Economic Issues, Vol. 23, Part 2, 2018

On the Relation between Domestic Output and Exchange Rates in 68 Countries: An Asymmetry Analysis

Mohsen Bahmani-Oskooee
and Amirhossein Mohammadian[1]

ABSTRACT

In an effort to engage in the most comprehensive analysis of the asymmetric effects of exchange rate changes on domestic production, we concentrate on bivariate linear and nonlinear models where domestic output is regressed on the real effective exchange rate. By using annual data from each of the 68 countries in our sample, the findings favour the nonlinear model and nonlinear adjustment of the exchange rate. Exchange rate changes are shown to have short-run asymmetric effects in almost all models. However, the short-run effects translate into long-run asymmetric effects in only 24 countries, though the findings are country-specific.

JEL Classification: F31
Keywords: Domestic Output, Exchange Rate, Asymmetry, Nonlinear ARDL, 68 Countries.

1. INTRODUCTION

Although most studies in international finance assess the impact of exchange rate changes on the trade balance, several studies are concerned with the ultimate impact of exchange rate changes on domestic production. After all, countries devalue their currencies or allow them to depreciate in the hope of gaining international competitiveness, exporting more, and eventually boosting domestic production and employment. However, since a devaluation or depreciation also raises the cost of imports, especially imported inputs, it could hurt aggregate supply, leaving the response of domestic output to exchange rate changes undetermined. If net exports and aggregate demand expand more than the contraction in aggregate supply, a devaluation could be expansionary. Otherwise, it is said to be contractionary.[2]

The empirical literature, which is mixed, includes panel models as well as time-series models. The list in chronological order includes Krugman and

Taylor (1978), Gylfason and Schmid (1983), Gylfason and Risager (1984), Edwards (1986, 1989), Agenor (1991), Rogers and Wang (1995), Bahmani-Oskooee (1996), Bahmani-Oskooee and Rhee (1997), Kamin and Rogers (2000), Anker and Bahmani-Oskooee (2001), Bahmani-Oskooee *et al* (2002), Chou and Chao (2001), Christopoulos (2004), Frankel (2005), Bahmani-Oskooee and Miteza (2006), Kim and Ying (2007), Narayan and Narayan (2007), Bahmani-Oskooee and Kutan (2008), Kalyoncu *et al* (2008), Bahmani-Oskooee and Kandil (2009), Sencicek and Upadhyaya (2010), Mejia-Reyes *et al* (2010), Eltalla (2013), Bahmani-Oskooee and Gelan (2013), Kappler *et al* (2013), Yang *et al* (2013), An *et al* (2014), and Manalo *et al* (2015).

Studies from the above list prior to 2003 have been reviewed by Bahmani-Oskooee and Miteza (2003). Post-2003 studies have been reviewed by Bahmani-Oskooee and Mohammadian (2016, 2017) and Bahmani-Oskooee *et al* (2018), who not only reviewed each article but also pointed out their common feature, i.e., the assumption that the effects of exchange rate changes on domestic production are symmetric. However, they argued that the response of domestic output to currency depreciation could be different from its response to appreciation, implying that exchange rate changes could have asymmetric effects on domestic output. As they argued, since exports and imports originate in two different countries that are subject to two different trade rules and trade environments, output could respond to exchange rate changes in an asymmetric manner. Furthermore, there is now clear evidence that import and export prices (Bussiere 2013) and net exports (Bahmani-Oskooee and Fariditavana 2015, 2016) respond to exchange rate changes in an asymmetric manner, implying that output should also respond in an asymmetric manner.

To demonstrate the asymmetric response of output to exchange rate changes, Bahmani-Oskooee and Mohammadian (2016, 2017) relied upon a reduced-form model in which the real effective exchange rate, money supply, government spending, oil prices, and wage rate were identified to be the main determinants of domestic output. By using quarterly data from Australia and Japan and by applying Shin *et al*'s (2014) nonlinear ARDL approach, they indeed showed that in both Australia and Japan, exchange rate changes have both short-run and long-run asymmetric effects on each country's domestic production. The same model specification and method also confirmed an asymmetric response in several emerging economies in a study conducted by Bahmani-Oskooee and Mohammadian (2018), also using quarterly data.

Quarterly data for these variables mentioned above are not available for many other countries. Therefore, our goal in this paper is to expand the literature on the asymmetric effects of exchange rate changes on domestic output by using annual data, which allows us to test the asymmetry assumption for as many as 68 countries, resulting in the most comprehensive study to date. Shin *et al* (2014) demonstrated their method by having a model that included two variables. We will do the same by having output as the dependent variable and the real effective exchange rate as the independent variable. To that end, we introduce the models and methods in Section II and we present the results in Section III. While a summary is provided in Section IV, the data definitions and sources are identified in an Appendix.

2. The Models and Methods

As mentioned in the previous section, in order to be as comprehensive as possible, so that we can include all countries for which annual data are available, we begin with the following long-run relation between real output (*Y*) and the real effective exchange rate (*REX*):

$$LnY_t = a + bLnREX_t + \varepsilon_t \tag{1}$$

By way of construction, a decline in the real effective exchange rate signifies a depreciation of the domestic currency. Therefore, a positive (negative) estimate of *b* will be an indication of contractionary (expansionary) devaluation. This estimate is the long-run estimate, and in order to also assess the short-run effects of exchange rate changes on output, we must rewrite (1) in an error-correction format as follows:

$$\Delta LnY_t = \alpha_0 + \sum_{k=1}^{n1}\alpha_{1k}\Delta LnY_{t-k} + \sum_{k=0}^{n2}\alpha_{1k}\Delta LnREX_{t-k} + \lambda\varepsilon_{t-1} + \omega_t \tag{2}$$

Specification (2) is an error-correction model that follows Engle and Granger (1987), which requires both variables to be integrated of the same order. If both variables are, say, integrated of order one, I(1), but the residuals in (1) are integrated of order zero, I(0), the two variables are said to be cointegrated and the estimate of *b* will be valid. If the residuals in (1) are also I(1), Banerjee *et al* (1998) argue and demonstrate that if the estimate of λ in (2) is negative and significant, cointegration will still be supported. However, as they demonstrate, the t-ratio that is used to judge the significance of λ has a new distribution for which they tabulate new critical values.[3]

What should be done if one of the variables such as real output is I(1) and the other, i.e., the real effective exchange rate, is I(0)? Indeed, if Purchasing Power Parity holds in any country, its real effective rate will be stationary, or I(0). Prior to the introduction of the bounds testing approach by Pesaran *et al* (2001), such cases had to be excluded from analysis. Pesaran *et al* (2001) introduce a new method in which variables could be a combination of I(0) and I(1). Their approach amounts to solving (1) for ε_t, lagging the solution by one period, and then substituting the lagged solution into (2) to arrive at:

$$\Delta LnY_t = \alpha_0 + \sum_{i=1}^{n1}\alpha_{1i}\,\Delta LnY_{t-i} + \sum_{i=0}^{n2}\alpha_{2i}\Delta LnREX_{t-i} + \beta_0 LnY_{t-1} + \beta_1 LnREX_{t-1} + \omega_t \tag{3}$$

Pesaran *et al* (2001) propose applying the F test to establish the joint significance of the lagged level variables in (3), as a sign of cointegration. They tabulate new asymptotic critical values that account for integrating properties of variables and, indeed, variables could be a combination of I(1) and I(0). Since these are properties of most of the macro variables, there is no need for pre unit-root testing – the main advantage of this method.[4] Once cointegration is established, the estimate of β_1 is normalised on β_0, which will yield the long-run effects of exchange rate changes on output. The short-run effects are reflected by the estimates of α_{2i}.[5]

Models such as (1) or (3) assume that the effects of exchange rate changes on output are symmetric, meaning that if a depreciation raises domestic output by $b = -\frac{\hat{\beta}_1}{\hat{\beta}_0}$, an appreciation will lower it by the exact same amount. In order to demonstrate that this may not be the case and the effects of exchange rate changes could be asymmetric, Shin *et al* (2014) modify specification (3). Their modification involves decomposing the *LnREX* variable into two time-series variables, where one variable only represents currency appreciation and the other variable only represents currency depreciation. The procedure involves forming $\Delta LnREX$, which includes positive values, signifying currency appreciation and negative changes, reflecting only currency depreciation. Then the two new time-series variables are generated using the partial sum concept as outlined by (4):

$$POS_t = \sum_{j=1}^{t} \Delta \ln REX_j^+ = \sum_{j=1}^{t} \max(\Delta \ln REX_j,\ 0)$$
$$NEG_t = \sum_{j=1}^{t} \Delta \ln REX_j^- = \sum_{j=1}^{t} \min(\Delta \ln REX_j,\ 0) \qquad (4)$$

In (4) the *POS* (*NEG*) variable is the partial sum of positive (negative) changes and reflects only currency appreciation (depreciation). Shin *et al* (2014) then suggest replacing the *LnREX* variable in (3) by *POS* and *NEG* variables to arrive at:

$$\Delta LnY_t = \alpha_0 + \sum_{i=1}^{n1} \alpha_{1i}\, \Delta LnY_{t-i} + \sum_{i=0}^{n2} \alpha_{2i}^{+}\, \Delta POS_{t-i} + \sum_{i=0}^{n3} \alpha_{2i}^{-}\, \Delta NEG_{t-i} + \beta_0 LnY_{t-1} + \beta_1^{+} POS_{t-1} + \beta_1^{-} NEG_{t-1} + \omega_t \qquad (5)$$

Since the method of constructing the *POS* and *NEG* variables introduce nonlinearity into the model, Shin *et al* (2014) label (5) as a nonlinear ARDL model, whereas (3) is referred to as a linear model. However, both models are estimated by the OLS method and the same F test or t-test is equally applicable to both models. Shin *et al* (2014 p 291) further argue for treating the *POS* and *NEG* variables as one variable, so that when we shift from the linear model to the nonlinear model, the critical values of the F test do not change. This is due mostly to dependency between the two partial sum variables. As for asymmetry analysis, short-run adjustment asymmetry will be established if $n_2 \neq n_3$ once a set criterion is used to select optimum lags. Furthermore, short-run asymmetric effects will be established if $\hat{\alpha}_{2i}^{+} \neq \hat{\alpha}_{2i}^{-}$ at each individual lag i. Additionally, short-run cumulative or impact asymmetric effects will be established if $\sum \hat{\alpha}_{2i}^{+} \neq \sum \hat{\alpha}_{2i}^{-}$. Finally, long-run asymmetry will be established if $-\frac{\hat{\beta}_1^{+}}{\hat{\beta}_0} \neq \frac{\hat{\beta}_1^{-}}{\hat{\beta}_0}$. The Wald test is the recommended test to verify the last two inequalities.

