Do Exchange rate changes have symmetric or asymmetric effects on the remittance flow of Bangladesh from Saudi Arabia? Evidence from Time Series data from 1990 to 2016.

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Abstract:

This paper attempts to study the impact of exchange rate changes on wage earners remittance inflow from Saudi Arabia (SA) to Bangladesh (BD) for the period of 1990,Q3-2016,Q3. Both linear and non-linear ARDL in the adjustment processes are employed for Bahmani-Oskooee (2016) ARDL trade model to figure out the exchange rate impact on inward remittance flow. We observe both the short-run and long-run symmetric effects of exchange rate changes on the remittance influx to Bangladesh from Saudi Arabia. The coefficient of the real exchange rate variable is positive and significant in linear ARDL. In non-linear ARDL as well, symmetricity is observed in terms of duration and sign of the inward remittance of Bangladesh from Saudi Arabia. Simply, remittance from Saudi Arabia to Bangladesh is significantly and positively elastic with exchange rate means that higher exchange rate will induce migrant labourers to send higher level of remittance from abroad.

Keywords: Wage Earner Remittance flow, Exchange Rate, Linear and Non-linear ARDL.

JEL Classification F31

1. Introduction

Inward remittance earning by the expatriate workers of Bangladesh is an important topic for many empirical researchers of Bangladesh. Continuous remittance influx helps Bangladesh economy to keep it current account balance positive since 1990s. Like many other developing countries though the trade balance of Bangladesh is negative the overall current account balance is positive due to the role of ceaseless remittance influx particularly from Middle Eastern, South East Asia, Europe and North American countries. However, Saudi Arabia is the highest contributor in remittance earning of Bangladesh since the maximum level of migrant workers are staying in this country. The earlier researches put their concentration on overall remittance income of the country but the country specific attempt is not yet done by the empirical researchers. Initially, the studies attempts to show the link between devaluation and income level of the host countries through VAR analysis. The aggregation bias inherent in these studies could be circumvented through studies on bilateral remittance of a specific country with her partners. This issue is always boldly ignored by the existing research works of remittance flow between two countries. The currents trend rests mainly on panel data basis which is done by the cross country disaggregated data. However, country specific remittance flow between or among several partners provides a new cue to reexamine the symmetric or asymmetric link in a meaningful way. This author failed to get any research work that explores exchange rate impact in case of Bangladesh remittance earning from Saudi Arabia.

As remittance earning for developed countries has very little importance the researchers of those countries are highly reluctant to employ themselves for such works. That's why, there are scant empirical work on the link between the exchanges rate changes and the remittance earning by Bangladesh with her workers host partners around the world. There are also no studies on skilled and unskilled specific remittance earnings too. This study is the first attempt to show exchange rate variability on remittance earning by Bangladesh from Saudi Arabia. The remittance earning of Bangladesh from the rest of the world in December 2016 was about 12 thousands crore taka and contribution in it by only Saudi Arabia is 20%. About 1.5 millions migrant workers are presently in Saudi Arabia from Bangladesh. So, the contribution of Saudi Arabia in wage earners remittance income of Bangladesh is enormous. That is why; the objective of this paper is to test whether any relationship between exchange rate fluctuations and remittance earning of Bangladesh from Saudi Arabia is there.

The rest of the paper is crafted by the following phases. The methodology is explained in Section 2. Sections 3 present empirical findings and Sections 4 presents concluding observation. Appendix A gives the detailed empirical results, Tables 1-6.

2. The linear and non-linear ARDL methods

We consider the specification of Bahmani-Oskooee et al. (2016) to test the hypothesis that exchange rate movements have asymmetrical or symmetrical effects using Saudi Arabia-Bangladesh remittance flow. According to this model it is customary to include three variables, real GDP in both countries and real exchange rates in the long–run specification. However, we believe in remittance earning the earning country's real GDP cannot have any or very little impact. So, this variable is replaced by the earning country's number of expatriate workers left for foreign job.

