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On the Relationship Between Exchange Rate Changes and Domestic Production: Asymmetric Cointegration Approach

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ON THE RELATIONSHIP BETWEEN EXCHANGE RATE CHANGES AND DOMESTIC PRODUCTION:

ASYMMETRIC COINTEGRATION APPROACH

by

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ABSTRACT

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In the international economic literature studies mainly focused on the response of output to exchange rate in developing countries and find a positive, negative and sometimes neutral relationship between exchange rate changes and output in short run and long run. Perhaps, the mixed results are due to assuming a linear dynamic adjustment process in all previous models. This study investigates the asymmetry effects of exchange rate changes on output in a nonlinear modeling framework based on bounds testing approach which provides a flexible model to estimate short and long run effects jointly regardless of the degree of integration of variables. Nonlinearity is introduced by decomposing the real exchange rate into negative and positive partial sums. Using quarterly data for nine countries in a multivariate model, the results show that in the majority of the countries exchange rate changes have asymmetric effect on domestic production. Following the same path for a bivariate model and using annual data for 68 developed and developing countries, findings still confirm the existence of asymmetry relationship in 24 countries in favor of the nonlinear model. Moreover, the findings are country-specific and cannot be generalized.

To

my parents,

and my wife

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Chapter 1: Introduction

Referring to the aggregate demand (AD) and aggregate supply (AS) model, we can explain the effects of government policies and external shocks on inflation and output. Now specifically we identify the source of stagflation to be oil prices. There is another source of stagflation in many countries particularly in the developing world, and that is exchange rate depreciation. Currency devaluation is one of the causes of exchange rate fluctuations especially, in the economies with fixed exchange rate regimes where the exchange rate is controlled by governments or central banks. However, in other countries that allow market forces to determine the value of their currencies, currency depreciation and appreciation are the terms which refer to exchange rate fluctuations as a result of a change in the value of domestic currency. Exchange rate changes affect domestic output through two channels, i.e., aggregate demand and aggregate supply. In Keynesian open-economy macroeconomic, currency depreciation is supposed to increase competitiveness, increase the production of exports and import-competing goods, and therefore leads to an increase in aggregate demand. However, several theoretical studies cast doubt about the proposition that devaluations are always expansionary.

Alexander (1952) and Diaz-Alejandro (1963) are among the first studies to point out the contractionary effect of devaluation through redistributive effect. They argue that devaluation is usually inflationary as a result of an increase in relative price of traded goods. Since there are always lags behind the adjustment of wages toward inflation, devaluation reduces real wages. Therefore, aggregate consumption declines because of the reversal effects arise from the redistribution of income from workers with the higher marginal propensity to consume (MPC) toward profit earners with the lower MPC. This decline in the aggregate consumption may depress aggregate demand and eventually total output.

Krugman and Taylor (1978) extend the previous knowledge by introducing the income effects of devaluation and initial trade position to their model. They infer that devaluation can be contractionary for several reasons: First when there is trade deficit, an increase in the price of traded goods as a result of devaluation has an immediate contractionary impact on domestic output. Moreover, even if the trade is in balance, devaluation could hurt the economy when nominal wages growth is slower than inflation rate, and the propensity to save from the profits is higher than wages. Finally, since devaluation could increase trade taxes by raising trade value in terms of local currency, it might be contractionary when part of government revenue includes import tariffs or export taxes. This increase in tax revenue leads to real income transfer from the private sector toward government with a higher marginal propensity to save. Frankel (2010) and Kohler (2017) refer to the balance sheet effect from currency mismatch as another factor of contractionary devaluation[1]. They explain that devaluation will increase debt service payments in terms of local currency and diverts the country's resources from production to paying off debt that results in the reduced aggregate output.

After the oil crisis in the 1970's, the importance of aggregate supply shocks to output became the subject of many studies. Gylfason and Schmid (1983), Gylfason and Risager (1984), Islam (1984), and Van Wijnbergen (1986) explain that several of the most important effects of depreciation are

[1] Currency mismatch refers to a situation where a large amount of country's debts is dominated in foreign currency whereas much of revenues are in domestic currency.

hypothesized to work through an increase in the domestic price of imported inputs and labor demand for higher wages, which hurts aggregate supply. They claim that previous studies focus on contractionary effects of a devaluation on aggregate demand while the effects on aggregate supply are more damaging since a decrease in aggregate supply has inflationary effects on the economy.