3. The Results

In this section, we estimate both the linear model outlined by specification (3) and the nonlinear model outlined by specification (5), for as many countries as data permit. We were able to collect annual real GDP data and real effective exchange rate data for 68 countries. The study period differed from one country to another, as shown in the Appendix. Since data are annual, we imposed a maximum of four lags on each first-differenced variable and used Akaike's Information Criterion (AIC) to select the optimum lags. Furthermore, since there are different critical values for different statistics, we have collected them in the notes in the table of results and used them to identify significance by * at the 10% level and ** at the 5% level. Results for each country are reported in Table 1.

The estimates of our linear models come under the heading of L-ARDL and those of our nonlinear models, under NL-ARDL. Short-run estimates are reported in Panel A, with normalised long-run estimates reported in Panel B. The diagnostic statistics appear in Panel C. From the results of the linear model, we see that the exchange rate carries at least one significant short-run coefficient in 37 countries. However, when we consider the results from the nonlinear models, either ΔPOS or ΔNEG carry at least one significant lagged coefficient in 48 countries. This increase must be attributed to introducing nonlinear adjustment of the real exchange rate and favours the nonlinear ARDL model. Furthermore, in the nonlinear model, the size of estimated coefficients attached to the ΔPOS variable is different from those attached to the ΔNEG variable at the same lags, supporting short-run asymmetric effects. However, short-run asymmetric impacts are supported in Bahrain, Cameroon, Chile, China, Cyprus, Denmark, Dominica, Ecuador, Fiji, Finland, Greece, Indonesia, Japan, Malawi, Malaysia, Mexico, Paraguay, the Philippines, Sweden, Trinidad and Tobago, the United Kingdom, and Venezuela. In these 22 cases the Wald test, reported as the Wald-Short in Panel C, is significant, implying that the sum of the coefficients attached to ΔPOS is different from the sum attached to the ΔNEG variable. Included in the list are developed countries (e.g., Denmark, Finland, Japan, Sweden, and the UK) and developing countries (e.g., Mexico, the Philippines).

In how many models do the short-run effects of exchange rate changes actually translate into long run meaningful and significant effects that are supported by at least one of the tests for cointegration? The answer is in nine linear models and 25 nonlinear models. Again, this increase should be attributed to the nonlinear adjustment of the exchange rate. The nine linear models belong to: Belize, Finland, France, Japan, Malawi, Malaysia, Norway, Singapore, and Uganda. The 25 nonlinear models belong to Antigua and Barbuda, Austria, Bolivia, Cameroon, Canada, Chile, Dominica, Fiji, Finland, France, Iran, Ireland, Japan, Malawi, Malaysia, Malta, Norway, Pakistan, Paraguay, Singapore, Spain, St. Vincent and the Grenadines, Sweden, Togo, and Uganda. Again, both developed and developing countries are among the 25 countries.

Table 1: Full-Information Estimates of Both Linear (L-ARDL) and Nonlinear NL-ARDL Models

	Antigua and Barbuda		Australia		Austria		Bahrain	
	L-ARDL	**NL-ARDL**	**L-ARDL**	**NL-ARDL**	**L-ARDL**	**NL-ARDL**	**L-ARDL**	**NL-ARDL**
Panel A: Short-Run Estimates								
ΔLnY_t								
ΔLnY_{t-1}	.20 (1.00)		.03 (.18)	.01 (.06)				
ΔLnY_{t-2}			-.36 (2.31)**	-.34 (2.05)**				
ΔLnY_{t-3}								
ΔLnY_{t-4}								
ΔLER_t	-.20 (1.00)		.00 (.12)		.04 (.30)		-.09 (.90)	
ΔLER_{t-1}					-.17 (1.31)			
ΔLER_{t-2}					-.04 (.31)			
ΔLER_{t-3}					.32 (2.40)**			
ΔLER_{t-4}								
ΔPOS_t		.30 (0.51)		.02 (.50)		.27 (1.24)		.81 (2.47)**
ΔPOS_{t-1}		-1.52 (2.28)**				-.33 (1.55)		
ΔPOS_{t-2}		-.31 (0.68)				-.36 (1.76)*		
ΔPOS_{t-3}						.33 (1.50)		
ΔPOS_{t-4}								
ΔNEG_t		.00 (.00)		-.02 (-.39)		.03 (.15)		-.32 (2.06)**
ΔNEG_{t-1}								
ΔNEG_{t-2}								
ΔNEG_{t-3}								
ΔNEG_{t-4}								
Panel B: Long-Run Estimates								
Constant	6.73 (0.78)	2.75 (5.72)**	7354.0 (.00)	5.11 (.94)	-4.09 (.20)	3.76 (92.49)**	13.50 (8.40)**	2.88 (25.21)**
LER_t	-.46 (0.25)		-1276.1 (.00)		2.05 (.46)		-1.85 (5.69)**	
POS_t		7.52 (2.37)**		-1.16 (.24)		1.67 (6.31)**		1.12 (2.33)**
NEG_t		2.02 (1.54)		-2.05 (.43)		-.60 (1.76)*		-.98 (5.53)**
Panel C: Diagnostic Statistics								
F	1.37	4.41	2.01	1.29	1.03	2.77	3.34	2.88
ECM_{t-1}	-.06 (1.56)	-.25 (3.77)**	.00 (1.92)	-.02 (1.91)	-.02 (1.45)	-.37 (2.95)*	-.08 (2.50)	-.22 (2.69)
LM	.14	.47	.08	.07	2.67	.84	.08	.14
RESET	.59	1.45	.70	1.34	1.97	.37	.25	.15
CUSUM	S	S	S	S	S	S	S	S
CUSUMSQ	S	S	U	U	S	S	U	U
Wald-Long		5.80 **		1.09		557.11**		14.82**
Wald-Short		2.08		.21		.04		3.81**
Adjusted R^2	.07	.30	.08	.06	.16	.32	.11	.18

	Belgium		Belize		Bolivia		Brazil	
	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL
Panel A: Short-Run Estimates								
ΔLnY_t								
ΔLnY_{t-1}			-.10 (.61)	-.09 (.73)	.43 (2.54)**		.10 (.58)	
ΔLnY_{t-2}			-.39 (2.97)**	-.27 (2.30)**			.03 (.16)	
ΔLnY_{t-3}			.16 (1.24)	.29 (2.71)**			-.39 (2.31)**	
ΔLnY_{t-4}								
ΔLER_t	.01 (.10)		-.04 (.29)		-.01 (1.13)		.09 (2.69)**	
ΔLER_{t-1}			-.85 (4.49)**		-.03 (2.48)**		-.06 (1.59)	
ΔLER_{t-2}			-.48 (2.50)**					
ΔLER_{t-3}			-.53 (3.20)**					
ΔLER_{t-4}								
ΔPOS_t		.17 (.83)		-.17 (.71)		.11 (3.13)**		.04 (.60)
ΔPOS_{t-1}				-1.24 (2.93)**		-.14 (2.59)**		
ΔPOS_{t-2}				-.76 (1.97)*				
ΔPOS_{t-3}								
ΔPOS_{t-4}								
ΔNEG_t		0.00 (0.02)		.18 (.88)		-.05 (2.03)*		.12 (2.43)**
ΔNEG_{t-1}				-.58 (3.77)**				
ΔNEG_{t-2}				-.26 (1.68)				
ΔNEG_{t-3}				-.46 (2.94)**				
ΔNEG_{t-4}								
Panel B: Long-Run Estimates								
Constant	8.83 (.67)	3.85 (45.10)**	63.98 (2.57)**	1.88 (1.87)*	-6.61 (.78)	1.74 (6.12)**	2.83 (.12)	3.91 (24.06)**
LER_t	-.69 (.24)		-13.09 (2.38)**		1.89 (1.21)		-1.50 (.16)	
POS_t		1.32 (4.17)**		22.86 (1.35)		.71 (1.90)*		.24 (1.45)
NEG_t		-.38 (1.60)		9.36 (1.01)		-1.17 (2.70)**		-.28 (1.47)
Panel C: Diagnostic Statistics								
F	2.98	2.72	11.00**	11.34**	3.33	24.90**	.08	1.78
ECM_{t-1}	-.02 (2.47)	-.21 (2.61)	.06 (4.80)**	-.07 (6.17)**	.01 (2.63)	-.03 (8.00)**	.00 (.41)	-.19 (2.31)
LM	.13	.28	3.72*	.39	.13	4.60**	.98	.26
RESET	.35	.04	2.29	4.23**	.14	3.31*	.28	1.26
CUSUM	S	S	S	S	S	S	S	S
CUSUMSQ	S	S	S	S	U	S	S	S
Wald-Long		61.32**		2.99*		1.21		86.26**
Wald-Short		.02		1.62		.17		.51
Adjusted R^2	.09	.08	.61	.78	.73	.77	.21	.26

