA	**−0.170**	**−6.009**	−0.045	−0.317	−0.015	−0.125	**2.005**	**3.481**	0.738	1.424	**−0.371**	**−9.293**
NEW ZEALAND	**−0.122**	**−4.687**	0.108	0.503	0.048	0.124	0.954	0.675	0.144	0.164	**−0.446**	**−13.550**
SOUTH AFRICA	**−0.157**	**−5.718**	0.229	0.378	**−1.446**	**−2.029**	−1.507	−0.568	3.115	1.073	**−0.377**	**−10.411**
ARGENTINA	**−0.090**	**−3.512**	0.568	0.738	−0.255	−0.688	0.807	0.254	−0.025	−0.011	**−0.366**	**−10.389**
BRAZIL	**−0.116**	**−5.884**	−0.055	−0.220	0.120	0.548	1.711	0.925	−0.250	−0.228	**−0.408**	**−12.027**
CHILE	**−0.179**	**−7.489**	−0.447	−0.932	−0.312	−0.505	**5.004**	**2.147**	0.829	0.476	**−0.424**	**−10.224**

Table 5 (continued)

	Δb_{t-1}	t-stat	Δe_t	t-stat	Δe_{t-1}	t-stat	Δy_t	t-stat	Δy_{t-1}	t-stat	$\hat{u}_{t-1}$	t−stat
MEXICO	**−0.190**	**−5.977**	0.015	0.037	−0.319	−0.794	−0.053	−0.030	0.449	0.196	**−0.228**	**−8.976**
PERU	**−0.148**	**−5.434**	0.570	1.009	0.171	0.251	−0.109	−0.056	**5.535**	**3.310**	**−0.369**	**−9.672**
SAUDI ARABIA	**−0.218**	**−8.771**	0.567	1.409	0.362	0.367	−0.154	−0.035	−2.373	−0.460	**−0.269**	**−9.360**
INDIA	**−0.169**	**−6.205**	−0.672	−1.527	−0.108	−0.262	**2.760**	**3.290**	1.522	1.654	**−0.421**	**−9.805**
INDONESIA	**−0.212**	**−9.946**	−0.111	−0.320	0.872	1.335	**4.258**	**2.311**	1.063	0.621	**−0.277**	**−6.233**
KOREA, REPUBLIC OF	**−0.202**	**−10.367**	0.188	1.158	0.072	0.374	5.214	1.570	2.156	1.339	**−0.251**	**−9.558**
MALAYSIA	**−0.158**	**−6.065**	−0.105	−0.679	−0.189	−1.055	0.769	1.155	1.405	1.537	**−0.300**	**−8.083**
PHILIPPINES	**−0.200**	**−8.109**	**0.579**	**1.785**	0.376	0.698	0.699	0.500	1.960	1.287	**−0.322**	**−7.299**
SINGAPORE	**−0.163**	**−7.815**	−0.033	−0.211	−0.017	−0.098	**2.481**	**2.227**	0.847	1.210	**−0.301**	**−8.374**
THAILAND	**−0.151**	**−6.988**	0.014	0.041	**0.522**	**1.762**	**4.281**	**2.597**	1.800	0.971	**−0.316**	**−7.307**

Embolden items refer to the significance at %10 percent level. The standard errors of t statistics are computed based on non-parametric variance estimator of Equation (69) in Pesaran (2006)

on the trade balance should appear in the short run only before achieving long-run improvements.[15]

5 Conclusion

In this study, we have re-examined the long-run Marshall-Lerner condition and the short-run J curve relationship by using bilateral trade flow data for a group of 33 countries. The approach reveals the fact that the real depreciation of the home currency has favorable effects on the home country's trade balance in the long run; hence, the ML condition holds as a global phenomenon. However, this favorable effect can typically be observed in the long run. Only in 7 countries do we observe an immediate or lagged favorable impact in the short run on the trade balance. On the other hand, our analysis does not support the J-curve hypothesis, which states that a long-run favorable impact should be preceded by a deteriorating impact.

Following the recent orientations in the literature, extensions of the framework presented in this paper can be accomplished by incorporating industry/commodity level data into the analysis and considering a nonlinear functional form or a non-parametric method for the estimation of panel data models. While the former may provide valuable information in terms of the development industrial policy taken into consideration trade balance constraints, the latter can be useful in the analysis of possible asymmetric responses of trade balance to exchange rate changes.

Acknowledgements The authors would like to thank the Editor and two anonymous referees for their helpful comments and suggestions. The usual disclaimer applies.

Appendix

A.1 Results with CCEMG estimators

In this appendix we provide the estimation results when CCEMG is also preferred in the long-run estimation.

Table 6 provides the long-run coefficient estimates. In 22 countries, the real depreciation of the domestic currency leads to an improvement in the trade balance in the long run, supporting the validity of Marshall-Lerner condition. For most of these countries, the results indicate an improvement in the trade balance of more than 1 percent as a result of 1 percent real depreciation.

[15] It can be argued that not allowing more lags prevents the appearance of such effects. However, in all cases, 1 lag has appeared to be sufficient to capture all short-run effects. In other words, allowing more lags does not alter the results presented here.