Summing up, the combined effects of aggregate demand and aggregate supply channels determine the net result of currency depreciation on domestic output. When the decline in aggregate supply outperforms the increase in aggregate demand, the net effect of devaluation will be contractionary which is more prevalent in countries that are more heavily reliant on imported inputs. Bahmani-Oskooee and Miteza (2003) have reviewed the literature on the impact of devaluation on domestic production. They demonstrate that the majority of literature indicate devaluation is contractionary in developing countries. However, contractionary devaluation occurs in developed countries as well as in developing countries. Therefore, they conclude that the effects of currency depreciation are inconclusive and depend on countries under study, model specifications, research methodology, and other factors.

The common feature of most theoretical models and empirical studies in the literature is that all models assume that if exchange rate depreciation increases the output, its appreciation will necessarily lead to a reduction in output by the same amount. Therefore, exchange rate changes have a symmetric effect on output and that is called symmetry assumption. The question then arises as to whether the symmetry assumption will always hold?

Bussiere (2013) argues that since prices are rigid downwards and quantities are rigid upwards, the effect of exchange rate changes on trade prices could be asymmetry. Moreover, Bahmani-

Oskooee and Fariditavana (2016) mention that due to adjustment lags such as production and delivery lags, the response of trade balance to exchange rate depreciation could be different from that of appreciation. Therefore, since trade prices and trade balance would react differently to exchange rate depreciation and appreciation, domestic output is expected to follow the same path and react asymmetrically to exchange rate depreciation and appreciation. Since assessing the asymmetry impact introduces the nonlinearity to models, the question could come down to introducing nonlinear adjustment, and maybe that solves the problem of getting mixed results in the literature.

The main contribution of this dissertation is that I investigate the effect of the real exchange rate appreciation and depreciation on domestic output and test for symmetry assumption. To address the issue, I employ the linear autoregressive distributed lag (ARDL) approach introduced by Pesaran *et al.* (2001) and use its results as a benchmark to compare with the results of the nonlinear autoregressive distributed lag (NARDL) approach introduced by Shin *et al.* (2014). For demonstration purposes, I apply ARDL and NARDL approach to estimate a multivariate model for nine countries (Australia, Japan, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, and Russia) for which quarterly data is available. To extend the literature, I set up a bivariate model where the real effective exchange rate is the only explanatory variable and using annual data allows me to test the asymmetry assumption for 68 countries.

The plan of this dissertations is as follows: Chapter 2 provides a review of the literature. Model and estimation methods are explained in Chapter 3. Chapter 4 presents the empirical findings. Chapter 5 concludes. The exact definition, study period, and sources of data are provided in an Appendix.

Chapter 2: Literature Review

There exists rich literature that investigates the effect of exchange rate changes on output. As mentioned in the introduction, studies introduced various channels by which exchange rate changes affect domestic production. In some cases, exchange rate changes affect aggregate demand and in others, aggregate supply will be affected. Therefore, to find out how exchange rate changes affect economic activities the combined effects of demand and supply channels should be considered to determine the net effects. For example, if exchange rate depreciation expands demand and an economy is dependent on imported inputs, depreciation could have contractionary effects when the decline in aggregate supply outweighs expansion in aggregate demand. Therefore, considering that each country has its unique economic characteristics, the effect of exchange rate on aggregate demand and aggregate supply could be different from one country to another one, it seems unlikely that a consensus on this issue can be reached. However, using data and conducting empirical studies is one way to understand economic issues and test theories behind them.

Bahmani-Oskooee and Miteza (2003) outlined various channels by which a devaluation could affect the output and summarized them in aggregate demand and aggregate supply model. They categorized the existing literature into four groups, i.e., before-after approach, control-group approach, macro-simulation approach, and econometric approach. In the survey of studies that use the econometric approach they show that first, due to different model specifications, estimation techniques, and data spans the evidence shows a mixture of contractionary and expansionary effects of devaluation on output. Moreover, they find that most of the studies that focus on the short run effects of devaluation find that devaluation will initially result in a contraction to be followed by an expansion and the others find either contractionary or expansionary effects. Also, focusing on the medium and long run, the effect of devaluation is still open to question. However, there are not many studies support that devaluations always have an expansionary effect on domestic output. Finally, the contractionary effects of devaluation are country specific and do not only belong to developing countries. Here, I focus on more recent empirical studies and those closer to the objective of this work.

Early studies that engaged in investigating the effect of exchange rate changes on output relied upon panel models, mostly due to lack of data for each country within the panel. For example, Edwards (1986, 1989), Nunnenkamp and Schweickert (1990) studied sample of developing countries and found that in the short run devaluation is contractionary while they could not find the evidence of long run contractionary devaluation. Similarly, Kamin and Klau (1998) studied Latin America, Asia and the industrialized world and their finding were similar to those obtained in previous studies.