Eq (1) gives the specification:

$$In(R)_t = a + blnY_t^{SA} + clnM_t^{BD} + dlnREX_t + \in_t \qquad (1)$$

The model is specified from Bangladesh perspective, meaning that REM_t is defined as Bangladesh remittance earning from Saudi Arabia., real income in Saudi Arabia denoted by Y_t^{SA} , Migrant workers left from Bangladesh is denoted by MIG_t^{BD} and the real bilateral exchange rate denoted by *REX*. The best replacement of real GDP of Bangladesh of Bahmani-Oskooee (2016) trade model would be the figure of the number of migrant workers left for Saudi Arabia from Bangladesh. But, unfortunately, due to unavailability of such data we have used the total figure of Bangladesh workers left for abroad from Bangladesh as foreign job seekers. Again, Saudi Arabia does calculate her quarterly GDP. To overcome

this hindrance of unavailability quarterly GDP data we have used Chow and Lin (1976) method to extrapolate quarterly GDP. To generate the quarterly figure of Saudi Arabian GDP from annual GDP we have used a linear import function M = e+ gY where M= Imports and Y= GDP. However, our purpose the quarterly series to be estimated (Y) was regressed on Import. Therefore, using annual observations we estimated the following relation: $Y_t = e + gM_t + €_t$ by then, using quarterly data for M we obtained a quarterly series for Y, say Ŷ, were adjusted such that $Y= \hat{Y}_I+\hat{Y}_{II}+\hat{Y}_{III}+\hat{Y}_{IV}$, where Y is the actual yearly observed data of Saudi Arabian GDP. Now, we expect the estimate of both *b* and c in equation (1) to be positive. *REX* is defined such that a decrease signifies depreciation of the Bangladeshi Taka against Saudi Arabian Riyal; hence we expect the estimate of *d* to be positive. The real bilateral exchange rate between the Taka and the Riyal is given by [$(P^{SA} \times NEX) / P^{bd}$] where P^{SA} and P^{bd} are the price levels in Saudi Arabia and Bangladesh respectively, measured by the consumer price index. *NEX* is the nominal exchange rate defined as the number of Taka per Riyal.

Table 01, Unit Root Test

Unit Root Test							
ADF Test				PP Test			
With Trend and Intercept				With Trend and Intercept			
Remit =R	QGDP=Y	MIG=M	REX	Remit =R	QGDP=Y	MIG=M	REX
I(1)	I(1)	I(1)	I(0)	I(1)	I(1)	I(1)	I(0)

Eq. (1) is a long-run model with the estimated coefficients reflecting the long-run effects of the exogenous variables on remittance earning level. The short-run effects in particular with regard to the real exchange rate, Eq. (1) is rewritten in an error-correction format as follows:

$$\Delta \ln Rt = \alpha + \sum_{k=1}^{n} \beta_{t-k} \Delta ln(R)_{t-k} + \sum_{k=0}^{n} \partial_{t-k} \Delta lnY_{t-k}^{SA} + \sum_{k=0}^{n} M_{t-k} \Delta lnM_{t-k}^{BD} + \sum_{k=0}^{n} \pi_{t-k} \Delta lnREX_{t-k} + \lambda_1 ln(R)_{t-1} + \lambda_2 lnY_{t-1}^{SA} + \lambda_3 lnM_{t-1}^{BD} + \lambda_4 lnREX_{t-1} + \mu_t \quad ..(2)$$

This specification by Pesaran et. el (2001) recommend applying the standard *F* test to test the null hypothesis $H_0: \lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = 0$ against the alternative of $H_1: \lambda_1 \neq 0 \lambda_2 \neq 0, \lambda_3 \neq 0, \lambda_4 \neq 0.$ When the calculated *F* statistic is significant, the null is rejected in favour of the alternative hypothesis and the variables are said to be cointegrated. They demonstrate that the *F* test in this context has new critical values, which they have tabulated. These critical values indicate the integrating properties of the variables ruling out pre-unit root

testing. However, besides of such remissions we have performed unit root tests by using Augmented Dicky-Fuller (ADF) and Phillip-Perron (PP) methods which is presented in Table 1. As unit root test confirms that the variables are mixer of I(1) and I(0) we can proceed to use ARDL version model for our purpose. Now, once cointegration is established, the error correction component of Eq. (2) is set equal to zero and the long-run effects are derived by normalizing estimates of $\lambda_2 - \lambda_4$ on λ_1 Bahmani and Fariditavana (2015).