Table 6 The long-run equation estimation results

Country	e_t	t−stat	y_t	t−stat
UNITED STATES	**1.250**	**4.395**	0.190	1.580
UNITED KINGDOM	0.501	0.799	0.021	0.160
AUSTRIA	**1.147**	**2.151**	0.243	1.017
BELGIUM	**0.728**	**1.967**	**0.224**	**1.852**
FRANCE	**1.018**	**3.562**	**0.342**	**2.536**
GERMANY	**1.663**	**6.114**	**0.257**	**3.529**
ITALY	**2.443**	**5.829**	**0.443**	**4.193**
NETHERLANDS	**0.632**	**1.848**	0.036	0.187
NORWAY	0.799	0.846	0.510	1.620
SWEDEN	**1.833**	**3.845**	**0.288**	**2.238**
SWITZERLAND	**0.889**	**1.978**	**0.229**	**1.787**
CANADA	**1.379**	**1.747**	0.157	1.045
JAPAN	**1.945**	**5.340**	**0.251**	**2.129**
CHINA	1.634	1.192	**0.584**	**2.930**
FINLAND	**2.226**	**3.479**	**0.554**	**2.746**
SPAIN	0.829	1.328	**0.480**	**2.357**
TURKEY	1.444	0.956	**1.144**	**1.765**
AUSTRALIA	**2.266**	**5.259**	0.141	0.739
NEW ZEALAND	**1.849**	**3.070**	0.243	1.017
SOUTH AFRICA	−0.649	−0.336	0.608	0.737
ARGENTINA	**1.965**	**1.778**	0.663	1.616
BRAZIL	**1.769**	**2.218**	**−0.489**	**−1.801**
CHILE	**3.517**	**3.847**	**1.134**	**5.242**
MEXICO	−1.085	−0.966	−0.237	−0.454
PERU	−1.976	−1.188	**1.124**	**1.977**
SAUDI ARABIA	0.143	0.078	**1.870**	**2.589**
INDIA	**1.883**	**2.395**	−0.211	−0.856
INDONESIA	**2.617**	**1.842**	0.254	0.648
KOREA, REPUBLIC OF	**4.194**	**3.124**	0.142	0.624
MALAYSIA	2.615	1.821	−0.154	−0.598
PHILIPPINES	0.279	0.304	**1.050**	**2.393**
SINGAPORE	**1.633**	**2.850**	**0.526**	**2.574**
THAILAND	**1.772**	**2.501**	0.237	0.615

Embolden items refer to the significance at %10 percent level. The standard errors of t statistics are computed based on Newy-West type variance estimator of Equation (74) in Pesaran (2006)

Table 7 presents the estimation results of panel error correction equations. We find evidence in favor of a significant positive relationship between exchange rate depreciation and the trade balance for only 3 countries in the short run. On the other

Table 7 The short-run equation estimation results

	Δtb_{t-1}	t-stat	Δe_t	t-stat	Δe_{t-1}	t-stat	Δy_t	t-stat	Δy_{t-1}	t-stat	$\hat{u}_{t-1}$	t-stat
UNITED STATES	**−0.088**	**−2.952**	−0.161	−1.578	**0.324**	**1.801**	0.464	1.201	**0.782**	**2.298**	**−0.339**	**−7.805**
UNITED KINGDOM	**−0.209**	**−8.441**	−0.104	−1.188	0.024	0.277	0.297	0.795	**1.057**	**2.355**	**−0.179**	**−6.582**
AUSTRIA	**−0.252**	**−11.308**	−0.209	−1.423	0.091	0.548	0.860	1.267	0.912	1.296	**−0.210**	**−8.489**
BELGIUM	**−0.093**	**−3.175**	0.109	0.775	0.126	0.884	0.300	0.795	**0.868**	**2.790**	**−0.323**	**−7.623**
FRANCE	**−0.165**	**−8.651**	0.188	1.227	0.102	0.798	**1.074**	**4.178**	**0.987**	**3.300**	**−0.294**	**−11.408**
GERMANY	**−0.190**	**−7.994**	0.153	1.449	0.028	0.295	**1.205**	**4.149**	**1.149**	**6.011**	**−0.245**	**−10.032**
ITALY	**−0.300**	**−9.599**	**0.218**	**2.481**	**0.345**	**3.809**	**1.970**	**5.053**	**1.319**	**3.570**	**−0.201**	**−12.663**
NETHERLANDS	**−0.207**	**−10.549**	0.072	0.499	0.005	0.039	**0.759**	**2.500**	0.597	1.643	**−0.171**	**−7.512**
NORWAY	**−0.193**	**−7.446**	−0.414	−1.525	0.071	0.374	**2.052**	**2.632**	−0.472	−0.486	**−0.414**	**−10.953**
SWEDEN	**−0.210**	**−6.775**	0.198	1.083	0.112	0.900	**1.193**	**2.729**	0.135	0.158	**−0.295**	**−7.018**
SWITZERLAND	**−0.168**	**−6.020**	0.264	1.540	0.060	0.173	0.228	0.355	**1.167**	**2.307**	**−0.326**	**−10.175**
CANADA	**−0.152**	**−6.568**	0.035	0.254	−0.082	−0.268	0.895	1.612	0.694	1.213	**−0.354**	**−10.142**
JAPAN	**−0.119**	**−5.673**	0.036	0.473	0.033	0.343	**1.474**	**5.513**	**1.144**	**5.763**	**−0.254**	**−9.093**
CHINA	**−0.148**	**−5.366**	−0.090	−0.437	0.343	1.502	**−0.855**	**−0.688**	−0.284	−0.238	**−0.225**	**−8.996**
FINLAND	**−0.178**	**−6.460**	−0.195	−0.903	−0.298	−0.835	2.743	3.470	0.974	1.238	**−0.325**	**−10.621**
SPAIN	**−0.200**	**−7.876**	**0.404**	**2.295**	−0.513	−0.774	**1.557**	**1.941**	1.111	1.541	**−0.258**	**−9.803**
TURKEY	**−0.207**	**−7.596**	0.652	1.396	−0.119	−0.138	2.857	1.508	−0.379	−0.209	**−0.340**	**−10.251**
AUSTRALIA	**−0.169**	**−5.767**	−0.099	−0.700	0.014	0.118	**2.034**	**3.600**	0.542	1.032	**−0.372**	**−8.691**
NEW ZEALAND	**−0.117**	**−4.500**	0.034	0.156	0.143	0.355	0.857	0.617	0.014	0.016	**−0.457**	**−13.744**
SOUTH AFRICA	**−0.164**	**−5.689**	−0.070	−0.113	**−1.330**	**−1.847**	−1.842	−0.692	2.544	0.878	**−0.364**	**−9.340**
ARGENTINA	**−0.070**	**−2.861**	0.589	0.841	−0.221	−0.653	0.851	0.283	−0.480	−0.204	**−0.402**	**−12.077**
BRAZIL	**−0.118**	**−5.964**	−0.063	−0.253	0.146	0.668	1.693	0.928	−0.350	−0.315	**−0.406**	**−11.932**
CHILE	**−0.181**	**−7.551**	−0.443	−0.923	−0.325	−0.523	**5.012**	**2.155**	0.613	0.353	**−0.420**	**−10.186**

Table 7 (continued)