The main criticism about the earlier studies is that they use non-stationary data, and thus the results obtained may be spurious. Chou and Chao (2001) by using the annual data for five Asian countries over 1966 – 1998 find that real output and exchange rate have a unit root. Therefore, there is not a long run relationship between currency devaluation and output in the long run. However, in the short run, they find contractionary devaluation for the selected countries. Similarly, Christopoulos (2004) use Engle and Granger (1987) and Johansen (1990) cointegration methodologies for a sample of eleven Asian economies during 1968 – 1999. They show that real output and real exchange rate are non-stationary. However, these variables are cointegrated and results support the hypothesis of contractionary devaluation in the long run. Bahmani-Oskooee and Miteza (2006) have applied cointegration techniques for 42 countries (18 OECD and 24 non-OECD). Their study is different from the previous studies in the sense that first, they add policy variables to their model specification to solve the omitted variable problem. Also, they use the nominal effective exchange rate instead of the bilateral exchange rate to consider the variation in the overall value of a country's currency against currencies of trading partners. They considered four estimation techniques (Panel OLS, Panel fixed-effect, Panel random-effect, and MLE) and provide estimation results for each case. The findings prove that all variables have a unit root and since they are cointegrated, the model estimation supports the contractionary devaluation in the long run for non-OECD countries. However, for OECD countries, results depend on the estimation technique.

Miteza (2006) tests the contractionary devaluation hypothesis in the context of five emerging countries in a panel setting. Using quarterly data from 1993-2000 and the panel cointegration technique, the long run relationship between real output, real exchange rate, real money and real wages is tested. Findings show that similar to previous studies devaluations have long run contractionary effect on output. Yiheyis (2006) has assessed the effects of devaluation on aggregate output in a pooled data framework for 20 African countries from 1981-1999. The empirical model includes political instability as well as other economic factors. The results reveal the contractionary effect of devaluation in the short run. However, he finds no evidence to support the long run relationship between devaluation and output.

Upadhyaya et al. (2013) attempt to find the effect of currency devaluation on aggregate output in four South-East Asian countries using panel data over the period 1980 to 2010. Their model includes monetary, fiscal and exchange rate variables and has two forms. For the first version of the model, they assess the effect of the real exchange rate. To find out which component of real exchange rate affects the aggregate output, they decompose the real exchange rate into nominal exchange rate and foreign to domestic price ratio and use them separately as explanatory variables in their model. By employing panel cointegration methodology, they find that first, currency devaluations are contractionary in the short and intermediate run and these effects do not translate to the long run. Second, the same pattern is observed for nominal and real exchange rates which implies that contractionary effects are only due to the change in the nominal exchange rate but not the change in relative price ratio.

Bussiere et al. (2012) use annual data from the period 1960-2006 for 108 developing countries and look at the effect of currency collapses (large nominal depreciations) on output. Using static and dynamic panel analysis, they conclude that currency collapses are expansionary in the short run and help the output to raise about 5 to 8 % and after three years they lead to output loss from 2 to 6 % of GDP and they will be contractionary in the long run. Following the same methodology, Kappler et al. (2013) have considered the impact of large exchange rate appreciations for 128 countries over the years 1960 – 2008. Their results indicate that exchange rate appreciations have a relatively small contractionary effect on output (about 1% after six years) but, they have stronger effects on current account. However, both studies limit themselves to one side of the exchange rate changes and, on the other side, remains unnoticed.

Levy-Yeyati *et al.* (2013) used annual data for the period 1974-2004 for 179 countries and examined the effect of exchange rate depreciation on output growth using a panel regression technique. Their findings reveal that exchange rate depreciation leads to faster economic growth in the short and long run and these effects come from an increase in domestic savings and investment rather than net export expansion.

Habib et al. (2017) considered 150 countries from 1970 to 2010 and employed instrumental variables estimates in their panel model to deal with the real exchange rate endogeneity and reverse causality from output to exchange rate. They introduced capital flows as an instrument since it is driven by global factors and it is also associated with real exchange rate changes. Their findings indicate that exchange rate depreciation is expansionary in developing countries while they could not find significant results for advanced countries.

The main criticism of the panel techniques is that panel models suffer from aggregation bias in the sense that the results that come from the panel estimation may not necessarily hold for all individual countries. Since there are enough time series data available, using time series techniques in country-specific models will solve the aggregation bias problem in panel studies.