	Burundi		Cameroon		Canada		Chile	
	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL
Panel A: Short-Run Estimates								
ΔLnY_t								
ΔLnY_{t-1}	.34 (2.11)**	.40 (2.56)**	.56 (5.55)**			.32 (2.34)**		.16 (1.37)
ΔLnY_{t-2}								-.08(.97)
ΔLnY_{t-3}								.09 (1.06)
ΔLnY_{t-4}								
ΔLER_t	.00 (.05)		-.09 (1.95)*		-.03 (.65)		.34 (4.10)**	
ΔLER_{t-1}								
ΔLER_{t-2}								
ΔLER_{t-3}								
ΔLER_{t-4}								
ΔPOS_t		.01 (.06)		-.01 (.06)		.09 (.76)		.70 (4.68)**
ΔPOS_{t-1}				-.45 (3.83)**				
ΔPOS_{t-2}				.22 (2.22)**				
ΔPOS_{t-3}				-.24 (2.64)**				
ΔPOS_{t-4}								
ΔNEG_t		.05 (.40)		-.12 (3.92)**		-.02 (.17)		.10 (1.05)
ΔNEG_{t-1}				.10 (3.08)**				
ΔNEG_{t-2}				-.08 (2.35)**				
ΔNEG_{t-3}								
ΔNEG_{t-4}								
Panel B: Long-Run Estimates								
Constant	3.27 (.26)	4.03 (17.42)**	22.80 (1.49)	3.40 (25.73)**	14.30 (2.73)**	3.69 (51.50)**	9.88 (2.29)**	3.20 (11.29)**
LER_t	.42 (.13)		-3.85 (1.21)		-1.97 (1.78)*		-.94 (1.01)	
POS_t		.78 (1.10)		4.42 (6.16)**		.34 (1.83)*		1.46 (4.90)**
NEG_t		.18 (.51)		2.09 (4.66)**		-.73 (5.18)**		-.53 (1.99)*
Panel C: Diagnostic Statistics								
F	1.46	1.96	7.24**	43.87**	3.90	3.78	14.68**	8.47**
ECM_{t-1}	-.03 (1.47)	-.13 (2.39)	-.02 (3.86)**	.11 (12.09)**	-.03 (2.64)	-.21 (3.43)*	-.03 (2.48)	-.14 (5.00)**
LM	.01	.49	.03	.20	2.21	.16	5.49*	.33
RESET	5.94**	4.95**	.30	6.89**	1.11	3.57*	.91	1.22
CUSUM	S	U	U	S	S	S	U	S
CUSUMSQ	S	S	U	S	S	S	S	S
Wald-Long		6.19**		56.40**		231.10**		122.63**
Wald-Short		.10		2.80*		.28		8.22**
Adjusted R^2	.11	.17	.72	.91	.10	.24	.34	.65

	China		Colombia		Costa Rica		Cote d'Ivoire	
	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL
Panel A: Short-Run Estimates								
ΔLnY_t								
ΔLnY_{t-1}	.51 (2.51)**	.47 (3.08)**	.40 (2.38)**	.45 (2.66)**	.19 (1.31)	.23 (1.13)	.39 (2.16)**	.40 (2.34)**
ΔLnY_{t-2}	-.33 (1.68)*				-.36 (2.73)**	-.50 (2.66)**		
ΔLnY_{t-3}						-.38 (1.85)*		
ΔLnY_{t-4}								
ΔLER_t	-.04 (1.07)		.06 (.86)		-.06 (.69)		-.02 (.30)	
ΔLER_{t-1}								
ΔLER_{t-2}								
ΔLER_{t-3}								
ΔLER_{t-4}								
ΔPOS_t		-.53 (4.71)**		.16 (.89)		.31 (1.57)		.04 (.29)
ΔPOS_{t-1}						-.51 (2.51)**		
ΔPOS_{t-2}						-.43 (2.63)**		
ΔPOS_{t-3}						.18 (1.49)		
ΔPOS_{t-4}								
ΔNEG_t		.12 (2.68)**		.02 (.14)		-.03 (.15)		-.04 (.60)
ΔNEG_{t-1}						.28 (1.40)		
ΔNEG_{t-2}						.19 (1.01)		
ΔNEG_{t-3}						-.27 (1.65)		
ΔNEG_{t-4}								
Panel B: Long-Run Estimates								
Constant	45.87 (.61)	1.01 (1.64)	3.53 (.43)	3.99 (19.52)**	-49.34 (.76)	2.82 (2.65)**	-27.63 (.14)	4.01 (11.27)**
LER_t	-3.31 (.40)		.34 (.18)		10.42 (.83)		6.46 (.16)	
POS_t		3.74 (7.15)**		.52 (1.86)*		1.38 (1.32)		-.30 (.12)
NEG_t		.57 (1.52)		-.14 (.43)		-1.76 (1.27)		-1.05 (.43)
Panel C: Diagnostic Statistics								
F	.13	2.89	.25	1.23	1.27	.82	.81	1.29
ECM_{t-1}	.00 (.35)	.03 (2.19)	-.01 (.50)	-.14 (1.81)	0.01 (1.62)	-.09 (1.67)	.01 (1.22)	-.07 (1.83)
LM	1.24	2.08	.05	.77	1.19	3.09*	1.06	.40
RESET	.53	1.87	8.69**	.31	3.61*	.23	8.44**	5.83**
CUSUM	S	S	S	S	S	S	S	S
CUSUMSQ	U	S	U	U	S	S	U	U
Wald-Long		73.19**		28.80**		28.74**		3.94**
Wald-Short		26.14**		.31		.79		.43
Adjusted R^2	.08	.42	.11	.17	.14	.36	.13	.16

	Cyprus		Denmark		Dominica		Dominican Republic	
	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL
Panel A: Short-Run Estimates								
ΔLnY_t								
ΔLnY_{t-1}						.39 (2.96)**	.19 (1.17)	.24 (1.43)
ΔLnY_{t-2}						.00 (.03)	-.49 (2.78)**	-.41 (2.32)**
ΔLnY_{t-3}						.45 (3.71)**		
ΔLnY_{t-4}								
ΔLER_t	.11 (.69)		-.08 (.69)		-.75 (3.11)**		.16 (2.76)**	
ΔLER_{t-1}					.29 (1.28)		.04 (.78)	
ΔLER_{t-2}							.11 (2.15)**	
ΔLER_{t-3}								
ΔLER_{t-4}								
ΔPOS_t		.58 (1.77)*		-.34 (1.69)*		-1.43 (3.33)**		.15 (1.28)
ΔPOS_{t-1}		.17 (.57)		-.40 (2.09)**		-.63 (2.04)*		
ΔPOS_{t-2}		.35 (1.20)				-.57 (2.24)**		
ΔPOS_{t-3}		.80 (2.37)**				.55 (2.45)**		
ΔPOS_{t-4}								
ΔNEG_t		-.60 (2.00)*		.10 (.52)		.13 (.49)		.12 (1.58)
ΔNEG_{t-1}				.56 (2.62)**		.77 (2.62)**		
ΔNEG_{t-2}				.31 (1.47)				
ΔNEG_{t-3}								
ΔNEG_{t-4}								
Panel B: Long-Run Estimates								
Constant	12.31 (1.41)	5.55 (.82)	-704.35 (.03)	4.38 (13.25)**	9.25 (6.66)**	3.93 (22.28)**	31.68 (.22)	4.24 (3.80)**
LER_t	-1.66 (.87)		151.17(.03)		-1.01 (3.42)**		-9.33 (.22)	
POS_t		-15.37 (.30)		-.91(.58)		.18 (.49)		2.68 (1.81)*
NEG_t		-3.39 (.43)		-2.53 (1.42)		-.84 (4.41)**		1.07 (.76)
Panel C: Diagnostic Statistics								
F	12.27**	11.30**	2.20	3.02	2.87	14.71**	.56	1.02
ECM_{t-1}	-.05 (4.86)**	-.02 (6.08)**	.00 (2.12)	-.12 (3.09)	-.09 (2.25)	-.60 (7.00)**	.00 (1.06)	-.06 (1.81)
LM	.39	.00	.58	.06	.00	.49	.54	.64
RESET	.63	.25	.22	1.55	.00	.19	2.59	.02
CUSUM	S	S	S	S	S	S	S	S
CUSUMSQ	S	S	S	S	S	S	S	S
Wald-Long		.06		25.14**		21.30**		15.23**
Wald-Short		6.41**		8.43**		7.95**		.03
Adjusted R^2	.39	.52	.05	.19	.22	.73	.25	.19

	Ecuador		Fiji		Finland		France	
	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL
Panel A: Short-Run Estimates								
ΔLnY_t								
ΔLnY_{t-1}	-.39 (1.89)*	-.54 (3.31)**	-.60 (3.66)**	-.37 (2.79)**	.37 (2.45)**	.35 (2.29)**		.43 (3.57)**
ΔLnY_{t-2}			-.30 (1.92)*			-.24 (1.55)		
ΔLnY_{t-3}								
ΔLnY_{t-4}								
ΔLER_t	.09 (1.85)*		.17 (1.70)*		-.04 (.45)		-.20 (3.29)**	
ΔLER_{t-1}								
ΔLER_{t-2}								
ΔLER_{t-3}								
ΔLER_{t-4}								
ΔPOS_t		-.11 (1.29)		-.50 (1.40)		.28 (1.28)		.06 (.57)
ΔPOS_{t-1}		-.10 (1.40)				-.62 (2.85)**		
ΔPOS_{t-2}						-.48 (2.10)**		
ΔPOS_{t-3}								
ΔPOS_{t-4}								
ΔNEG_t		.26 (4.19)**		.32 (2.98)**		.26 (1.81)*		-.33 (3.25)**
ΔNEG_{t-1}		-.02 (.25)				.23 (1.47)		
ΔNEG_{t-2}		-.19 (2.98)**				.34 (2.16)**		
ΔNEG_{t-3}								
ΔNEG_{t-4}								
Panel B: Long-Run Estimates								
Constant	6.32 (.67)	4.49 (7.37)**	11.06 (5.53)**	4.12 (54.36)**	17.72 (3.13)**	3.82 (59.68)**	21.54 (5.09)**	3.77 (71.97)**
LER_t	-1.10 (.46)		-1.30 (3.20)**		-2.81 (2.35)**		-3.63 (3.97)**	
POS_t		1.31 (1.94)*		.73 (1.98)*		1.07 (4.42)**		.50 (1.45)
NEG_t		.38 (.74)		-.54 (2.88)**		-.11 (.63)		-1.07 (4.35)**
Panel C: Diagnostic Statistics								
F	.91	1.93	4.29	5.43*	5.41*	6.54**	11.99**	4.30
ECM_{t-1}	.01 (.48)	-.08 (2.51)	-.12 (2.86)	-.36 (4.10)**	-.05 (3.33)*	-.35 (4.57)**	-.05 (4.90)**	-.25 (3.57)*
LM	.10	.02	1.74	1.04	2.53	1.34	1.84	.04
RESET	4.48**	8.91**	.37	.09	.57	4.56**	.73	.57
CUSUM	S	S	S	S	S	S	S	S
CUSUMSQ	S	S	S	S	U	U	S	S
Wald-Long		13.66**		35.62**		238.32**		132.74**
Wald-Short		3.10*		4.05**		9.45**		2.35
Adjusted R^2	.05	.40	.37	.52	.35	.47	.37	.40