	Δtb_{t-1}	t-stat	Δe_t	t-stat	Δe_{t-1}	t-stat	Δy_t	t-stat	Δy_{t-1}	t-stat	$\hat{u}_{t-1}$	t-stat
MEXICO	**−0.147**	**−4.751**	−0.272	−0.802	−0.165	−0.423	0.424	0.241	0.591	0.295	**−0.312**	**−12.619**
PERU	**−0.147**	**−5.371**	0.597	1.055	0.115	0.169	−0.093	−0.048	**5.415**	**3.255**	**−0.371**	**−9.618**
SAUDI ARABIA	**−0.224**	**−8.793**	0.615	1.345	0.152	0.149	1.604	0.350	−0.172	−0.035	**−0.247**	**−9.204**
INDIA	**−0.167**	**−6.185**	−0.741	−1.675	−0.019	−0.046	**2.599**	**3.008**	1.914	2.025	**−0.424**	**−10.084**
INDONESIA	**−0.215**	**−10.101**	−0.149	−0.425	0.963	1.468	**4.296**	**2.354**	1.247	0.763	**−0.273**	**−6.212**
KOREA, REPUBLIC OF	**−0.195**	**−9.476**	0.085	0.508	0.071	0.370	**5.448**	**1.657**	1.644	1.042	**−0.262**	**−8.304**
MALAYSIA	**−0.148**	**−6.152**	−0.180	−1.114	−0.144	−0.832	0.755	1.098	1.077	1.192	**−0.317**	**−8.495**
PHILIPPINES	**−0.198**	**−8.692**	0.378	1.393	0.529	1.133	1.181	0.881	**2.330**	**1.898**	**−0.332**	**−8.124**
SINGAPORE	**−0.154**	**−7.432**	−0.061	−0.392	−0.043	−0.239	**2.479**	**2.464**	0.531	0.730	**−0.318**	**−8.155**
THAILAND	**−0.152**	**−6.847**	−0.052	−0.152	**0.637**	**2.082**	**3.793**	**2.312**	1.941	1.050	**−0.315**	**−7.822**

Embolden items refer to the significance at %10 percent level. The standard errors of t statistics are computed based on non-parametric variance estimator of Equation (69) in Pesaran (2006)

hand, we could not find any support in favor of the J-curve hypothesis other than South Africa where a negative exchange rate coefficient appears to be significant. For all countries, the error correction coefficient estimates have the correct sign and are significant.

A. 2 Long-run Causality

In this paper, following the related literature we have assumed that the causality runs from real exchange rate to trade balance not vice versa. In this appendix we question this assumption and to what extend the data supports the possibility of an reverse causality running from trade balance to real exchange rate as in Zhang and Macdonald (2014). To accomplish this task we also estimate the below panel error correction equation with real exchange rate being the dependent variable.

$$\Delta e_{j,t} = \mu'_j + \sum_{l=0}^{z} \kappa_j'^l \Delta y_{t-l} + \sum_{l=1}^{s} \varphi_j'^{b,l} \Delta b_{j,t-l} + \sum_{l=0}^{q} \varphi_j'^{e,l} \Delta e_{j,t-l} + \sum_{l=0}^{p} \varphi_j'^{y,l} \Delta y_{j,t-l} + \phi'_j \hat{u}_{j,t-1} + \xi'_{j,t},$$

Together with Eq. (5), the above equation defines a panel vector error correction model with exogenous variables (PVECMX). Since all the ϕ_j in the trade balance equation (Table 5) are already found to be significant, testing the significance of the error correction coefficients ϕ'_j in the real exchange rate equation provides a test for the long-run non-causality from trade balance to real exchange rate versus bi-directional causality. Table 8 provides the estimation results of the above equation. As can be followed from the table, in only 8 of the 33 countries error correction coefficients appear to be significant.[16] This evidence supports the long-run non-causality from trade balance to real exchange rate.

Additionally we calculate the cointegration tests for the "reverse" equation of real exchange rate. Table 9 presents the results. As can be seen from the table, the results are in favor of cointegration only for a few countries and only for some test statistics. This result constitutes a sharp contrast with those that are presented in Table 5, where,

[16] Note that only in 5 of these 8 countries the sign of the coefficient is correct (a positive sign is correct unlike the trade balance equation in Table 5).

Table 8 The short-run equation estimation results

	Δe_{t-1}	t-stat	Δtb_t	t-stat	Δtb_{t-1}	t-stat	Δy_t	t-stat	Δy_{t-1}	t-stat	$\hat{u}_{t-1}$	t-stat
UNITED STATES	**0.127**	**7.122**	0.012	0.992	−0.005	−0.778	0.119	0.878	**0.268**	**2.446**	**0.010**	**2.100**
UNITED KINGDOM	**0.144**	**9.730**	−0.004	−0.930	0.002	0.482	−0.005	−0.033	**0.185**	**2.267**	**−0.007**	**−1.861**
AUSTRIA	**0.134**	**7.045**	0.001	0.388	0.001	0.324	0.059	0.383	**0.222**	**2.633**	0.001	0.640
BELGIUM	**0.158**	**8.092**	0.010	1.108	0.005	0.970	0.039	0.294	**0.165**	**2.117**	0.005	1.353
FRANCE	**0.123**	**6.827**	**0.010**	**2.590**	−0.001	−0.279	−0.033	−0.243	**0.161**	**1.759**	0.003	0.829
GERMANY	**0.156**	**7.542**	0.009	1.434	−0.001	−0.282	−0.030	−0.201	**0.188**	**1.977**	0.007	1.335
ITALY	**0.168**	**9.571**	**0.016**	**2.898**	−0.003	−0.700	−0.092	−0.650	0.113	1.425	−0.001	−0.222
NETHERLANDS	**0.146**	**6.545**	0.008	1.455	−0.001	−0.241	−0.006	−0.046	**0.162**	**1.987**	0.002	0.427
NORWAY	**0.144**	**8.825**	−0.003	−1.265	**−0.005**	**−2.273**	−0.004	−0.028	**0.257**	**2.959**	−0.001	−0.751
SWEDEN	**0.144**	**10.174**	0.000	−0.064	−0.007	−1.522	0.022	0.158	**0.154**	**1.781**	**0.010**	**1.993**
SWITZERLAND	**0.178**	**10.273**	**0.007**	**2.090**	0.003	1.116	0.032	0.258	**0.231**	**2.887**	0.003	1.082
CANADA	**0.130**	**9.225**	**0.007**	**2.006**	−0.003	−0.841	0.164	1.247	**0.293**	**2.960**	−0.002	−0.733
JAPAN	**0.159**	**10.788**	0.012	1.485	0.008	1.575	0.066	0.497	**0.250**	**2.341**	−0.003	−0.803
CHINA	**0.130**	**9.547**	−0.002	−0.539	−0.004	−1.470	0.061	0.415	**0.240**	**2.371**	0.000	−0.162
FINLAND	**0.165**	**10.716**	−0.004	−1.464	−0.004	−1.563	−0.015	−0.110	0.125	1.303	0.001	0.753
SPAIN	**0.147**	**8.459**	**0.008**	**2.403**	−0.001	−0.236	−0.057	−0.419	0.113	1.440	−0.003	−1.531
TURKEY	**0.154**	**12.462**	0.002	1.518	−0.002	−1.025	0.054	0.459	**0.339**	**2.924**	−0.001	−0.772
AUSTRALIA	**0.168**	**12.078**	−0.001	−0.286	−0.003	−1.098	0.075	0.511	**0.235**	**2.852**	−0.002	−0.638
NEW ZEALAND	**0.150**	**10.025**	−0.001	−0.275	**0.006**	**2.958**	0.062	0.414	**0.242**	**2.611**	**−0.005**	**−2.517**
SOUTH AFRICA	**0.159**	**11.471**	**0.002**	**1.669**	−0.002	−1.105	0.153	1.173	**0.220**	**2.344**	0.002	1.703
ARGENTINA	**0.127**	**9.858**	0.001	1.038	0.003	1.047	0.040	0.335	**0.270**	**2.658**	−0.001	−0.425
BRAZIL	**0.158**	**10.850**	0.000	−0.021	−0.001	−0.285	0.035	0.270	**0.281**	**2.961**	−0.004	−1.219
CHILE	**0.182**	**13.027**	0.000	0.175	0.001	0.346	0.056	0.398	**0.245**	**2.666**	0.001	0.403