There are a variety of studies in the literature that apply Vector autoregression (VAR) model. The purpose of using VAR models is to control for the wide range of external shocks that simultaneously affect the exchange rate and output. Therefore, VAR models have this advantage to consider the endogeneity of exchange rate and other explanatory variables.

Using a VAR approach Kim and Ying (2007) examine the impact of currency devaluation in East Asian countries (Indonesia, Korea, Malaysia, Philippines, Singapore, Taiwan, and Thailand) and compare them with Latin American countries (Chile and Mexico) using quarterly data. They divide the period of study into pre and post 1997 crisis. Their model contains capital inflows, real income, the relative price, real money supply, the current account balance, and the nominal exchange rate as endogenous variables and foreign real GDP and foreign interest rate as exogenous variables. The results show that in the pre-crisis period, devaluation is expansionary in the majority of East Asian countries while it is contractionary in Latin America. However, after they include post-crisis data in estimation, they find evidence of contractionary devaluation in East Asian as well as Latin American countries which is similar to Rajan and Shen (2006) findings where they find that for 24 countries during 1981 to 1999, contractionary effect of devaluation exists during the crisis period. Kohler et al. (2014) employed structural VAR methodology for Australia and using quarterly data from 1985 to 2013 for Australia. They used U.S. GDP and Australian terms of trade as exogenous variables while in their model real bilateral exchange rate, Australian real GDP, inflation, and cash rate were considered as endogenous variables. They find that a temporary 10% depreciation increases GDP by 0.25% to 0.50% over 1 to 2 years and permanent depreciation still has an expansionary effect on Australian GDP after 2 to 3 years. Manalo et al. (2015) followed the same approach found that appreciation has a persistent contractionary effect on GDP and a temporary 10% appreciation lowers GDP by 0.3% after 18 months and then GDP recovers gradually and returns to trend five years after initial appreciation.

An et al. (2014) employ sign restriction method in a VAR model and examine the effect of exchange rate changes on output in 16 countries for the period of 1973 to 2014. They conclude that contractionary devaluation could happen in developed countries as well as in developing countries. In their study, in all Latin American countries, output decreases after a real devaluation and Asian countries like Malaysia, Indonesia, and Philippines experience contractionary devaluation. They also find a mixture of contractionary and expansionary evidence in developed countries. In New Zealand and Australia output declines in response to exchange rate depreciation while it expands in Denmark, the Netherlands, Portugal, and Switzerland. The response of output to exchange rate changes is insignificant in Austria and Canada. Following the same line of research, An et al. (2015) examine the effect of exchange rate on output using VAR model with Cholesky decomposition for Canada, Switzerland, Australia, Italy, the Netherlands, and Spain as a sample of developing countries and Mexico, Indonesia, Korea, Malaysia, Philippines, Brazil, and Chile as developed countries. Their findings show that devaluation is contractionary in developing countries and evidence of expansionary devaluation is observed in developed countries.

Kamin and Klau (1998) criticize the VAR models based on their shortcomings in distinguishing the short run from the long run effects. They note that “in many of the VAR studies, it is difficult to interpret whether shocks represent short or long-term effects.”[2] To capture the short run dynamics and separate them from long run effects, some authors applied Johansen (1990) cointegration test to validate the existence of a long run relationship among variables in the models. Then, following Engle and Granger (1987) methodology they estimate an error correction model to distinguish between the short run from the long run effect of variables. For example, Bahmani-Oskoee (1998) for a sample of 25 LDCs finds the exchange rate devaluation has expansionary and contractionary short run effects on output. However, in the long run, he finds cointegration exists for 17 countries and concludes that exchange rate changes are neutral in the long run for most countries. Bahmani-Oskooee and Anker (2001) applied similar technique and found the expansionary effect of currency depreciation on German output. Bahmani Oskooee et

[2] Kamin and Klau (1998, p. 5)

al. (2002) find a positive relationship between real exchange rate and output for Indonesia and Malaysia, negative relationship for Philippines and Thailand and no relationship for Korea in the long run.