The short-run effects are judged by the estimates of coefficients attached to first-differenced variables. A major assumption behind Eq (2) is that a change in any of the exogenous variables has symmetric effects on the remittance flow. This assumption implies that if depreciation improves the remittance flow, the appreciation must worsen it. Nevertheless, exchange rate effects could have symmetric or asymmetric effects when economic condition in Saudi Arabia changes, flow of migrant workers changes, migrant workers and their employers in Saudi Arabia react differently and thus exchange rate changes could have symmetric or asymmetric effects on the remittance earning.

A new variable comprising changes in the lnRex variable is calculated following the methodology used by Delatte and Lopez-Villavicento (2012), Verheyen (2013) and Bahamni and Friditavana (2015, 2016) where negative values reflect depreciation and positive values appreciation. Two new series; one denoted by *NEG* and the other denoted by *POS* representing depreciation and appreciation are given below. The variables are constructed by disentangling the variable comprising the changes in the lnRex variable.

$$POS_t = \sum_{j=1}^{t} \Delta InREX_j^+ = \sum_{j=1}^{t} max\,(\Delta lnREX_J, 0) \quad (3)$$

$$NEG_t = \sum_{j=1}^{t} \Delta LnREX_j^- = \sum_{j}^{t} min\,(\Delta lnREX_j, 0) \quad (4)$$

The replacement of the lnRex variable in the error correction model of Eq. (2) by the two newly created variables, *POS* and *NEG* following the formulation of Shin, Yu and Greenwood-Nimmo (2014) gives the Auto- regressive distributed lag model.

$$\Delta Ln(R)_t = \alpha + \sum_{k=1}^{n} \beta_{t-k} \Delta Ln(R)_{t-k} + \sum_{k=0}^{n} \sigma_{t-k} \Delta LnY_{t-k}^{SA} + \sum_{k=0}^{n} M_{t-k} \Delta LnM_{t-k}^{BD} + \sum_{k=0}^{n} \pi_{t-k} \Delta POS_{t-k} + \sum_{k=0}^{n} \upsilon_{t-k} \Delta NEG_{t-k} + \rho_1 ln(R)_{t-1} + \rho_2 lnY_{t-1}^{SA} + \rho_3 lnM_{t-1}^{BD} + \rho_4 POS_{t-1} + \rho_5 NEG_{t-1} + \psi_t \quad (5)$$

The above formulation Eq. (5) represents a non-linear ARDL in the presence of the variable *POS* and *NEG* variables, whereas Eq. (2) represents a linear ARDL model. Shin et al. (2014) show that the same method of estimating (2) and the related *F* test are equally applicable to (5). Given Eq. (5) is estimated, if *POS* and *NEG* variables carry the same coefficients in sign and size, exchange rate changes are shown to have symmetric effects. Otherwise, the effects are asymmetric.

2. Empirical findings

The study used quarterly data over the period 1990Q3-2016Q3 for which data are available. The data on remittance of earning of Bangladesh from Saudi Arabia is drawn from the monthly Economic Trend of Bangladesh Bank, those on Saudi Arabian real income from International Financial Statistics of IMF. Quarterly data on number of migrant workers is drawn from monthly Economic Trend of the Bangladesh Bank, the Central Bank in Bangladesh. Quarterly data on exchange rate is drawn from the various issues of Monthly Economic Trend published by the Bangladesh Bank and the CPI data is drawn from the various publication of the Bangladesh Bureau of Statistics.