	Germany		Greece		Grenada		Iceland	
	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL
Panel A: Short-Run Estimates								
ΔLnY_t								
ΔLnY_{t-1}	.26 (1.68)*	.37 (2.34)**	.49 (3.60)**	.47 (3.19)**			.32 (2.47)**	.22 (1.61)
ΔLnY_{t-2}	-.25 (1.66)*			.09 (.55)				
ΔLnY_{t-3}				.36 (2.40)**				
ΔLnY_{t-4}								
ΔLER_t	-.05 (.51)		-.15 (1.11)		-.11 (.50)		.21 (3.95)**	
ΔLER_{t-1}								
ΔLER_{t-2}								
ΔLER_{t-3}								
ΔLER_{t-4}								
ΔPOS_t		-.02 (.07)		.23 (.69)		.15 (.35)		.12 (.74)
ΔPOS_{t-1}				-.47 (1.66)*				-.03 (.24)
ΔPOS_{t-2}								.45 (3.46)**
ΔPOS_{t-3}								.25 (1.95)*
ΔPOS_{t-4}								
ΔNEG_t		-.05 (.27)		-.25 (1.35)		-.24 (.54)		.13 (1.38)
ΔNEG_{t-1}								.29 (3.10)**
ΔNEG_{t-2}								
ΔNEG_{t-3}								
ΔNEG_{t-4}								
Panel B: Long-Run Estimates								
Constant	15.91 (1.44)	3.77 (29.62)**	-74.79 (.20)	3.72 (23.53)**	-19.81 (.23)	2.16 (2.24)**	-106.71 (.13)	1.72 (.33)
LER_t	-2.32 (98)		17.59 (.21)		5.59 (.29)		24.89 (.14)	
POS_t		.86 (1.60)		.48 (1.07)		3.81 (1.59)		5.65 (.41)
NEG_t		-.62 (1.59)		-.73 (1.20)		-.14 (.09)		2.90 (.31)
Panel C: Diagnostic Statistics								
F	1.05	1.97	1.76	2.46	1.24	1.04	1.09	.63
ECM_{t-1}	-.03 (1.45)	-.23 (2.47)	.01 (1.57)	-.17 (2.78)	-.02 (1.39)	-.03 (.90)	.00 (1.50)	.02 (1.42)
LM	.18	.33	.91	.00	.08	.00	.09	.01
RESET	.00	1.05	2.01	3.33*	.04	3.53*	1.95	.20
CUSUM	S	S	U	S	S	S	S	S
CUSUMSQ	S	S	S	S	U	U	S	S
Wald-Long		89.68**		25.69**		3.03*		.35
Wald-Short		.01		5.01**		.03		1.49
Adjusted R^2	.07	.10	.29	.35	.01	-.05	.37	.48

	India		Indonesia		Iran		Ireland	
	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL
Panel A: Short-Run Estimates								
ΔLnY_t								
ΔLnY_{t-1}			.58 (3.88)**		.33 (2.23)**	.37 (2.88)**	.89 (3.70)**	.96 (6.41)**
ΔLnY_{t-2}			-.35 (2.60)**		-.18 (1.16)	-.08 (.58)	-.45 (2.00)*	
ΔLnY_{t-3}					-.53 (3.46)**	-.32 (2.53)**		
ΔLnY_{t-4}								
ΔLER_t	.06 (1.09)		.15 (6.45)**		-.08 (2.21)**		-.37 (2.49)**	
ΔLER_{t-1}			-.06 (2.03)**					
ΔLER_{t-2}								
ΔLER_{t-3}								
ΔLER_{t-4}								
ΔPOS_t		-.03 (.23)		-.14 (3.60)**		-.07 (.71)		-.08 (.27)
ΔPOS_{t-1}				-.09 (2.25)**				
ΔPOS_{t-2}				-.08 (2.01)**				
ΔPOS_{t-3}								
ΔPOS_{t-4}								
ΔNEG_t		.13 (1.45)		.22 (9.33)**		-.03 (.78)		-.52 (2.19)**
ΔNEG_{t-1}		.10 (1.14)						.50 (1.99)*
ΔNEG_{t-2}		-.23 (2.59)**						.62 (2.48)**
ΔNEG_{t-3}		.21 (2.51)**						.62 (2.31)**
ΔNEG_{t-4}								
Panel B: Long-Run Estimates								
Constant	-1.39 (.18)	.49 (.20)	12.58 (3.27)**	5.22 (3.15)**	.40 (.10)	3.37 (30.18)**	300.05 (.33)	3.38 (26.91)**
LER_t	.23 (.18)		-2.40 (1.99)*		.59 (.81)		-62.78 (.32)	
POS_t		2.73 (1.67)		.73 (1.30)		.25 (1.78)*		-.10 (.17)
NEG_t		.00 (.00)		.02 (.05)		-.19 (1.51)		-3.07 (5.32)**
Panel C: Diagnostic Statistics								
F	5.53*	.91	2.67	5.37*	4.16	5.54*	1.58	7.47**
ECM_{t-1}	.02 (3.27)*	.03 (1.70)	.02 (2.32)	-.04 (4.13)**	.05 (2.94)*	-.16 (4.24)**	.00 (1.77)	-.27 (4.95)**
LM	.69	.00	.02	.00	2.30	2.95*	.40	.88
RESET	.34	9.55**	19.99**	16.80**	1.52	1.76	.27	3.30*
CUSUM	S	S	U	S	S	U	S	S
CUSUMSQ	U	S	U	U	U	U	U	S
Wald-Long		6.83**		7.11**		13.94**		479.83**
Wald-Short		.76		33.14**		.08		2.31
Adjusted R^2	.24	.27	.54	.72	.44	.55	.49	.66

	Israel		Italy		Japan		Korea	
	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL
Panel A: Short-Run Estimates								
ΔLnY_t								
ΔLnY_{t-1}		.39 (1.45)				.33 (2.51)**		
ΔLnY_{t-2}		.20 (1.39)						
ΔLnY_{t-3}								
ΔLnY_{t-4}								
ΔLER_t	-.06 (.45)		-.10 (1.70)*		.02 (.72)		-.03 (.65)	
ΔLER_{t-1}	-.20 (1.35)				-.08 (2.54)**		.13 (3.33)**	
ΔLER_{t-2}	.15 (1.17)							
ΔLER_{t-3}	-.27 (2.01)**							
ΔLER_{t-4}								
ΔPOS_t		.24 (.92)		-.04 (.28)		-.01 (.21)		-.14 (1.61)
ΔPOS_{t-1}		.06 (.29)				-.20 (3.37)**		-.17 (2.01)**
ΔPOS_{t-2}		-.32 (1.57)				.06 (.97)		.15 (1.95)*
ΔPOS_{t-3}		-.59 (3.07)**				-.09 (1.74)*		
ΔPOS_{t-4}								
ΔNEG_t		-.52 (1.69)*		-.17 (1.81)*		.08 (1.64)		.08 (1.92)*
ΔNEG_{t-1}		-.63 (3.13)**						.17 (3.42)**
ΔNEG_{t-2}		.49 (2.66)**						-.15 (3.10)**
ΔNEG_{t-3}								
ΔNEG_{t-4}								
Panel B: Long-Run Estimates								
Constant	38.80 (1.13)	2.46 (10.16)**	7.92 (1.70)*	1.74 (.17)	.43 (.31)	3.77 (26.77)**	15.35 (2.42)**	-16.03 (.22)
LER_t	-7.06 (.99)		-.70 (.70)		.93 (3.02)**		-2.07 (1.49)	
POS_t		1.07 (1.42)		5.29 (.25)		.89 (6.89)**		13.15 (.24)
NEG_t		-1.06 (1.64)		.93 (.15)		.54 (3.54)**		2.75 (.13)
Panel C: Diagnostic Statistics								
F	.45	2.21	8.59**	4.91*	15.68**	3.29	13.88**	10.80**
ECM_{t-1}	-.02 (.96)	-.22 (2.67)	-.05 (4.19)**	.01 (3.93)**	-.08 (5.49)**	-.15 (3.24)*	-.03 (5.33)**	.01 (5.85)**
LM	.13	1.46	.43	.11	1.50	2.52	.13	.04
RESET	7.39	5.76**	.29	.34	1.30	2.58	5.73**	.13
CUSUM	S	S	S	S	S	S	S	S
CUSUMSQ	U	S	S	S	S	S	U	S
Wald-Long		106.24**		.41		17.58**		.02
Wald-Short		.00		.35		3.37*		1.96
Adjusted R^2	.20	.54	.31	.33	.39	.44	.41	.61