Among recent studies that employed Engle and Granger methodology, Kalyoncu et al. (2008) use quarterly data in a bivariate model for 23 OECD countries over the period of 1980-2005. Their findings show that in the short run, depreciation is contractionary in Finland, Germany, and Turkey and it is expansionary in Hungary and Switzerland. They find evidence of cointegration among real exchange rate and output in 9 countries, such that depreciation is contractionary Austria, Hungary, Poland, Portugal, Switzerland, and Turkey while it is expansionary in Finland, Germany, and Sweden. Sencicek and Upadhyaya (2010) study the effect of currency devaluation on output in Turkey using annual data over the period 1970 to 2004. In addition to the exchange rate and output, they include terms of trade, monetary, and fiscal variables in the model. They decompose the real exchange rate into the nominal exchange rate and relative price level and conclude that real and nominal exchange rates follow the same path and relative price level does not affect output. Moreover, in Turkey real devaluation is contractionary in the short run and has no impact on output in the long run.

Using recent advances in time series econometrics, Pesaran et al. (2001) develop the Autoregressive Distributed Lag (ARDL) approach that the test for the existence of a long run relationship between variables is valid irrespective of whether the variables are I(0), I(1), or mutually cointegrated. Their bound-testing approach has some advantages over the previous methods of cointegration in the sense that there is no need for performing unit root tests for each variable. Moreover, the error correction model is estimated in one step which improves the model performance in small samples. The following studies have applied Pesaran et al.'s (2001) bound testing approach to cointegration and error correction modeling to the base model introduced by Edwards (1986) that uses the reduced form model that includes fiscal and monetary policy variables in addition to real exchange rate and real output.

Bahmani-Oskooee and Kandil (2009) examine the effect of devaluation on output in the context of MENA countries using annual data over 1970 - 2004. They decompose the real effective exchange rate into anticipated and unanticipated exchange rates and estimate the model. Findings show that in the long run, anticipated exchange rate depreciation is expansionary in Bahrain, Oman, Saudi Arabia, Egypt, Syria, and Tunisia; it is contractionary in Lebanon and Libya

On the other hand, unanticipated exchange rate depreciation is expansionary only in the short run but, in the long run, it contractionary effects are observed in Jordan, Kuwait, and Qatar mainly due to increase in the cost of production and its adverse effect on aggregate supply.

Narayan and Narayan (2007) use annual data for Fiji during 1970-2000 and conclude that both in the short and long run, real effective exchange rate and GDP are positively related. Shahbaz et al. (2012) find similar results for Pakistan using annual data over the period 1975-2008. Bahmani-Oskooee and Kutan (2008) using quarterly assess the effect of currency depreciation across the sample of emerging countries of the European Union. They find that in the short run, real depreciation is expansionary in Belarus, Latvia, Poland, Slovak Republic; it is contractionary in Czech Republic, Estonia, Hungary, and Russia and has no effect in Lithuania. They also concluded that almost in none of the economies the devaluation has long run effect on output. Using the same technique, Bahmani-Oskooee and Gelan (2013) examined the impact of devaluation on domestic output in the long run and short run for a sample of 22 African countries during 1971-

2009. Their results show that devaluations are expansionary in Cote d'Ivoire, Ethiopia, Gabon, Kenya, Morocco, Niger, Nigeria and Togo countries, contractionary in Algeria, Mauritius, Rwanda, Tanzania, and Tunisia.

Chapter 3: Model and Methodology

As Mentioned in the previous section, there are various model specifications to assess the relationship between output and exchange rate changes. In most studies, domestic output is determined by a wide range of macroeconomic variables such as exchange rate, and measures of monetary and fiscal policies from demand side (Edwards 1986, Ratha 2010, and Bahmani-Oskooee and Gelan 2013). Referring to the supply side, Mills and Pentecost (2001) developed a simple structural macroeconomic model based on the IS-LM framework and derived a reduced form equation. They examined the contractionary effects of devaluations on real output through aggregate supply channel by including the real wages in their model alongside the real level of money stock, and real exchange rate. Following the same path, Kandil and Mirzaie (2002) and Jimenez-Rodriguez and Sanchez (2005) identified the oil price to be another factor that affects aggregate supply and real output.

3.1 Linear Autoregressive Distributed Lag (ARDL) Model

For estimation purposes, I follow the literature and adopt a model specification which takes the following reduced form and estimated coefficients measure the long run elasticities of explanatory variables in the model:

$$\mathrm{LnY_t = a + bLnM_t + cLnG_t + dLnREX_t + eLnOP_t + fLnW_t + \varepsilon_t} \tag{1}$$