Table 8 (continued)

	Δe_{t-1}	t-stat	Δtb_t	t-stat	Δtb_{t-1}	t-stat	Δy_t	t-stat	Δy_{t-1}	t-stat	$\hat{u}_{t-1}$	t-stat
MEXICO	**0.131**	**8.809**	−0.001	−0.423	−0.003	−1.526	0.119	0.878	**0.276**	**2.891**	0.003	2.802
PERU	**0.157**	**12.580**	−0.001	−0.573	−0.001	−1.224	0.028	0.240	**0.240**	**2.656**	0.002	1.213
SAUDI ARABIA	**0.091**	**4.509**	0.000	−0.100	0.001	1.180	0.113	0.894	**0.269**	**2.756**	0.002	1.371
INDIA	**0.190**	**11.111**	−0.003	−1.692	−0.001	−0.413	0.109	0.825	**0.279**	**2.867**	**−0.004**	**−3.250**
INDONESIA	**0.149**	**9.791**	−0.002	−0.721	**−0.004**	**−2.520**	0.036	0.283	**0.246**	**2.484**	**0.003**	**2.473**
KOREA, REPUBLIC OF	**0.149**	**9.896**	0.004	1.421	0.000	−0.069	0.000	0.000	**0.275**	**3.106**	0.002	1.007
MALAYSIA	**0.123**	**8.214**	−0.002	−0.848	−0.001	−0.387	0.044	0.325	**0.255**	**2.495**	−0.003	−1.182
PHILIPPINES	**0.152**	**10.567**	0.002	1.330	**−0.005**	**−1.874**	0.034	0.274	**0.283**	**3.392**	**0.007**	**4.207**
SINGAPORE	**0.096**	**6.671**	−0.001	−0.250	−0.002	−0.828	0.067	0.526	**0.195**	**1.946**	−0.003	−1.420
THAILAND	**0.129**	**9.724**	**0.004**	**1.869**	**−0.004**	**−1.909**	0.035	0.268	**0.326**	**3.070**	**0.003**	**1.931**

Embolden items refer to the significance at %10 percent level. The standard errors of t statistics are computed based on non-parametric variance estimator of Equation (69) in Pesaran (2006)

Table 9 Cointegration test results (Dependent variable: *e*)

Country	Westerlund test			Banerjee−Silvestre test				
	Test statistic	P-Value	Robust P-value	No break	1 break- M. 2	1 break- M. 5	2 breaks- M. 2	2 breaks- M. 5
UNITED STATES	−3.417	0.155	0.180	−0.499	−1.011	−0.379	0.579	0.94
UNITED KINGDOM	−3.271	0.195	0.240	0.204	−0.099	1.034	−0.535	−1.941
AUSTRIA	−1.555	0.833	0.810	−1.972	**−2.674**	−1.036	−0.388	0.267
BELGIUM	−1.020	0.937	0.960	0.859	2.9	0.111	1.173	1.444
FRANCE	−1.340	0.884	0.960	−1.656	−2.099	0.168	−1.69	−0.835
GERMANY	−1.603	0.820	0.860	**−2.572**	−0.438	0.762	−0.031	−1.271
ITALY	−1.403	0.870	0.900	**−2.452**	−1.451	0.257	**−2.54**	0.464
NETHERLANDS	−1.265	0.889	0.920	−0.504	−2.182	**−3.271**	−2.058	−1.717
NORWAY	−2.589	0.447	0.590	−0.993	−0.696	1.889	−1.706	−1.184
SWEDEN	−1.437	0.862	0.940	**−2.235**	**−2.727**	−1.428	−1.892	−2.634
SWITZERLAND	−1.877	0.733	0.710	−1.79	0.11	1.282	0.252	−1.244
CANADA	−2.371	0.539	0.510	−1.063	−2.101	1.258	−1.474	−0.359
JAPAN	−2.384	0.534	0.560	**−2.838**	−1.903	−1.644	−0.078	−1.837
CHINA	−2.285	0.574	0.650	−1.224	−1.68	−0.274	−1.937	−0.913
FINLAND	−0.528	0.980	1.000	−1.869	−0.981	1.873	−1.328	1.257
SPAIN	−0.725	0.968	0.960	**−2.593**	−1.722	−1.447	−2.058	−1.655
TURKEY	−3.043	0.269	0.330	−1.548	−4.278	2.053	−1.683	−1.854
AUSTRALIA	−2.480	0.493	0.590	−0.3	−0.765	1.17	−1.344	1.206
NEW ZEALAND	−1.916	0.720	0.750	−1.95	−1.32	−0.373	−1.706	−0.212
SOUTH AFRICA	−2.461	0.501	0.690	0.077	−0.743	−0.728	2.63	0.33
ARGENTINA	−4.601	0.012	0.020	−1.95	−0.676	−1.326	−0.294	−0.27