	Lesotho		Luxembourg		Malawi		Malaysia	
	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL
Panel A: Short-Run Estimates								
ΔLnY_t								
ΔLnY_{t-1}					.11 (.70)	-.19 (1.42)		.15 (1.23)
ΔLnY_{t-2}					.25 (1.67)*	.46 (2.63)**		.05 (.45)
ΔLnY_{t-3}					-.23 (1.54)			.31 (2.64)**
ΔLnY_{t-4}								
ΔLER_t	-.16 (.53)		-.11 (.70)		.11 (1.70)*		.24 (3.07)**	
ΔLER_{t-1}					.04 (.51)			
ΔLER_{t-2}					.24 (3.23)**			
ΔLER_{t-3}								
ΔLER_{t-4}								
ΔPOS_t		-.49 (.83)		-.23 (1.31)		.25 (1.69)		-.07 (.30)
ΔPOS_{t-1}						.61 (3.95)**		-.60 (2.62)**
ΔPOS_{t-2}						.39 (3.08)**		-.40 (1.85)*
ΔPOS_{t-3}								-.55 (2.45)**
ΔPOS_{t-4}								
ΔNEG_t		.02 (.04)		.21 (.51)		-.08 (.90)		.48 (5.03)**
ΔNEG_{t-1}						.21 (2.27)**		
ΔNEG_{t-2}						.31 (3.83)**		
ΔNEG_{t-3}						.30 (3.18)**		
ΔNEG_{t-4}								
Panel B: Long-Run Estimates								
Constant	7.65 (1.98)*	4.30 (10.20)**	28.87 (1.28)	4.55 (3.01)**	9.87 (9.95)**	3.83 (60.56)**	16.05 (6.46)**	3.04 (10.11)**
LER_t	-.63 (.78)		-5.09 (1.05)		-1.13 (6.12)**		-2.27 (4.13)**	
POS_t		-.38 (.26)		-3.56 (.72)		-1.76 (2.77)**		3.38 (4.39)**
NEG_t		-.52 (.65)		-5.11 (1.34)		-1.46 (3.86)**		-.37 (1.07)
Panel C: Diagnostic Statistics								
F	1.78	1.23	2.27	1.01	4.42	9.28**	5.15*	4.71
ECM_{t-1}	-.11 (1.92)	-.12 (1.92)	-.02 (1.73)	-.03 (1.73)	-.22 (3.04)*	-.37 (5.60)**	-.05 (3.24)*	-.17 (3.91)**
LM	.00	.03	.00	.15	1.60	1.79	.94	3.16*
RESET	.14	.01	4.08**	.48	3.41*	6.18**	8.32**	9.33**
CUSUM	S	S	S	S	S	S	S	S
CUSUMSQ	U	U	S	S	S	S	S	S
Wald-Long		.06		.01		1.38		64.61**
Wald-Short		.59		.58		4.35**		9.46**
Adjusted R^2	.05	.06	.06	.09	.44	.65	.35	.55

	Malta		Mexico		Netherlands		New Zealand	
	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL
Panel A: Short-Run Estimates								
ΔLnY_t								
ΔLnY_{t-1}	.31 (2.12)**	.31 (2.45)**			.27 (1.81)*	.39 (2.81)**		
ΔLnY_{t-2}		.29 (2.45)**						
ΔLnY_{t-3}								
ΔLnY_{t-4}								
ΔLER_t	-.33 (2.87)**		.11 (4.21)**		-.11 (1.25)		.02 (.44)	
ΔLER_{t-1}	.04 (.28)		.08 (3.17)**				.07 (1.50)	
ΔLER_{t-2}	-.19 (1.60)						.08 (1.75)*	
ΔLER_{t-3}	-.23 (1.81)*							
ΔLER_{t-4}								
ΔPOS_t		-.17 (90)		0.00 (.07)		-.16 (.84)		.06 (.66)
ΔPOS_{t-1}								
ΔPOS_{t-2}								
ΔPOS_{t-3}								
ΔPOS_{t-4}								
ΔNEG_t		-.18 (1.05)		.13 (3.51)**		.00 (.00)		.00 (.01)
ΔNEG_{t-1}		.63 (2.74)*		.15 (4.51)**				.11 (1.51)
ΔNEG_{t-2}		.19 (.89)						.13 (1.81)*
ΔNEG_{t-3}								
ΔNEG_{t-4}								
Panel B: Long-Run Estimates								
Constant	4.88 (.28)	2.83 (63.98)**	-.40 (.08)	4.75 (4.16)**	32.49 (1.48)	3.81 (17.23)**	-23.01 (1.46)	3.80 (18.90)**
LER_t	.19 (.05)		1.23 (1.14)		-5.93 (1.26)		5.74 (1.71)*	
POS_t		.72 (6.11)**		.23 (.42)		.54 (.58)		-.24 (.31)
NEG_t		-1.81 (22.81)**		.05 (.10)		-1.07 (1.40)		-1.10 (1.20)
Panel C: Diagnostic Statistics								
F	1.34	6.52**	7.46**	5.67*	1.58	1.99	.69	.77
ECM_{t-1}	-.02 (1.66)	-.37 (4.53)**	-.03 (3.91)**	-.06 (4.24)**	-.01 (1.78)	-.13 (2.47)	.01 (1.08)	-.07 (1.44)
LM	.98	3.73*	.02	.03	.33	.26	.05	.10
RESET	.76	.37	2.25	3.36*	.11	.10	.05	.61
CUSUM	S	S	S	S	S	S	S	S
CUSUMSQ	S	S	S	S	S	S	U	U
Wald-Long		772.05**		.43		38.36**		46.06**
Wald-Short		2.53		6.18**		.35		.59
Adjusted R^2	.67	.77	.50	.54	.14	.18	.04	.04

	Norway		Pakistan		Paraguay		Philippines	
	L-ARDL	**NL-ARDL**	**L-ARDL**	**NL-ARDL**	**L-ARDL**	**NL-ARDL**	**L-ARDL**	**NL-ARDL**
Panel A: Short-Run Estimates								
ΔLnY_t								
ΔLnY_{t-1}	.39 (2.50)**	.38 (2.79)**	.34 (2.00)**	.28 (1.78)*		.26 (1.53)	.58 (3.44)**	.71 (4.18)**
ΔLnY_{t-2}	-.09 (.54)	.14 (.93)				.31 (1.68)	-.31 (1.80)*	-.22 (1.29)
ΔLnY_{t-3}	-.28 (1.80)*	-.25 (1.95)*				.68 (3.50)**		
ΔLnY_{t-4}								
ΔLER_t	-.21 (2.66)**		.04 (.63)		.10 (1.24)		.04 (.56)	
ΔLER_{t-1}							.09 (1.58)	
ΔLER_{t-2}								
ΔLER_{t-3}								
ΔLER_{t-4}								
ΔPOS_t		-.28 (1.99)*		.04 (.28)		.24 (1.49)		.33 (2.04)**
ΔPOS_{t-1}		.01 (.06)				-.50 (2.92)**		
ΔPOS_{t-2}		.39 (2.95)**				-.35 (1.80)*		
ΔPOS_{t-3}						-.35 (2.09)**		
ΔPOS_{t-4}								
ΔNEG_t		-.09 (.71)		.05 (.64)		-.06 (.54)		-.09 (.93)
ΔNEG_{t-1}		.09 (.44)				.17 (1.62)		
ΔNEG_{t-2}		.04 (.19)				.26 (2.20)**		
ΔNEG_{t-3}		.40 (2.63)**				.24 (2.22)**		
ΔNEG_{t-4}								
Panel B: Long-Run Estimates								
Constant	37.42 (3.70)**	3.88 (28.95)**	-7.34 (.12)	3.52 (8.74)**	-25.87 (.17)	3.71 (79.26)**	-7.53 (.45)	3.39 (24.55)**
LER_t	-7.06 (3.22)**		3.90 (.23)		8.14 (.20)		2.14 (.63)	
POS_t		-1.39 (2.08)**		1.96 (3.07)**		.62 (8.42)**		1.63 (2.75)**
NEG_t		-3.74 (6.67)**		-.72 (1.97)*		-.33 (5.47)**		.06 (.14)
Panel C: Diagnostic Statistics								
F	5.81*	4.20	1.36	3.51	.07	6.93**	.92	1.12
ECM_{t-1}	-.03 (3.46)**	-.18 (3.68)**	.00 (1.66)	-.11 (3.19)	.00 (.28)	-.72 (4.85)**	.01 (1.37)	-.05 (1.88)
LM	.19	1.35	.29	.57	.00	12.64**	.21	.73
RESET	.02	.92	2.48	2.71*	7.28**	1.57	6.08**	9.06**
CUSUM	S	S	S	S	S	S	S	S
CUSUMSQ	S	S	S	S	S	U	S	S
Wald-Long		207.60**		53.66		523.97**		5.69**
Wald-Short		.31		.16		7.64**		3.17*
Adjusted R^2	.45	.62	.22	.35	-.01	.53	.31	.34

	Portugal		Saudi Arabia		Sierra Leone		Singapore	
	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL
Panel A: Short-Run Estimates								
ΔLnY_t								
ΔLnY_{t-1}							-.17 (1.35)	-.12 (1.01)
ΔLnY_{t-2}							-.35 (3.12)**	-.32 (2.94)**
ΔLnY_{t-3}								.17 (1.62)
ΔLnY_{t-4}								
ΔLER_t	.22 (1.07)		-.27 (2.77)**		-.06 (70)		.37 (5.12)**	
ΔLER_{t-1}								
ΔLER_{t-2}								
ΔLER_{t-3}								
ΔLER_{t-4}								
ΔPOS_t		.53 (1.71)*		-.25 (1.10)		.27 (1.10)		.41 (2.52)**
ΔPOS_{t-1}								
ΔPOS_{t-2}								
ΔPOS_{t-3}								
ΔPOS_{t-4}								
ΔNEG_t		-.30 (.66)		-.32 (2.98)**		-.13 (1.27)		.46 (3.77)**
ΔNEG_{t-1}								
ΔNEG_{t-2}								
ΔNEG_{t-3}								
ΔNEG_{t-4}								
Panel B: Long-Run Estimates								
Constant	3.35 (.57)	4.05 (7.00)**	242.60 (.11)	1.50 (.50)	2.88 (90)	-16.19 (.15)	15.22 (3.22)**	3.41 (1.95)*
LER_t	.27 (.21)		-47.30 (.11)		.21 (.34)		-1.87 (1.79)*	
POS_t		.14 (.12)		-2.70 (.36)		23.92 (.18)		-.12 (.07)
NEG_t		-.86 (.34)		-4.42 (.72)		5.23 (.18)		-1.93 (2.88)**
Panel C: Diagnostic Statistics								
F	4.03	2.00	15.53**	18.32**	.75	3.87	11.16**	9.35**
ECM_{t-1}	-.10 (2.88)	-.13 (2.52)	-.003 (5.66)**	-.04 (7.59)**	.07 (1.24)	-.01 (3.36)*	-.03 (4.74)**	-.07 (5.46)**
LM	.13	.01	1.31	.28	1.71	.04	.24	.18
RESET	7.30**	4.47**	.38	.10	1.14	3.97**	6.67**	3.41*
CUSUM	S	S	S	S	S	S	S	S
CUSUMSQ	U	U	U	U	S	U	S	S
Wald-Long		.73		4.26**		.01		2.24
Wald-Short		1.35		.03		.59		.04
Adjusted R^2	.16	.17	.47	.63	-.01	.22	.49	.55