In the above model specification, Y is a measure of domestic output (real GDP), M refers to real money supply as a measure of monetary policy, G indicates real government spending as a measure of fiscal policy, REX is the real effective exchange rate, OP stands for crude oil price, W is real wage, and finally ε captures the error term. It is expected that estimates of *b* and *c* to be positive if monetary and fiscal policies are to be expansionary. By way of construction, real depreciation (appreciation) of domestic currency is reflected in a decline (increase) in the real effective exchange rate. Therefore, a positive *d* implies contractionary depreciation and a negative *d* implies expansionary depreciation. Since the increase in oil price and real wage reduces aggregate supply and output, therefore, estimates of both *e* and *f* are expected to be negative. The estimated coefficients from Equation (1) show only the long run impacts of explanatory variables on domestic output. In order to infer the short run effects, one needs to specify an error-correction model to incorporate the short run dynamics. Following Engle and Granger (1987) methodology the error-correction outlined by the following model specification:

$$\begin{aligned}\Delta \mathrm{LnY}_t &= \alpha_0 + \sum_{k=1}^{n1} \alpha_{1k}\, \Delta \mathrm{LnY}_{t-k} + \sum_{k=0}^{n2} \alpha_{2k}\, \Delta \mathrm{LnM}_{t-k} + \sum_{k=0}^{n3} \alpha_{3k}\, \Delta \mathrm{LnG}_{t-k} \\ &+ \sum_{k=0}^{n4} \alpha_{4k}\, \Delta \mathrm{LnREX}_{t-k} + \sum_{k=0}^{n5} \alpha_{5k}\, \Delta \mathrm{LnOP}_{t-k} + \sum_{k=0}^{n6} \alpha_{6k}\, \Delta \mathrm{LnW}_{t-k} + \lambda \varepsilon_{t-1} + \omega_t \end{aligned} \tag{2}$$

Where Δ is first difference operator and short run effects are inferred by the estimates of $\alpha_{2k} - \alpha_{6k}$. If cointegration among the variables is established, any deviation from the long run equilibrium should be adjusted toward their long run values and λ measures the speed of this adjustment. Therefore, the estimated λ should be significant and negative to support cointegration among the variables. The significance of λ can be tested by t-test with the new critical values tabulated by Banerjee et al. (1998) . Engle and Granger (1987) proposed a two-step residual-based approach to estimate Equations (1) and (2). Their assumption is that all variables should be integrated of the same order i.e., I(1) and the error term (ε_t) is cointegrated of the order zero i.e., I(0) which can be tested using the unit root test procedures. What if all variables are not integrated of the same order and we may have a combination of I(1) and I(0) variables in the model?

Pesaran et al. (2001) introduced the bounds testing approach to estimate short and long run coefficients in one step when variables are I(1), I(0) or combination of the two. Following their approach, I replace ε_{t-1} in equation (2) with the linear combination of lagged level variables which yields autoregressive distributed lag (ARDL) model outlined by equation (3):

$$\Delta \mathrm{LnY_t} = \alpha_0 + \sum_{k=1}^{n1} \alpha_{1k}\, \Delta \mathrm{LnY_{t-k}} + \sum_{k=0}^{n2} \alpha_{2k}\, \Delta \mathrm{LnM_{t-k}} + \sum_{k=0}^{n3} \alpha_{3k}\, \Delta \mathrm{LnG_{t-k}}$$

$$+ \sum_{k=0}^{n4} \alpha_{4k}\, \Delta \mathrm{LnREX_{t-k}} + \sum_{k=0}^{n5} \alpha_{5k}\, \Delta \mathrm{LnOP_{t-k}} + \sum_{k=0}^{n6} \alpha_{6k}\, \Delta \mathrm{LnW_{t-k}} + \beta_0 \mathrm{LnY_{t-1}} \tag{3}$$

$$+\beta_1 \mathrm{LnM_{t-1}} + \beta_2 \mathrm{LnG_{t-1}} + \beta_3 \mathrm{LnREX_{t-1}} + \beta_4 \mathrm{LnOP_{t-1}} + \beta_5 \mathrm{LnW_{t-1}} + \omega_t$$

Where coefficients of first difference variables show short run effects and obtained by estimating $\alpha_{2k} - \alpha_{6k}$ and the long run effects inferred by estimation of $\beta_1 - \beta_5$ normalized on β_0. The significance of the normalized coefficients is judged by t-statistics. "….. estimation of the long run parameters and computation of valid standard errors for the resultant estimators can be carried out either by the OLS method, using the so-called delta method (Δ-method) to compute the

Standard errors, or by the Bewley (1979) regression approach. These two procedures yield identical results and a choice between them is only a matter of computational convenience."[3]

In order to test the existence of cointegration among variables, Pesaran et al. (2001) proposed to conduct F-test to check the joint significance of lagged level variables under study. They tabulate the new critical values based on the degree of integration and the number of regressors entering the long run relationship.[4] They provide upper bound critical values if all variables are I(1) and lower bound critical values when all variables are I(0). If the F-statistic is higher than the upper bound critical value, the null hypothesis of no cointegration is rejected and there will be a long run relationship among variables. However, if F-statistic is less than lower bound value, the null hypothesis is not rejected and variables are not cointegrated. For the case that the F-statistic lies between the critical values, no statistical inference can be made.