We estimate both the linear ARDL model (2) and the non-linear ARDL model (5) for the remittance earning of Bangladesh from Saudi Arabia. The results are presented in Table 2 to 6. Coefficients estimated for the linear model (2) is reported in table 2.

Table 1

Dependent Variable	Short run coefficient estimates			Long run coefficient estimates			
	$\Delta lnREX_t$	$\Delta lnREX_{t-1}$	$\Delta lnREX_{t-2}$ $\Delta lnREX_{t-3}$	*Constant*	lnY^{SA}	lnY^{BD}	$lnREX$
Δlog (Remittance of BD from Saudi Arabia)	0.81 [1.98]**	1.33 [2.26]**	1.21 [1.80]*	-4.361 [8.35]***	0.832 [8.75]***	0.380 [3.40]***	0.166 [4.81]***

Notes: Numbers in parentheses are the absolute values of the t-ratio. *, ** & *** indicate significance at 10%, 5% & 1%level respectively.

We report short –run coefficients for the exchange rate only and long-run estimates for all variables. For the short-run, 0.81 percent exhibit significant positive real exchange rate coefficients at 5 % level of significance. This result confirm that as the Saudi Arabian economy grows, the Saudi Arabian reliance on foreign labour does not diminish and for Bangladesh increased earning of remittance from Saudi Arabian.

The long- run coefficient estimates are valid only when if we can establish cointegration. The results of the *F* test applied to joint significance of lagged level variables in Eq (2) and the presence of at least one long- run significant estimated coefficient confirm cointegration. A set of diagnostic tests is also reported in Table 3.

Table 3

Industry (trade, share in %)	Diagnostic Statistics

	F	ECM_{t-1}	LM	RESET	CUSUM	CUSUMSQ	Adj. R^2
$\Delta \log$ (Remittance of BD from Saudi Arabia)	12.69***	-0.59**	0.57	2.59	S	S	0.62

Notes: *, ** & *** indicate significance at 10%, 5% & 1%level respectively.

Given critical value of 3.84, the Lagrange Multiplier Test (LM) statistic which is distributed as χ^2 with one degrees freedom confirms that the residuals except in two cases are free of autocorrelation. The RESET statistic which is distributed as χ^2 with one degrees freedom and is used to judge misspecification tells insignificant for the model we have fitted. The stability of all short–run and long-run estimates is tested by the CUSUM and CUSUMSQ test to the residuals of each model. The results show that our fitted model is stable. Finally, the adjusted R^2 square statistic is pretty good to rely on the model where variability of the dependent variable is highly explained the variability of the considered explanatory variables.

The estimates of the non-linear ARDL (5) help us to judge whether exchange rate changes have symmetric or asymmetric effects. Short-run estimates are given in Table 4, long-run estimates are in Table 5.

Table 4

Industry	Short run coefficient estimates							
	ΔPOS_t	ΔPOS_{t-1}	ΔPOS_{t-2}	ΔPOS_{t-3}	ΔNEG_t	ΔNEG_{t-1}	ΔNEG_{t-2}	ΔNEG_{t-3}
$\Delta \log$ (Remittance of BD from Saudi Arabia)	0.30**	-	-	-	0.49*	-	-	-
	[3.02]				[1.97]			

Notes: Numbers in parentheses are the absolute values of the t-ratio. *, ** & *** indicate significance at 10%, 5% & 1%level respectively.

Table 5

Industry	Long run coefficient estimates				
	Constant	lnY^{SA}	lnY^{BD}	POS	NEG
$\Delta \log$ (Remittance of BD from Saudi Arabia)	-55.67**	8.79***	-3.51***	0.19*	0.35**
	[2.32]	[2.88]	[2.95]	[1.77]	[2.03]

Notes: Numbers in parentheses are the absolute values of the t-ratio. *, ** & *** indicate significance at 10%, 5% & 1%level respectively.