Table 9 (continued)

Country	Westerlund Test			Banerjee−Silvestre Test				
	Test Statistic	P-Value	Robust P-value	No Break	1 Break- M. 2	1 Break- M. 5	2 Breaks- M. 2	2 Breaks- M. 5
BRAZIL	−1.331	0.886	0.900	−0.671	−2.56	−1.974	−1.635	−1.366
CHILE	−2.660	0.415	0.510	**−2.791**	−1.282	1.9	−1.915	0.626
MEXICO	−3.469	0.143	0.160	**−2.652**	−2.8	2.09	−2.078	10.007
PERU	−2.607	0.439	0.450	**−2.329**	**−2.668**	−0.693	−1.762	−0.266
SAUDI ARABIA	−3.487	0.138	0.130	0.427	0.057	1.547	0.661	0.891
INDIA	−2.493	0.487	0.530	**−2.777**	−1.782	1.418	−1.913	−1.935
INDONESIA	**−4.625**	**0.011**	**0.020**	−1.509	−1.355	−0.796	0.421	0.842
KOREA, REPUBLIC OF	−2.155	0.628	0.760	−0.062	−0.588	−0.486	−0.688	−0.148
MALAYSIA	−3.064	0.262	0.370	**−3.179**	−1.977	−0.334	−1.219	0.746
PHILIPPINES	−1.987	0.694	0.700	−1.42	−1.76	**2.377**	−0.533	−1.141
SINGAPORE	−3.159	0.230	0.290	−0.9	0.775	−1.502	−0.542	0.456
THAILAND	−2.948	0.303	0.340	**−3.528**	−3.803	**−2.474**	**−3.278**	−0.461

Embolden items refer to that cointegration cannot be rejected at %5 percent level. Robust p-value in Westerlund test refers to bootstrap tests. In Banerjee-Silvestre test M.2 and M.5 denote the model 2 and model 5 in Banerjee and Carrion-i Silvestre (2015)

cointegration is supported by the data for almost all countries. This provides a further evidence on the uni-directional long-run causality running from real exchange rate to trade balance.

A. 3. Results with semi-logarithmic model

In this appendix we provide all the estimation results with trade the trade balance is defined as the difference between exports and imports, without taking its logarithm where all the other variables are expressed in logarithms.

Table 10 provides the long-run coefficient estimates. In 18 countries the real exchange rate appear to have significant long run effects on the trade balance. In 14 of them, the real depreciation of the domestic currency leads to an improvement in the trade balance in the long run, supporting the validity of Marshall-Lerner condition. The coefficients estimates indicate the response of trade balance in billion US dollars as a response to 1 percent change in the real exchage rate. The magnitudes vary across countries from 150 billion to 3.5 trillion (Japan).

Table 11 illustrates the CIPS panel unit root test statistics for the estimated residuals $\hat{u}_{jt}$. We conclude in favor of the stationarity for the majority of the countries up to lag 2, whereas the majority of these countries' tests statistics indicate the presence of unit roots at higher orders.

Table 12 shows the result of panel cointegration tests. Overall the results indicate the presence of cointegration for the majority of the countries.

Table 13 presents the estimation results of panel error correction equations. We find evidence in favor of a significant positive relationship between exchange rate depreciation and the trade balance for 10 countries in the short run. On the other hand, we could not find any support in favor of the J-curve hypothesis other than Malaysia, Switzerland and the UK, where a negative exchange rate coefficients appear to be significant. For all countries, the error correction coefficient estimates have the correct sign and are significant.

Table 10 The long-run equation estimation results

Country	e_t	t-stat	y_t	t-stat
UNITED STATES	−513.824	−0.803	−86.183	−0.305
UNITED KINGDOM	−236.647	−1.387	**−340.543**	**−4.439**
AUSTRIA	**193.683**	**2.967**	**31.531**	**2.309**
BELGIUM	**225.234**	**1.645**	28.708	0.622
FRANCE	96.551	0.371	**136.055**	**2.932**
GERMANY	**1072.489**	**3.321**	**396.101**	**3.724**
ITALY	**792.519**	**4.776**	**179.598**	**3.830**

Table 10 (continued)

Country	e_t	t-stat	y_t	t-stat
NETHERLANDS	−119.540	−0.721	37.178	0.429
NORWAY	**−166.490**	**−3.725**	11.032	0.525
SWEDEN	83.933	1.147	19.911	1.128
SWITZERLAND	**365.342**	**5.160**	11.774	0.722
CANADA	**−956.297**	**−4.172**	**−234.717**	**−1.888**
JAPAN	**3438.881**	**6.749**	246.945	1.583
CHINA	**749.831**	**1.648**	75.887	0.442
FINLAND	−7.138	−0.191	−5.511	−0.474
SPAIN	**−222.695**	**−2.069**	**−78.579**	**−1.895**
TURKEY	−119.212	−1.385	**60.955**	**2.764**
AUSTRALIA	**486.906**	**3.343**	−60.043	−1.338
NEW ZEALAND	37.057	1.536	**16.583**	**1.994**
SOUTH AFRICA	−8.756	−0.135	36.359	1.564
ARGENTINA	**−117.074**	**−2.970**	**−96.745**	**−3.960**
BRAZIL	**307.431**	**2.460**	−17.827	−0.436
CHILE	**371.328**	**4.949**	**155.897**	**5.547**
MEXICO	−337.435	−1.021	−96.473	−0.799
PERU	−19.219	−0.521	12.901	1.154
SAUDI ARABIA	**884.617**	**4.930**	−0.832	−0.017
INDIA	47.416	0.428	**−38.988**	**−1.983**
INDONESIA	**205.864**	**2.374**	**−68.127**	**−2.548**
KOREA, REPUBLIC OF	**1265.811**	**4.055**	−29.475	−0.351
MALAYSIA	162.666	1.005	1.454	0.037
PHILIPPINES	**149.141**	**2.619**	−15.287	−0.856
SINGAPORE	84.126	0.436	**320.901**	**3.501**
THAILAND	95.624	1.416	**96.501**	**4.393**

Embolden items refer to the significance at %10 percent level. The standard errors of t statistics are computed based on Newey-West type variance estimator of Equation (74) in Pesaran (2006)