	South Africa		Spain		St. Kitts and Nevis		St. Lucia	
	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL
Panel A: Short-Run Estimates								
ΔLnY_t								
ΔLnY_{t-1}	.32 (2.20)**	.42 (2.71)**	.50 (3.90)**	.39 (3.23)**	.45 (2.55)**	.39 (2.18)**		
ΔLnY_{t-2}					-.43 (2.18)**			
ΔLnY_{t-3}								
ΔLnY_{t-4}								
ΔLER_t	-.01 (.23)		-.01 (.12)		-.39 (2.00)*		-.60 (3.10)**	
ΔLER_{t-1}	.09 (2.26)**							
ΔLER_{t-2}								
ΔLER_{t-3}								
ΔLER_{t-4}								
ΔPOS_t		.04 (.56)		.02 (.15)		-.51 (1.29)		-.44 (1.16)
ΔPOS_{t-1}								-.80 (2.11)**
**ΔPOS_{t-2}								-.30 (.90)
ΔPOS_{t-3}								
ΔPOS_{t-4}								
ΔNEG_t		.02 (.32)		.03 (.27)		-.01 (.03)		-.72 (1.98)*
ΔNEG_{t-1}				.28 (2.34)**				.60 (1.62)
ΔNEG_{t-2}								
ΔNEG_{t-3}								
ΔNEG_{t-4}								
Panel B: Long-Run Estimates								
Constant	11.61 (4.30)**	3.77 (43.55)**	-52.75 (.48)	3.96 (15.79)**	20.70 (1.54)	4.23 (2.31)**	15.42 (2.60)**	4.21 (6.35)**
LER_t	-1.46 (2.81)**		12.18 (.52)		-3.40 (1.18)		-2.32 (1.82)*	
POS_t		.60 (2.21)**		-.63 (.77)		-.39 (.09)		.74 (.52)
NEG_t		-.12 (.69)		-2.31 (2.33)**		-1.51 (.83)		-.15 (.10)
Panel C: Diagnostic Statistics								
F	.89	1.05	3.08	6.28**	1.37	.71	3.90	3.46
ECM_{t-1}	-.03 (1.32)	-.13 (1.82)	.01 (2.51)	-.08 (4.33)**	-.03 (1.69)	-.04 (1.33)	-.05 (2.55)	-.09 (3.13)
LM	1.06	.18	.10	.30	2.58	.81	.03	1.27
RESET	.05	3.80*	.00	.06	1.32	.67	.02	1.63
CUSUM	S	S	S	S	S	S	S	S
CUSUMSQ	U	U	S	S	S	S	S	S
Wald-Long		30.49**		27.92**		10.57**		2.02
Wald-Short		.02		.07		.26		2.30
Adjusted R^2	.13	.10	.44	.55	.27	.18	.26	.36

	St. Vincent and the Grenadines		Sweden		Switzerland		Togo	
	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL
Panel A: Short-Run Estimates								
ΔLnY_t								
ΔLnY_{t-1}	-.26 (1.51)	-.18 (1.13)	.32 (2.17)**	.31 (2.41)**	.26 (1.73)*	.29 (2.05)**		
ΔLnY_{t-2}		.30 (1.90)*	-.22 (1.53)		-.21 (1.45)			
ΔLnY_{t-3}								
ΔLnY_{t-4}								
ΔLER_t	-.24 (1.23)		.05 (.94)		-.14 (2.28)**		-.13 (1.13)	
ΔLER_{t-1}	-.43 (2.13)**		-.01 (.07)		-.10 (1.53)			
ΔLER_{t-2}			.11 (1.51)					
ΔLER_{t-3}			.12 (1.84)*					
ΔLER_{t-4}								
ΔPOS_t		.28 (.71)		.05 (.41)		.01 (.07)		.23 (1.23)
ΔPOS_{t-1}		-1.13 (3.14)**						
ΔPOS_{t-2}		-.60 (1.41)						
ΔPOS_{t-3}								
ΔPOS_{t-4}								
ΔNEG_t		-.68 (1.63)		.10 (1.61)		-.31 (2.57)**		.01 (.08)
ΔNEG_{t-1}				.10 (1.13)		-.03 (.19)		
ΔNEG_{t-2}				.18 (2.29)**		.31 (2.43)**		
ΔNEG_{t-3}				.24 (3.40)**				
ΔNEG_{t-4}								
Panel B: Long-Run Estimates								
Constant	-106.28 (.42)	3.57 (6.26)**	14.17 (15.32)**	3.86 (218.2)**	-72.35 (.11)	3.93 (56.86)**	10.91 (3.29)**	4.22 (61.63)**
LER_t	24.30 (.44)		-2.03 (10.86)**		18.69 (.12)		-1.35 (1.92)*	
POS_t		4.16 (2.04)**		-.01 (.03)		.02 (.10)		.71 (2.36)**
NEG_t		1.00 (.53)		-.86 (7.22)**		-1.12 (3.71)**		-.01 (.04)
Panel C: Diagnostic Statistics								
F	5.02	4.33	4.09	8.09**	.07	2.88	3.64	3.74
ECM_{t-1}	-.01 (3.22)*	-.20 (3.75)**	-.11 (2.90)	-.39 (5.08)**	.00 (.02)	-.18 (2.86)	-.18 (2.71)	-.63 (3.39)*
LM	.19	.23	3.54*	2.41	1.35	1.23	.25	.52
RESET	1.86	9.15**	5.81**	9.91**	.26	.78	.10	.48
CUSUM	S	S	S	S	S	U	S	S
CUSUMSQ	U	S	U	U	S	U	S	S
Wald-Long		58.42**		87.86**		109.00**		27.76**
Wald-Short		.46		5.45**		.01		.34
Adjusted R^2	.26	.36	.39	.56	.25	.38	.14	.29

	Trinidad and Tobago		Tunisia		Turkey		Uganda	
	L-ARDL	**NL-ARDL**	**L-ARDL**	**NL-ARDL**	**L-ARDL**	**NL-ARDL**	**L-ARDL**	**NL-ARDL**
Panel A: Short-Run Estimates								
ΔLnY_t								
ΔLnY_{t-1}	.42 (2.24)**	.31 (1.49)					.04 (.23)	.05 (.35)
ΔLnY_{t-2}							-.42 (2.69)**	-.46 (2.97)**
ΔLnY_{t-3}								
ΔLnY_{t-4}								
ΔLER_t	-.19 (2.08)**		.10 (1.36)		.18 (3.21)**		-.27 (3.02)**	
ΔLER_{t-1}								
ΔLER_{t-2}								
ΔLER_{t-3}								
ΔLER_{t-4}								
ΔPOS_t		-.64 (3.11)**		.05 (.08)		.08 (.55)		-.05 (.21)
ΔPOS_{t-1}								
ΔPOS_{t-2}								
ΔPOS_{t-3}								
ΔPOS_{t-4}								
ΔNEG_t		-.03 (.20)		.05 (.70)		.15 (1.84)*		-.33 (2.71)**
ΔNEG_{t-1}								
ΔNEG_{t-2}								
ΔNEG_{t-3}								
ΔNEG_{t-4}								
Panel B: Long-Run Estimates								
Constant	-12.99 (1.55)	2.88 (9.26)**	10.38 (4.37)**	3.97 (9.68)**	13.90 (.86)	3.24 (30.44)**	15.44 (5.52)**	-.87 (.95)
LER_t	3.70 (2.01)**		-1.00 (1.85)*		-1.37 (.44)		-2.09 (4.47)**	
POS_t		1.80 (2.05)**		7.96 (2.31)**		.37 (2.53)**		-.16 (.08)
NEG_t		1.17 (1.24)		-.41 (.98)		-.60 (4.40)**		-1.58 (2.23)**
Panel C: Diagnostic Statistics								
F	1.91	1.05	1.97	2.20	.74	2.80	4.53	4.45
ECM_{t-1}	.03 (1.98)	.08 (1.83)	-.03 (1.93)	-.07 (2.50)	-.01 (1.21)	-.21 (2.97)	-.09 (3.05)*	-.12 (3.67)**
LM	.05	.46	.14	.28	.88	.77	.02	.17
RESET	.02	.00	.91	2.07	1.51	3.25*	.94	1.16
CUSUM	S	S	S	S	S	S	S	S
CUSUMSQ	U	U	S	S	S	S	U	U
Wald-Long		5.03**		6.15**		339.38**		5.65**
Wald-Short		3.16*		.14		.10		.83
Adjusted R^2	.39	.44	.08	.11	.19	.29	.38	.44