Table 4 shows that the variable representing appreciation *(Δ POS)* and the variable representing depreciation *(Δ NEG)* are with coefficients that differ in sign, size, and duration. With respect to duration, following Shin et al (2014), adjustment symmetry is indicated in the remittance earning level of Bangladesh from Saudi Arabia. The coefficients of both *Δ POS* and *Δ NEG* are significant. Thus the non-linear ARDL model supports more significant short-run effects compared to the results from the linear model.

As for the long-run asymmetry effects, Table 5 shows significant coefficients estimates for either *POS* or *NEG* variables in inward remittance flow of Bangladesh from Saudi Arabia for the linear model of Table 2. This manifests greater sensitivity of the non-linear model in capturing a relationship between exchange rate changes and remittance influx effects.

Table 6

Industry (trade share in %)	Diagnostic Statistics								
	F	ECM(t-1)	LM	RESET	Wald-S	Wald-L	CUSUM	CUSUMSQ	Adj R^2
$\Delta\log$ (Remittance of BD from Saudi Arabia)	11.20***	-0.29*	0.08	0.76	2.25**	1.98**	S	S	0.60

Notes: *, ** & *** indicate significance at 10%, 5% & 1%level respectively.

The effects of the income variable in non-linear model carry expected sign with significant coefficient which indicates the importance of economic growth in Saudi Arabia for remittance earning of Bangladesh. The second one indicates the importance of increasing in migrant workers number and skilled level. The long-run non-linear estimates are valid conditional on cointegration which we can check through the diagnostic statistics of Table 6. Cointegration is established either by the significant *F* test or the ECM_{t-1} test and the presence of at least one significant long-run coefficient in Eq.5. We find cointegration in between remittance earning of Bangladesh from Saudi Arabia and their bilateral real exchange rate. F statistic is significant for the error component term. Table 6 reports two additional statistics; *Wald-s and Wald-L. Wald-s* supports short-run impact symmetry and *Wald-L* supports long-term impact symmetry.

3. Summary and conclusions

We estimate two remittance earning models modified from the Bahmani-Oskooee (2016) trade model, for Bangladesh remittance earning time series data from Saudi Arabia which constitutes about 20 percents of its total remittance earnings, namely one is linear ARDL and the other is non-linear ARDL model. The linear ARDL incorporates the real bilateral taka-riyal rate as a determinant of remittance in Bangladesh from Saudi Arabia along with the real income of Saudi Arabia and number of Bangladesh labourers left for job seeking in Saudi Arabia [substituted by aggregate income of Bangladesh in the Bahmani-Oskooee (2016) trade model]. The non-linear ARDL differentiates between one variable for currency appreciation and another for depreciation through which non-linearity is introduced into the model. We use quarterly data for the period 1990 Q3-2016 Q3.

According to Bahamani-Oskooee and Fariditavana (2015, 2016) trade model fitted in the bilateral remittance earning of Bangladesh from Saudi Arabia, the symmetry assumption that depreciation improves the earning country remittance inflow or appreciation worsens it, is a very logical and tenable. Exchange rate changes could have in principle symmetric effects on the bilateral remittance flow for this couple of countries because migrant workers reaction to home country currency depreciation might conceivably analogous to their reaction to appreciation. Remitters are directly and immediately affected

due to slow adjustment lags such as decision lags, earning level lags and wage lags etc. Thus, migrant labourers may be affected by appreciation of their home country currency for some time but the family members left behind show an urgent necessities for their daily livelihood.

We find evidence in a variety of ways to support symmetry in responses in remittance inflow to exchanges rate changes for Bangladesh remittance earning from Saudi Arabia. First, adjustment symmetry in the form of different response times of the remittance earning to depreciation and to appreciation was observed. Second, in the short-run, symmetry in the size or sign coefficient estimates on the exchange rate also did not differed between appreciation and depreciation. Finally, long-run symmetric effect was also found. Overall, both the linear and non-linear models which allows to show for symmetry or asymmetry effect of exchange rate on remittance earning revealed very clearly a more significant role for the exchange rate in remittance earning for Bangladesh from Saudi Arabia can play if the authorities from Bangladesh side take proper action to pay incentive to the remitters. In Bangladesh, government gives cash subsidies to the exporters of all conventional and unconventional items exporting. However, government did not gives any such incentives who earns foreign currency by managing jobs abroad which is almost free from any foreign currency spending like back-to-back LCs payment for input and capital machinery importing in case of exports proceeds earning. According to our findings in this study government should pay either a depreciated separate exchange rate or (like exporters) direct cash subsidies to the expatriate wage earning communities to improve remittance earning by the migrant wage earners.