Table 11 CIPS tests for $\hat{u}_{jt}$

	CADF(0)	CADF(1)	CADF(2)	CADF(3)	CADF(4)
UNITED STATES	**−3.924**	**−2.934**	−2.459	−1.793	−2.091
UNITED KINGDOM	**−3.846**	**−3.232**	−2.302	−1.716	−1.833
AUSTRIA	**−3.136**	−2.177	−1.808	−1.529	−1.646
BELGIUM	−2.386	−1.815	−1.353	−1.103	−1.173
FRANCE	**−4.863**	**−3.578**	−2.666	−2.088	−2.018
GERMANY	−2.420	−1.665	−1.319	−1.013	−1.084
ITALY	**−4.210**	−2.500	−2.415	−1.809	−2.247
NETHERLANDS	**−4.749**	**−3.746**	**−2.659**	−1.884	−2.255
NORWAY	**−4.860**	**−3.354**	−2.486	−1.892	−1.970
SWEDEN	**−3.568**	−2.500	−2.032	−1.730	−1.909
SWITZERLAND	**−4.186**	**−3.167**	−2.360	−1.981	−1.767
CANADA	**−2.999**	−2.135	−1.726	−1.465	−1.740
JAPAN	−2.575	−2.023	−1.566	−1.207	−1.557
CHINA	−0.196	−0.363	0.533	0.748	0.526
FINLAND	**−3.950**	**−2.815**	−2.280	−1.995	−2.032
SPAIN	**−4.622**	**−2.924**	−2.089	−1.606	−1.613
TURKEY	**−3.638**	**−2.699**	−2.118	−1.773	−1.686
AUSTRALIA	**−4.050**	**−2.949**	−1.977	−1.298	−0.984
NEW ZEALAND	**−5.345**	**−3.897**	**−3.222**	**−2.701**	−2.527
SOUTH AFRICA	**−5.236**	**−3.912**	**−3.113**	**−2.958**	**−2.629**
ARGENTINA	**−3.436**	**−2.719**	−2.113	−1.854	−2.022
BRAZIL	**−3.390**	−2.575	−1.910	−1.458	−1.341
CHILE	−2.579	−1.830	−1.588	−1.558	−1.529
MEXICO	−2.145	−1.533	−1.243	−1.087	−1.194
PERU	**−4.397**	**−3.079**	**−2.638**	−2.377	−2.193
SAUDI ARABIA	−2.394	−1.925	−1.571	−1.461	−1.462
INDIA	**−4.552**	**−2.879**	−2.159	−1.957	−0.931
INDONESIA	**−2.631**	−1.882	−1.306	−1.090	−0.905
KOREA, REPUBLIC OF	**−3.633**	**−2.610**	−2.027	−1.473	−1.481
MALAYSIA	**−2.886**	−2.085	−1.537	−1.282	−1.358
PHILIPPINES	**−3.381**	−2.427	−1.801	−1.656	−1.604
SINGAPORE	**−2.858**	−2.167	−1.621	−1.414	−1.282
THAILAND	**−3.420**	−2.522	−1.799	−1.451	−1.262

Embolden items refer to the significance at %10 percent level

Table 12 Cointegration tests results

Country	Westerlund test			Banerjee-Silvestre Test				
	Test statistic	P-Value	Robust P-value	No break	1 break- M. 2	1 break- M. 5	2 breaks- M. 2	2 breaks- M. 5
UNITED STATES	**−4.646**	**0.010**	**0.030**	−1.278	**−2.731**	1.235	**−2.816**	0.171
UNITED KINGDOM	**−4.729**	**0.008**	**0.000**	**−2.624**	−0.699	**−5.072**	**−2.576**	**−5.112**
AUSTRIA	−0.982	0.942	0.960	0.22	0.308	**2.343**	0.715	**4.037**
BELGIUM	−0.276	0.375	0.400	**−4.771**	**−4.693**	−1.215	**−4.501**	**−3.529**
FRANCE	**−3.734**	**0.089**	0.130	−1.306	0.554	−1.834	1.932	−1.282
GERMANY	−2.530	0.472	0.550	**−3.143**	**−2.583**	−0.2	−1.79	−4.491
ITALY	**−4.615**	**0.011**	**0.020**	−1.502	**−2.448**	0.025	−1.522	0.813
NETHERLANDS	**−5.995**	**0.000**	**0.000**	−0.952	−1.055	−1.285	1.041	**−7.098**
NORWAY	−3.560	0.122	0.180	**−4.908**	**−4.963**	**−4.964**	**−4.794**	−0.949
SWEDEN	−1.646	0.807	0.900	1.52	**2.327**	**−3.449**	1.513	**−3.859**
SWITZERLAND	**−5.914**	**0.000**	**0.000**	**−3.227**	**−4.915**	−0.476	**−4.02**	**−3.194**
CANADA	−3.277	0.194	0.270	1.05	0.701	−0.225	0.156	−1.465
JAPAN	**−4.904**	**0.005**	**0.010**	1.268	1.223	**−6.101**	0.474	**−2.882**
CHINA	**−4.268**	**0.028**	**0.040**	−1.142	**−3.268**	−0.714	**−3.696**	−1.696
FINLAND	**−8.769**	**0.000**	**0.000**	−2.1	**−2.35**	−2.049	−2.101	−0.482
SPAIN	**−3.870**	**0.068**	0.110	0.366	−0.071	−0.272	0.242	−0.935
TURKEY	**−0.397**	**0.055**	0.120	**−7.258**	**−3.72**	0.383	**−3.349**	−0.61
AUSTRALIA	−3.188	0.221	0.300	−1.233	0.598	1.433	0.558	0.211
NEW ZEALAND	**−6.250**	**0.000**	**0.000**	−1.943	**−3.267**	−0.876	**−2.374**	0.497
SOUTH AFRICA	**−4.033**	**0.048**	**0.060**	**−2.468**	−0.989	0.99	**−4.218**	0.117
ARGENTINA	**−3.652**	**0.100**	0.140	**−8.938**	**−9.636**	−2.207	**−5.512**	0.21

Table 12 (continued)