	United Kingdom		United States		Uruguay		Venezuela	
	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL
Panel A: Short-Run Estimates								
ΔLnY_t								
ΔLnY_{t-1}	.45 (2.97)**	.45 (3.11)**	.22 (1.46)	.33 (2.21)**	.38 (2.01)**	.46 (3.03)**	.16 (.93)	.23 (1.50)
ΔLnY_{t-2}	-.32 (2.00)**	-.18 (1.18)					-.33 (1.90)*	
ΔLnY_{t-3}								
ΔLnY_{t-4}								
ΔLER_t	.00 (.04)		.01 (.15)		-.03 (.32)		-.01 (.18)	
ΔLER_{t-1}							-.10 (1.99)*	
ΔLER_{t-2}								
ΔLER_{t-3}								
ΔLER_{t-4}								
ΔPOS_t		.01 (.10)		-.01 (.13)		.13 (1.03)		-.01 (.25)
ΔPOS_{t-1}		-.18 (1.91)*		-.18 (1.78)*				-.23 (2.38)**
ΔPOS_{t-2}				.16 (1.55)				
ΔPOS_{t-3}								
ΔPOS_{t-4}								
ΔNEG_t		.01 (.12)		.08 (.84)		-.11 (1.37)		.07 (.86)
ΔNEG_{t-1}		.14 (2.11)**						
ΔNEG_{t-2}								
ΔNEG_{t-3}								
ΔNEG_{t-4}								
Panel B: Long-Run Estimates								
Constant	89.23 (.02)	3.86 (44.09)**	-15.10 (.29)	4.07 (6.05)**	-6.01 (.36)	3.47 (10.82)**	-1.43 (.23)	3.95 (16.66)**
LER_t	-33.51 (.02)		4.93 (.40)		2.18 (.66)		1.27 (.91)	
POS_t		.49 (1.69)*		1.45 (1.13)		.34 (1.12)		.06 (.28)
NEG_t		-.27 (1.08)		.28 (.24)		-.78 (1.11)		-.35 (1.18)
Panel C: Diagnostic Statistics								
F	.16	2.19	1.50	1.10	5.01	8.15**	1.79	1.62
ECM_{t-1}	.00 (.45)	-.15 (2.54)	-.01 (1.75)	-.07 (1.86)	.06 (2.60)	-.20 (5.04)**	.05 (1.92)	-.20 (2.29)
LM	.83	.66	1.39	.49	.15	.26	.03	.27
RESET	1.74	5.10**	.00	1.83	4.09**	3.20*	.08	2.08
CUSUM	S	S	S	S	S	S	S	S
CUSUMSQ	S	U	S	S	S	S	S	S
Wald-Long		82.13**		41.84**		6.34**		14.64**
Wald-Short		3.45*		.19		1.93		4.25**
Adjusted R^2	.13	.26	.09	.17	.34	.56	.27	.35

Notes:

a. Numbers in parentheses are t-ratios. **, * denote significance at the 5% and 10% levels, respectively.

b. At the 10% (5%) significance level when there is one exogenous variable (k=1), the upper bound critical value of the F test is 5.050 (6.175). These come from Narayan (2005 p 1988) for our sample size (n=35).

c. Number in parentheses next to ECM_{t-1} is the absolute value of the t-ratio. Its upper bound critical value at the 10% (5%) significance level is 2.95 (3.35) when k=1 and these come from Banerjee et al (1998 p 276). In the nonlinear model where k=2, these critical values change to 3.24 (3.64). (T=24)

d. LM is the Lagrange Multiplier test of residual serial correlation. It is distributed as χ^2 with one degree of freedom (first order). Its critical value at 10% (5%) significance level is 2.70 (3.84). These critical values are also used for Wald tests since they also have a χ^2 distribution with one degree of freedom.

e. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom.

These findings are clearly country-specific. For example, in the first country in Table 1, the Antigua and Barbuda exchange rate has no long-run significant effect on output. If we were to rely upon the linear model, the process would have stopped here and we would have concluded that exchange rate plays no long run role. However, once appreciations are separated from depreciations, the nonlinear model reveals that while appreciation has a significant effect on output, depreciation does not. This finding is supported by asymmetry cointegration by the ECM_{t-1} test. Since *POS* carries a significantly positive coefficient, appreciation is said to be expansionary in this case, implying that an expansion in aggregate supply more than offsets the decline in aggregate demand. Furthermore, the long-run asymmetric effects are significant, since the Wald test reported as Wald-Long in Panel C is significant. Now consider the case of Canada. Again since there is no evidence of cointegration in the linear model, the estimated exchange rate elasticity is spurious. However, in its nonlinear model, there is evidence of asymmetric cointegration, which validates long-run estimates obtained for *POS* and *NEG* variables. It appears that in Canada, depreciation is expansionary and so is appreciation, a sign of asymmetric long-run effects, which is also supported by the Wald-Long test. Indeed, in 24 of 25 nonlinear models where there is evidence of long-run asymmetric effects of exchange rate changes, the Wald-Long is significant, supporting long-run asymmetric effects.

As mentioned in the introductory section, for several countries for which quarterly data on output, money supply, government spending, wages, etc. are available, asymmetric analysis has been carried out. Our findings for Japan in this paper is somewhat different from those of Bahmani-Oskooee and Mohammadian (2017). While we find yen depreciation to be contractionary and yen appreciation to be expansionary in a symmetric manner, they found long-run asymmetric effects where yen depreciation was contractionary and yen appreciation had no effect. These results were even sensitive to introducing nonlinear adjustment of other variables in the model. However, our findings for Australia are consistent with Bahmani-Oskooee and Mohammadian (2016), who also estimate a multivariate model for Australia. Our findings for Turkey are consistent with Bahmani-Oskooee *et al* (2017), who estimated a multivariate model. Both studies find significant long-run asymmetric effects on Turkey's domestic production. The significant asymmetric effects in both studies are reflected in the fact that both lira depreciation and lira appreciation are expansionary in Turkey. While adding other determinants of output alters the results in the case of Japan, it does not in the cases of Australia and Turkey. If data permit, future avenues of research should concentrate on estimating multivariate models for other countries.

4. Summary and Conclusion

Contractionary *devaluations* before 1973 and contractionary *depreciations* after 1973 (the year the international monetary system changed from fixed to flexible exchange rates) are two terms used to describe the ultimate impact of a devaluation or a depreciation on domestic output. Using devaluation and depreciation interchangeably, a depreciation stimulates aggregate demand by boosting its net export component and it hurts aggregate supply by raising the costs of imported inputs. If aggregate supply declines by more than the expansion in aggregate demand, a depreciation is contractionary. Otherwise, it is said to be expansionary.

Almost all previous empirical research assumed that if a depreciation is contractionary, an appreciation must be expansionary, implying that exchange rate changes have symmetric effects on domestic output. A few recent studies, however, have argued and demonstrated empirically that exchange rate changes could have asymmetric effects on domestic output. To show asymmetric effects of exchange rate changes on domestic output, these studies have used data from Australia, Japan, and several emerging countries. We contribute to the literature by investigating the issue at hand by including all countries for which enough time-series observations are available on their real GDP and real effective exchange rate. A total of 68 countries are included in our study.

Because investigating asymmetric effects requires using nonlinear models, we employ Shin *et al*'s (2014) nonlinear ARDL approach as our method. However, for comparison purposes, we also apply Pesaran *et al*'s (2001) linear ARDL approach. The results could best be summarised by saying that in the linear model, exchange rate changes had significant short-run effects in 37 countries. However, when we shifted to the nonlinear model, the figure was 48. Thus, separating appreciations from depreciations and introducing the nonlinear adjustment of the real effective exchange rate favours the nonlinear model, which resulted in relatively more significant short-run effects. Furthermore, the short-run effects were asymmetric in all models. However, the short-run effects translated into the long run effects only in nine linear models and 24 nonlinear models. Once again, the long-run effects were also asymmetric in all 24 cases.

Overall, although we found more evidence of short-run and long-run asymmetric effects of exchange rate changes on domestic output, the results are country specific. Two important points emerge from this multi-country study, the most comprehensive study conducted to date. The first is the fact that in the linear model, we found countries for which exchange rate changes did not have any significant long-run effects. Based on the old approach of estimating a linear model, the process would have stopped at this point. However, separating appreciations from depreciations and introducing nonlinear adjustments of the exchange rate proved fruitful and yielded significant long-run asymmetric effects. Second, the long-run asymmetric effects were country specific. In some countries, an appreciation had long-run effects on domestic output but depreciation did not, while in some countries the opposite was true.

Accepted for publication: 3 December 2017

Appendix: Data Definition and Sources

Data are collected from the International Financial Statistics (IFS) of the IMF and from the Bank for International Settlements (BIS). Domestic output is proxied by Real GDP (RGDP) and the exchange rate by the real effective exchange rate (REX).

Country	**Source of data**		**Period**	**Country**	**Source of data**		**Period**
	RGDP	**REX**			**RGDP**	**REX**	
Antigua and Barbuda	IFS	IFS	1979–2010	Japan	IFS	BIS	1970–2015
Australia	IFS	BIS	1970–2015	Korea, Republic of	IFS	BIS	1970–2015
Austria	IFS	IFS	1970–2015	Lesotho	IFS	IFS	1980–2015
Bahrain, Kingdom of	IFS	IFS	1980–2015	Luxembourg	IFS	IFS	1980–2015
Belgium	IFS	IFS	1970–2015	Malawi	IFS	IFS	1980–2013
Belize	IFS	IFS	1980–2015	Malaysia	IFS	IFS	1975–2015
Bolivia	IFS	IFS	1980–2015	Malta	IFS	IFS	1970–2015
Brazil	IFS	IFS	1980–2011	Mexico	IFS	BIS	1970–2015
Burundi	IFS	IFS	1974–2013	Netherlands	IFS	IFS	1970–2015
Cameroon	IFS	IFS	1980–2013	New Zealand	IFS	BIS	1970–2015
Canada	IFS	IFS	1970–2015	Norway	IFS	IFS	1970–2015
Chile	IFS	IFS	1980–2015	Pakistan	IFS	IFS	1980–2015
China, P.R.: Mainland	IFS	IFS	1980–2015	Paraguay	IFS	IFS	1980–2014
Colombia	IFS	IFS	1980–2015	Philippines	IFS	IFS	1975–2015
Costa Rica	IFS	IFS	1980–2014	Portugal	IFS	IFS	1978–2015
Cote d'Ivoire	IFS	IFS	1980–2014	Saudi Arabia	IFS	IFS	1980–2015
Cyprus	IFS	IFS	1980–2015	Sierra Leone	IFS	IFS	1980–2014
Denmark	IFS	IFS	1970–2015	Singapore	IFS	BIS	1970–2014
Dominica	IFS	IFS	1976–2010	South Africa	IFS	IFS	1970–2015
Dominican Republic	IFS	IFS	1980–2015	Spain	IFS	BIS	1970–2015
Ecuador	IFS	IFS	1980–2015	St. Kitts and Nevis	IFS	IFS	1978–2010
Fiji	IFS	IFS	1980–2014	St. Lucia	IFS	IFS	1977–2010
Finland	IFS	IFS	1970–2015	St. Vincent and the Grenadines	IFS	IFS	1975–2010
France	IFS	BIS	1970–2015	Sweden	IFS	IFS	1970–2015
Germany	IFS	IFS	1970–2015	Switzerland	IFS	IFS	1970–2015
Greece	IFS	BIS	1970–2015	Togo	IFS	IFS	1980–2014
Grenada	IFS	IFS	1976–2010	Trinidad and Tobago	IFS	IFS	1970–2014
Iceland	IFS	IFS	1970–2015	Tunisia	IFS	IFS	1975–2014
India	IFS	FRED	1970–2014	Turkey	IFS	FRED	1970–2014
Indonesia	IFS	FRED	1970–2014	Uganda	IFS	IFS	1981–2013
Iran, Islamic Republic of	IFS	IFS	1970–2010	United Kingdom	IFS	BIS	1970–2015
Ireland	IFS	IFS	1980–2015	United States	IFS	BIS	1970–2015
Israel	IFS	IFS	1970–2015	Uruguay	IFS	IFS	1980–2015
Italy	IFS	BIS	1970–2015	Venezuela	IFS	IFS	1980–2015