References

Tasneem S. and Chowdhury A. (2003) Migrant workers remittance and Microfinance in Bangladesh. Working paper No. 38. Refugee and Migrant Worker Research Unit

Shirin S. (2016) Remittance inflows and its contribution to the economic growth in Bangladesh, Eastern Economic Reviews, March, 2016

Rahim SA and Alam M A (2013) Foreign Remittance Income in Bangladesh: Opportunities and Challenges. Asian Business Review, Volume 2, Numeber 2/2013 (Issue 4) ISSN 2304-2613 (Print); ISSN 2305-8730 (Online)

Chowdhury K R, Hamid F and Chatterjee D D (2010) Remittance as a tool of economic development: Bangladesh perspective; Bangladesh research publications journal
ISSN: 1998-2003, Volume:4, Issue:3, Page:286-296,September-October, 2010

Barai M K (2010) Development Dynamics of Remittances in Bangladesh; SAGE Open 1 –13 The Author(s) 2012, DOI: 10.1177/2158244012439073, http://sgo.sagepub.com

Begum M N and Sutradhar R R (2012) Behavior of Remittance Inflows and its Determinants in Bangladesh, Working Paper Series: WP1202, Research Department, Bangladesh Bank, Head Office, Dhaka

Azad A K (2003), Importance of migrant workers remittance for Bangladesh economy. Prepared for presentation in the conference organized by DFID and International Migration Policy Program, IMF, Geneva, 2003.

Hossain B. M. S. and Hossain M. D. (2014). Role of remittance in the economic development of Bangladesh, Economics Department, Atish Dipankar University, Dhaka

Stevanovic N. (2012), Remittances and Moral Economies of Bangladeshi New York Immigrants in Light of the Economic Crisis, Submitted in partial fulfillment of the Requirements for the degree of Doctor of Philosophy in the Graduate School of Arts and Sciences, Columbia University, 2012

Ahmed M. S. (2010), Migrant Workers Remittance and Economic Growth: Evidence from Bangladesh, ASA University Review, Vol. 4 No. 1, January–June, 2010.

Mamun K. A. and Nath H. K. (2010) Workers' Migration and Remittances in Bangladesh, Department of Economics and Finance, John F. Welch College of Business, Sacred Heart University, Fairfield, CT, USA

Datta K. and Sarkar B. (2014), Relationship between Remittances and Economic Growth in Bangladesh: An Econometric Study, The Bangladesh Development Research Working Paper Series (BDRWPS) is a peer reviewed working paper series of the Bangladesh Development Research Center (BDRC)

Bahmani-Oskooee, M. (1985), Devaluation and the J-curve: some evidence from LDCs. The Review of Economics and Statistics, 67, 500–504.

Bahmani-Oskooee, M. (1986), Determinants of international trade flows: the case of developing countries. Journal of Development Economics, 20(1), 107–123.

Bahmani-Oskooee, M. (1989)' Devaluation and the J-curve: some evidence from LDCs: errata. The Review of Economics and Statistics, 69, 553–554.

Bahmani-Oskooee, M., and Malixi, M. (1992), More evidence on the J-curve from LDCs. Journal of Policy Modeling, 14, 641–653.

Bahmani-Oskooee, M., & Ratha, A. (2004), Dynamics of the U. S. trade with developing countries, Journal of Developing Areas, 37, 1–11.

Bahmani-Oskooee, M., Goswami, G. G., & Talukdar, B. K. (2005),The bilateral J-curve: Australia versus her 23 trading partners. Australian Economic Papers, 44 (2), 110–120.