3.2 Nonlinear Autoregressive Distributed Lag (NARDL) Model

The common feature of most theoretical models and empirical studies in the literature and model (3) is that all models assume explanatory variables have a symmetric effect on the dependent variable and that is called symmetry assumption. Considering the exchange rate, the symmetric assumption implies that if exchange rate depreciation increases the output, its appreciation will lead to a reduction in output by the same amount. However, this symmetry assumption is not always true, especially if firms are confronted with downward price and upward quantity rigidities. Bussiere (2013) note that downward price and upward quantity rigidities are sources of

[3] Pesaran and Shin (1998, p. 373)

[4] Pesaran et al. (2001, p. 300)

exchange rate asymmetry. When exchange rate appreciates and exporters lose their competitiveness, downward price rigidity prevents firms to lower their prices below a given level. Then, appreciation might have smaller effect than depreciation on export prices. On the other hand, quantity rigidity occurs when exporters gain a competitive advantage as a result of depreciation and decide to increase production capacities. Since expanding production and distribution network is costly and time-consuming, exporters face upward quantity rigidity and therefore, export quantities react more during an appreciation than a depreciation. Furthermore, Bahmani-Oskooee and Fariditavana (2016) explain due to adjustment lags such as production and delivery lags, the response of trade balance to exchange rate depreciation could be different from that of appreciation. Therefore, since trade prices and trade balance would react differently to exchange rate depreciation and appreciation, domestic output is expected to follow the same path and react asymmetrically to exchange rate depreciation and appreciation. Since assessing the asymmetry impact introduces the nonlinearity to model, I employ the nonlinear autoregressive distributed lag model introduced by Shin et al. (2014) to examine the asymmetry effect of exchange rate changes on domestic output.

Shin et al. (2014) propose an error-correction framework where they combine asymmetric cointegration with a dynamically flexible ARDL model and label the model as nonlinear ARDL. Therefore, I follow Shin et al. (2014) approach to examine the asymmetric effects of exchange rate changes on output by decomposing real effective exchange rate changes into negative and positive partial sums which reflect appreciation (POS) and depreciation (NEG) of home currency, respectively:

$$\mathrm{POS}_t = \sum_{j=1}^{t} \Delta \mathrm{LnREX}_j^{+} = \sum_{j=1}^{t} \max(\Delta \mathrm{LnREX}_j, 0)$$

$$\mathrm{NEG}_t = \sum_{j=1}^{t} \Delta \mathrm{LnREX}_j^{-} = \sum_{j=1}^{t} \min(\Delta \mathrm{LnREX}_j, 0) \tag{4}$$

Now by replacing LnREX in equation (3) with POS and NEG variables, I come up with an error-correction (nonlinear ARDL) model which takes the following form:

$$\begin{aligned} \Delta \mathrm{LnY}_t = {} & \alpha_0 + \sum_{k=1}^{n1} \alpha_{1k} \Delta \mathrm{LnY}_{t-k} + \sum_{k=0}^{n2} \alpha_{2k} \Delta \mathrm{LnM}_{t-k} + \sum_{k=0}^{n3} \alpha_{3k} \Delta \mathrm{LnG}_{t-k} + \sum_{k=0}^{n4} \alpha_{4k}^{+} \Delta \mathrm{POS}_{t-k} \\ & + \sum_{k=0}^{n5} \alpha_{4k}^{-} \Delta \mathrm{NEG}_{t-k} + \sum_{k=0}^{n6} \alpha_{5k} \Delta \mathrm{LnOP}_{t-k} + \sum_{k=0}^{n7} \alpha_{6k} \Delta \mathrm{LnW}_{t-k} + \beta_0 \mathrm{LnY}_{t-1} + \beta_1 \mathrm{LnM}_{t-1} \\ & + \beta_2 \mathrm{LnG}_{t-1} + \beta_3^{+} \mathrm{POS}_{t-1} + \beta_3^{-} \mathrm{NEG}_{t-1} + \beta_4 \mathrm{LnOP}_{t-1} + \beta_5 \mathrm{LnW}_{t-1} + \mu_t \end{aligned} \tag{5}$$