Endnotes

1. The Center for Research on International Economics and Department of Economics, the University of Wisconsin-Milwaukee, Milwaukee, WI 53201. We would like to thank an anonymous referee for their valuable comments. Any remaining error, however, are our own. Corresponding author's e-mail: bahmani@uwm.edu

2. For the theoretical derivation of the link between domestic output and the exchange rate, see Krugman and Taylor (1978) and for a graphical presentation using an aggregate demand and aggregate supply model, see Gylfason and Radetzki (1991).

3. See Banerjee *et al* (1998 p 276).

4. Narayan (2005) provides the same critical values, but for small samples, such as ours.

5. Note that Pesaran *et al* (2001) also propose an alternative test for cointegration which is the same as Banerjee *et al*'s (1998) t-test. Under this alternative test the normalised long-run estimate and equation (1) is used to generate the error term, called ECM. After replacing the lagged level variables in (2) by ECM_{t-1}, the new specification is estimated. If ECM_{t-1} carries a significantly negative coefficient, cointegration will be supported. Like the F test, they also tabulate new asymptotic critical values for this t-test. See Pesaran *et al* (2001 p 303). Since asymptotic critical values are the same from both sources, for small samples such as ours we will rely upon Banerjee *et al*'s critical values.

References

Agenor P R (1991) 'Output, devaluation, and the real exchange rate in developing countries', *Weltwirtschaftliches Archiv*, 127, 18–41.

An L, Kim G and Ren X (2014) 'Is devaluation expansionary or contractionary: Evidence based on vector autoregression with sign restrictions', *Journal of Asian Economics*, 34, 27-41.

Anker P and Bahmani-Oskooee M (2001) 'On the relationship between the value of the Mark and German production', *Applied Economics*, 33, 1525-1530.

Bahmani-Oskooee M (1996) 'Source of stagflation in an oil exporting country: Evidence from Iran', *Journal of Post Keynesian Economics*, 18, 609-620.

Bahmani-Oskooee M and Fariditavana H (2015) 'Nonlinear ARDL approach, asymmetric effects and the J-curve', *Journal of Economic Studies*, 43, 519-530.

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

Bahmani-Oskooee M and Gelan A (2013) 'Are devaluations contractionary in Africa?', *Global Economic Review*, 42, 1-14.

Bahmani-Oskooee M and Kandil M (2009) 'Are devaluations contractionary in MENA countries?', *Applied Economics*, 41, 139-150.

Bahmani-Oskooee M and Kutan A (2008) 'Are devaluations contractionary in emerging economies?', *Economic Change and Restructuring,* 41, 61-74.

Bahmani-Oskooee M and Miteza I (2003) 'Are devaluations expansionary or contractionary? A survey article', *Economic Issues*, 8, 1-28.

Bahmani-Oskooee M and Miteza I (2006) 'Are devaluations contractionary? Evidence from panel cointegration', *Economic Issues*, 11, 49-64.

Bahmani-Oskooee M and Mohammadian A (2016) 'Asymmetry effects of exchange rate changes on domestic production: Evidence from nonlinear ARDL approach', *Australian Economic Papers,* 55, 181-191.

Bahmani-Oskooee M and Mohammadian A (2017) 'Asymmetry effects of exchange rate changes on domestic production in Japan', *International Review of Applied Economics,* 31, 774-790.

Bahmani-Oskooee M and Mohammadian A (2018) 'Asymmetry effects of exchange rate changes on domestic production in emerging countries', *Emerging Market Finance and Trade*, 54, 1442-1459.

Bahmani-Oskooee M and Rhee H J (1997) 'Response of domestic production to depreciation in Korea: An application of Johansen's cointegration methodology', *International Economic Journal*, 11, 103-112.

Bahmani-Oskooee M, Chomsisengphet S and Kandil M (2002) 'Are devaluations contractionary in Asia?', *Journal of Post Keynesian Economics*, 25, 67-81.

Bahmani-Oskooee M, Halicioglu F and Mohammadian A (2018) 'On the asymmetric effects of exchange rate changes on domestic production in Turkey', *Economic Change and Restructuring*, 51, 97-112.

Banerjee A, Dolado J and Mestre R (1998) 'Error-correction mechanism tests for cointegration in a single-equation framework', *Journal of Time Series Analysis,* 19, 267-283.

Bussiere M (2013) 'Exchange rate pass-through to trade prices: The role of nonlinearities and asymmetries', *Oxford Bulletin of Economics and Statistics*, 75, 731-758.

Chou W L and Chao C C (2001) 'Are currency devaluations effective? A panel unit root test', *Economics Letters*, 72, 19-25.

Christopoulos D K (2004) 'Currency devaluation and output growth: New evidence from panel data analysis', *Applied Economics Letters*, 11, 809-813.

Edwards S (1986) 'Are devaluations contractionary?', *The Review of Economics and Statistics*, 68, 501-508.

Edwards S (1989) 'Exchange controls, devaluations, and real exchange rates: The Latin American Experience', *Economic Development and Cultural Change,* 37, 457-494.

Eltalla A H A (2013) 'Devaluation and Output Growth in Palestine: Evidence from a CGE model', *European Journal of Business and Economics*, 8, 26-31.

Engle R F and Granger C W J (1987) 'Cointegration and error correction: Representation, estimation, and testing', *Econometrica*, 55, 251-276.

Frankel J A (2005) 'Mundell-Fleming lecture: Contractionary currency crashes in developing countries', *IMF Staff Papers*, 52, 49-192.

Gylfason T and Risager O (1984) 'Does devaluation improve the current account?', *European Economic Review*, 25, 37-64.

Gylfason T and Schmid M (1983) 'Does devaluation cause stagflation?', *The Canadian Journal of Economics*, 25, 37-64.

Gylfason T and Radetzki M (1991) 'Does devaluation make sense in the least developed countries', *Economic Development and Cultural Change*, 40, 1-25.

Kalyoncu H, Artan S, Tezekici S and Ozturk I (2008) 'Currency devaluation and output growth: an empirical evidence from OECD countries', *International Research Journal of Finance and Economics*, 14, 232-238.

Kamin S B and Rogers J H (2000) 'Output and the real exchange rate in developing countries: An application to Mexico', *Journal of Development Economics*, 61, 85-109.

Kappler M, Reisen H, Schularick M and Turkisch E (2013) 'The macroeconomic effects of large exchange rate appreciations', *Open Economies Review*, 24, 471-494.

Kim Y and Ying Y H (2007) 'An empirical assessment of currency devaluation in East Asian countries', *Journal of International Money and Finance*, 26, 265-283.

Krugman P and Taylor L (1978) 'Contractionary effects of devaluation', *Journal of International Economics,* 8, 445-456.

Manalo J, Perera D and Rees D M (2015) 'Exchange rate movements and the Australian economy', *Economic Modelling*, 47, 53-62.

Mejia-Reyes P, Osborn D R and Sensier M (2010) 'Modelling real exchange rate effects on output performance in Latin America', *Applied Economics*, 42, 2491-2503.

Narayan P K (2005) 'The saving and investment nexus for China: Evidence from cointegration tests', *Applied Economics,* 37, 1979-1990.

Narayan P K and Narayan S (2007) 'Is devaluation expansionary or contractionary? Empirical evidence from Fiji', *Applied Economics*, 39, 2589-2598.

Pesaran H M, Shin Y and Smith R J (2001) 'Bounds testing approach to the analysis of level relationships', *Journal of Applied Econometrics,* 16, 289-326.

Rogers J H and Wang P (1995) 'Output, inflation and stabilization in a small open economy: Evidence from Mexico', *Journal of Development Economics*, 46, 271-293.

Sencicek M and Upadhyaya K (2010) 'Are devaluations contractionary? The case of Turkey', *Applied Economics*, 42, 1077-1083.

Shin Y, Yu B C and Greenwood-Nimmo M (2014) 'Modelling asymmetric cointegration and dynamic multipliers in a nonlinear ARDL framework' in Sickels R and Horrace W (eds) *Festschrift in Honor of Peter Schmidt: Econometric Methods and Applications*, New York NY: Springer.

Yang J, Zhang W and Tokgoz S (2013) 'Macroeconomic impacts of Chinese currency appreciation on China and the rest of world: A global CGE analysis', *Journal of Policy Modeling*, 35, 1029-1042.