Bahmani-Oskooee, M., & Harvey, H. (2010), The J-curve: Malaysia versus her major trading partners, Applied Economics, 42, 1067–1076.

Bahmani-Oskooee, M., & Hegerty, S. (2010),The J- and S-curves: a survey of the recent literature. Journal of Economic Studies, 37, 580–596.

Bahmani-Oskooee, M., & Zhang, R. (2014), Is there J-curve effect in the commodity trade between Korea rest of the world? Economic Change and Restructuring, 47, 227–250.

Bahmani-Oskooee, M., & Jungho, Baek (2016), Do exchange rate changes have symmetric or asymmetric effects on the trade balance? Evidence from U.S.- Korea commodity trade, Journal of Asian Economics, 45, page number to be given???

Bahmani-Oskooee, M., Aftab,M., and Harvey, H., (2016),The Journal of Economic Asymmetries

Bahmani-Oskooee, M., and Fariditavana, H. (2015), Nonlinear ARDL approach, Asymmetric effects and the J-Curve, Journal of Economic Studies, 42, 519-530.

Bahmani-Oskooee, M., and Fariditavana, H. (2016), Nonlinear ARDL approach and the J-curve phenomenon. Open Economies Review, 27, 51–70.

Banerjee, A., Dolado, J., &Mestre, R. (1998), Error-correction mechanism tests in a single-equation framework. Journal of Time Series Analysis, 19, 267–285.

Buyangerel, B., &Kim,W. J. (2013), The effects of macroeconomics shocks on exchange rate and trade balances in Korea. Korea and the World Economy, 14(1), 91–119.

Chang, B.-K. (2005), Changes in effects of exchange rate on trade balance according to industrial structural change. Journal of Korea Trade, 9(2), 5–23.

Chang, B.K. (2009), Korean bilateral trade balances and exchange rate sensitivity: evidence from the panel approach. Journal of Korea Trade, 13(1), 1–19.

Delatte, A.-L., & Lopez-Villavicencio, A. (2012), Asymmetry exchange rate pass-through: evidence from major countries. Journal of Macroeconomics, 34, 833–844.

Hsing, H.-M., & Savvides, A. (1996),Does a J-curve exist for Korea and Taiwan? Open Economies Review, 7, 127–145.

Kim, A. (2009),An empirical analysis of Korea's trade imbalances with the US and Japan. Journal of the Asia Pacific Economy, 14(3), 211–226.

Lal, A. K., & Lowinger, T. C. (2002), The J-curve: evidence from East Asia. Journal of Economic Integration, 17, 397–415.

Mustafa, M., & Rahman, M. (2008), U.S. bilateral nominal trade balance with India, Japan, Malaysia, S. Korea and Thailand, and bilateral nominal exchange rate dynamics: evidence on J-curve? Southwestern Economic Review, 35, 153–161.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001), Bounds testing approaches to the analysis of level relationships. Journal of Applied Econometrics, 16, 289–326.

Rose, A. K., &Yellen, J. L. (1989). Is there a J-curve? Journal of Monetary Economics, 24, 53–68.

Sim, S.-H., & Chang, B.-K. (2006). Bilateral trade balance between Korea and her trading partners: the J-curve effect. Journal of Korea Trade, 10(3), 73–93.

Shin, Y., Yu, B. C., & Greenwood-Nimmo, M. (2014). In R. Sickels, &W. Horrace (Eds.), Modeling asymmetric cointegration and dynamic multipliers in a nonlinear

Verheyen, F. (2013). Interest rate pass-through in the EMU: new evidence using nonlinear ARDL framework. Economics Bulletin, 33, 729–739.

Wilson, P. (2001). Exchange rates and the trade balance for dynamic Asian economies-does the J-curve exist for Singapore, Malaysia and Korea? Open Economies Review, 12, 389–413.

Chow, G.C. and An-Loh Lin (1976) Best linear unbiased estimation of missing observations in an economic time series, Journal of the American Statistical Association, Sept. 719-722.