Country	Westerlund test			Banerjee-Silvestre Test				
	Test Statistic	P-Value	Robust P-value	No Break	1 Break- M. 2	1 Break- M. 5	2 Breaks- M. 2	2 Breaks- M. 5
BRAZIL	−2.711	0.396	0.500	0.245	0.289	0.497	−0.164	2.109
CHILE	−3.594	0.115	0.140	0.298	1.32	**−2.353**	−0.331	**−2.867**
MEXICO	−1.423	0.866	0.830	0.816	1.121	−0.573	1.173	−0.382
PERU	−1.787	0.764	0.770	−1.442	−2.197	**−2.444**	**−4.354**	**−3.333**
SAUDI ARABIA	−3.025	0.275	0.340	−1.586	−2.537	−2.757	−1.832	−0.581
INDIA	**−5.764**	**0.000**	**0.010**	**−3.308**	**−3.876**	−0.582	−1.759	**−3.608**
INDONESIA	**−5.356**	**0.001**	**0.000**	**−4.858**	**−5.35**	**−3.342**	**−4.296**	**−6.194**
KOREA, REPUBLIC OF	−2.011	0.685	0.690	**−3.746**	**−7.137**	**−3.156**	**−5.938**	−1.341
MALAYSIA	**−3.888**	**0.065**	**0.090**	**−3.642**	**−3.661**	−2.104	**−2.34**	**−3.456**
PHILIPPINES	**−4.137**	**0.038**	**0.080**	−0.821	−0.06	1.212	−0.39	0.156
SINGAPORE	−2.150	0.630	0.690	−1.056	−1.942	−0.732	−0.883	−0.99
THAILAND	**−5.932**	**0.000**	**0.000**	−0.994	−0.957	0.376	**−3.262**	1.795

Embolden items refer to that cointegration cannot be rejected at %5 percent level. Robust p-value in Westerlund test refers to bootstrap tests. In Banerjee-Silvestre test M.2 and M.5 denote the model 2 and model 5 in Banerjee and Carrion-i Silvestre (2015)

Table 13 The short-run equation estimation results

	Δtb_{t-1}	t-stat	Δe_t	t-stat	Δe_{t-1}	t-stat	Δy_t	t-stat	Δy_{t-1}	t-stat	$\hat{u}_{t-1}$	t-stat
UNITED STATES	**−0.230**	**−7.724**	−99.811	−0.279	453.498	1.156	−636.475	−0.587	**2808.172**	**1.811**	**−0.209**	**−7.200**
UNITED KINGDOM	**−0.163**	**−5.415**	**−659.201**	**−2.433**	−21.834	−0.168	270.062	0.286	800.732	1.521	**−0.226**	**−7.033**
AUSTRIA	**−0.298**	**−18.720**	16.022	0.131	−106.938	−0.895	**321.991**	**1.964**	−53.847	−0.338	**−0.117**	**−6.630**
BELGIUM	**−0.243**	**−6.821**	141.561	1.060	−228.493	−0.944	60.474	0.091	−292.612	−0.390	**−0.100**	**−4.094**
FRANCE	**−0.189**	**−6.062**	249.402	1.073	−178.340	−1.549	1069.388	1.480	**1557.153**	**1.981**	**−0.320**	**−8.148**
GERMANY	**−0.280**	**−10.466**	**856.505**	**1.682**	−270.252	−0.565	**2725.180**	**2.398**	997.169	1.062	**−0.085**	**−3.993**
ITALY	**−0.392**	**−12.769**	108.104	1.241	**335.453**	**1.696**	**1102.711**	**1.785**	936.181	1.305	**−0.154**	**−8.434**
NETHERLANDS	**−0.104**	**−5.046**	**434.427**	**1.810**	74.603	0.168	916.997	1.295	368.424	0.843	**−0.303**	**−8.825**
NORWAY	**−0.266**	**−7.826**	−63.624	−0.749	16.395	0.283	267.611	0.833	−149.086	−0.538	**−0.311**	**−6.918**
SWEDEN	**−0.294**	**−10.738**	−67.103	−0.972	−40.863	−0.940	358.801	1.442	−282.327	−0.958	**−0.174**	**−7.015**
SWITZERLAND	**−0.213**	**−8.783**	−138.509	−1.089	**−191.081**	**−1.767**	−163.914	−0.473	121.676	0.442	**−0.245**	**−6.397**
CANADA	**−0.270**	**−10.413**	−227.007	−1.081	−413.510	−1.217	−257.131	−1.097	873.377	0.903	**−0.129**	**−4.803**
JAPAN	**−0.187**	**−5.885**	**515.284**	**1.707**	87.288	0.707	1613.788	1.566	**3140.318**	**2.128**	**−0.108**	**−6.757**
CHINA	**−0.201**	**−5.037**	106.692	0.480	**440.137**	**2.170**	607.386	1.102	364.040	0.781	**−0.044**	**−2.669**
FINLAND	**−0.233**	**−8.013**	−54.434	−1.154	−2.889	−0.052	**349.119**	**2.137**	−282.090	−1.057	**−0.205**	**−8.211**
SPAIN	**−0.261**	**−7.697**	76.311	0.646	124.278	1.464	848.663	1.530	372.717	0.817	**−0.264**	**−5.784**
TURKEY	**−0.240**	**−9.356**	**50.554**	**1.653**	41.004	0.903	224.954	1.523	−113.616	−0.733	**−0.188**	**−5.958**
AUSTRALIA	**−0.278**	**−7.749**	−62.143	−0.743	−157.735	−1.632	128.028	0.336	**632.138**	**2.135**	**−0.213**	**−5.424**
NEW ZEALAND	**−0.226**	**−7.894**	31.196	1.164	−20.084	−1.063	55.050	0.584	80.388	0.978	**−0.366**	**−9.127**
SOUTH AFRICA	**−0.160**	**−4.760**	−29.267	−0.634	27.236	0.497	−28.555	−0.105	507.550	1.450	**−0.330**	**−9.669**
ARGENTINA	**−0.201**	**−6.108**	1.513	0.083	−4.002	−0.123	72.680	0.654	−213.585	−1.505	**−0.177**	**−6.109**
BRAZIL	**−0.203**	**−5.392**	−39.860	−0.820	−10.340	−0.171	−64.699	−0.254	191.244	0.429	**−0.196**	**−5.843**
CHILE	**−0.313**	**−10.182**	17.767	1.056	47.429	1.529	168.192	1.066	163.108	1.053	**−0.097**	**−4.368**

Table 14 The short-run equation estimation results

	Δtb_{t-1}	t-stat	Δe_t	t-stat	Δe_{t-1}	t-stat	Δy_t	t-stat	Δy_{t-1}	t-stat	$\hat{u}_{t-1}$	t-stat
MEXICO	**−0.279**	**−9.353**	−335.801	−1.085	4.447	0.059	−85.990	−0.239	37.544	0.160	**−0.063**	**−3.842**
PERU	**−0.235**	**−6.244**	−3.671	−0.239	3.220	0.159	40.983	0.533	58.494	1.208	**−0.251**	**−5.865**
SAUDI ARABIA	**−0.310**	**−11.667**	86.220	0.783	**88.821**	**1.990**	1381.423	1.140	−826.397	−0.962	**−0.100**	**−3.966**
INDIA	**−0.271**	**−6.462**	−16.332	−0.195	−35.545	−0.545	−161.192	−0.735	−62.170	−0.384	**−0.295**	**−6.668**
INDONESIA	**−0.284**	**−10.872**	−12.990	−0.173	−36.363	−0.564	−300.558	−1.236	130.922	0.863	**−0.102**	**−3.616**
KOREA, REPUBLIC OF	**−0.208**	**−5.815**	**204.552**	**2.033**	−115.961	−1.108	380.157	0.685	4.983	0.007	**−0.205**	**−5.283**
MALAYSIA	**−0.219**	**−7.043**	24.363	0.434	**−184.212**	**−1.771**	−198.596	−0.471	103.610	0.513	**−0.144**	**−4.979**
PHILIPPINES	**−0.257**	**−7.980**	**81.441**	**2.134**	48.106	1.275	19.110	0.158	94.996	0.832	**−0.158**	**−5.362**
SINGAPORE	**−0.257**	**−7.772**	69.293	0.624	**236.459**	**2.220**	197.285	0.947	339.832	0.724	**−0.138**	**−4.045**
THAILAND	**−0.222**	**−7.039**	33.724	0.773	28.109	0.289	114.248	0.764	−281.467	−1.370	**−0.189**	**−3.603**

Embolden items refer to the significance at %10 percent level. The standard errors of t statistics are computed based on non-parametric variance estimator of Equation (69) in Pesaran (2006)

References

Arize AC, Malindretos J, Igwe EU (2017) Do exchange rate changes improve the trade balance: an asymmetric nonlinear cointegration approach. Int Rev Econ Financ 49:313–326
Bahmani-Oskooee M (1985) Devaluation and the j-curve: some evidence from ldcs. The review of Economics and Statistics 500–504
Bahmani-Oskooee M, Fariditavana H (2015) Nonlinear ardl approach, asymmetric effects and the j-curve. J Econ Stud 42(3):519–530
Bahmani-Oskooee M, Fariditavana H (2016) Nonlinear ardl approach and the j-curve phenomenon. Open Econ Rev 27(1):51–70
Bahmani-Oskooee M, Goswami GG, Talukdar BK (2005) The bilateral j-curve: Australia versus her 23 trading partners. Aust Econ Pap 44(2):110–120
Bahmani-Oskooee M, Halicioglu F, Hegerty SW (2016) Mexican bilateral trade and the j-curve: an application of the nonlinear ardl model. Econ Anal Policy 50:23–40
Bahmani-Oskooee M, Hegerty SW (2010) The j-and s-curves: a survey of the recent literature. J Econ Stud 37(6):580–596
Bahmani-Oskooee M, Hegerty SW (2011) The j-curve and nafta: evidence from commodity trade between the us and mexico. Appl Econ 43(13):1579–1593
Bahmani-Oskooee M, Ratha A (2004) The j-curve: a literature review. Appl Econ 36(13):1377–1398
Bahmani-Oskooee M, Wang Y (2006) The j curve: China versus her trading partners. Bull Econ Res 58(4):323–343
Bahmani-Oskooee M, Wang Y (2007) The j-curve at the industry level: evidence from trade between us and australia. Aust Econ Pap 46(4):315–328
Bahmani-Oskooee M, Wang Y (2008) The j-curve: evidence from commodity trade between us and china. Appl Econ 40(21):2735–2747
Banerjee A, Carrion-i Silvestre JL (2015) Cointegration in panel data with structural breaks and cross-section dependence. J Appl Economet 30(1):1–23
Boyd D, Caporale GM, Smith R (2001) Real exchange rate effects on the balance of trade: cointegration and the marshall–lerner condition. Int J Financ Econ 6(3):187–200
Chudik A, Pesaran MH (2013) Large panel data models with cross-sectional dependence: a survey. CAFE Research Paper (13.15)
Chudik A, Pesaran MH, Tosetti E (2011) Weak and strong cross-section dependence and estimation of large panels. Econ J 14(1):C45–C90
Holly S, Pesaran MH, Yamagata T (2010) A spatio-temporal model of house prices in the usa. J Econ 158(1):160–173
Kapetanios G, Pesaran MH, Yamagata T (2011) Panels with non-stationary multifactor error structures. J Econ 160(2):326–348
Magee SP (1973) Currency contracts, pass-through, and devaluation. Brook Pap Econ Act 1973(1):303–325
Persyn D, Westerlund J (2008) Error-correction-based cointegration tests for panel data. Stata J 8(2):232–241
Pesaran MH (2006) Estimation and inference in large heterogeneous panels with a multifactor error structure. Econometrica 74(4):967–1012
Pesaran MH (2007) A simple panel unit root test in the presence of cross-section dependence. J Appl Economet 22(2):265–312
Pesaran MH, Schuermann T, Smith LV (2009) Forecasting economic and financial variables with global vars. Int J Forecast 25(4):642–675
Pesaran MH, Smith LV, Yamagata T (2013) Panel unit root tests in the presence of a multifactor error structure. J Econ 175(2):94–115
Pesaran MH, Tosetti E (2011) Large panels with common factors and spatial correlation. J Econ 161(2):182–202
Rose AK, Yellen JL (1989) Is there a j-curve? J Monet Econ 24(1):53–68
Sarafidis V, Wansbeek T (2012) Cross-sectional dependence in panel data analysis. Econ Rev 31(5):483–531
Westerlund J (2007) Testing for error correction in panel data. Oxf Bull Econ Stat 69(6):709–748
Zhang G, Macdonald R (2014) Real exchange rates, the trade balance and net foreign assets: long-run relationships and measures of misalignment. Open Econ Rev 25(4):635–653