Shin et al. (2014) propose the use of bounds testing approach introduced by Pesaran et al. (2001) to estimate the coefficients. Thus, I can investigate the effect of exchange rate on domestic output in different forms of asymmetry to see whether these asymmetries exist in the short run, long run or both. In the nonlinear ARDL model specification if POS variables carry positive (negative) and significant coefficients, appreciation is said to be expansionary (contractionary) whereas, positive (negative) and significant coefficients of NEG imply that depreciation has contractionary (expansionary) effect on output. Once the nonlinear ARDL model is estimated by OLS, different types of asymmetries could be tested. First, the long run asymmetry where the normalized coefficients of POS_{t-1} and NEG_{t-1} are different ($-\frac{\hat{\beta}_3^{+}}{\hat{\beta}_0} \neq -\frac{\hat{\beta}_3^{-}}{\hat{\beta}_0}$). Second, short run asymmetry exists when contemporaneous ΔPOS and ΔNEG carry different coefficients ($\widehat{\alpha}_{4k}^{+} \neq \widehat{\alpha}_{4k}^{-}, \forall\, k$). Third, short run impact asymmetry is defined as inequality between the sum of the coefficients of ΔPOS and the sum of the coefficients of ΔNEG ($\sum \widehat{\alpha}_{4k}^{+} \neq \sum \widehat{\alpha}_{4k}^{+}$). Finally, the adjustment asymmetry is captured by the pattern of the dynamic multipliers meaning the number of lags for ΔPOS and ΔNEG in the optimum model are different. To test if the long run and short run asymmetries are valid, the Wald test is applied where the equality of the coefficients is the null hypothesis. The Wald statistic has χ^2 distribution with one degree of freedom. In fact, if the null hypothesis is rejected, there will be asymmetric effect in the sense that the estimated coefficients are different in the sign, size, or both.

Chapter 4: Empirical Results

In this Chapter, I estimate linear and nonlinear ARDL models for a sample of selected countries. The exact definition, study period, and sources of data are provided in the Appendix.

The first section of this chapter, I choose a sample of countries for which quarterly data are available for variables of interest in the multivariate model specification and report the results in Tables 1-9. In section two, since quarterly data is not available for many other countries, for a more comprehensive study I consider a bivariate model specification for 68 countries. In the bivariate model, I use annual data and consider output as a dependent variable and the real effective exchange rate as an explanatory variable and report the results in Table 10.[5] In each table, Section I reports the results for the linear model, which I use as a benchmark to compare with Section II of the table, that includes the results of the nonlinear model.

I begin the estimation process by selecting the optimum number of lags for first-differenced variables based on Akaike's Information Criterion (AIC) for each model. After selecting the optimum model, I report the short and long run coefficients in Panel A and Panel B, respectively and Panel C includes diagnostic statistics. In all the tables, the significance level of coefficients and statistics are is based on critical values that are reported in the notes to each table.

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[5] Bahmani-Oskooee (1998), Kamin and Rogers (2000), Christopoulos (2004), Narayan and Narayan (2007), and Kalyoncu et al. (2008) employ a bivariate model in which exchange rate is the only determinant of output.

4.1 Multivariate Model Results

In this section, I report the estimation results for both linear equation (3) and nonlinear equation (5) for Australia, Japan, and emerging economies such as Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, and Russia using quarterly data. Since I used quarterly data for these countries, I impose a maximum of eight lags to select the optimum model based on Akaike's Information Criterion (AIC). The full information estimate of the optimum linear and nonlinear models for each country are reported in tables 1-9.

Considering the linear model, from the short run coefficient estimates reported in Panel A, I gather that the real effective exchange rate affects domestic production in all countries except for Japan and Hungary. While in Australia, Czech Republic, Estonia, and Lithuania, currency depreciation is contractionary, in Latvia and Russia, it is expansionary. The estimated coefficients in Panel B show if the short run effects last into the long run. The long run estimates of the real effective exchange rate show that depreciation is contractionary in Czech Republic and expansionary in Poland, and Russia while in other countries, exchange rate changes has no effect on domestic output. Although in Japan none of the variables has a significant long run effect on output, in all other countries, at least for one variable, a significant coefficient has been obtained.

The validity of the long run relationship between variable is subject to the existence of cointegration among the variables. I perform F-test to check for joint significance of the variables and provide the results in Panel C. As the reported F-statistics for Czech Republic, Lithuania, and Russia are higher than upper bound critical values which support cointegration among variables in these countries. For other countries, I conduct an alternative test of cointegration similar to

Engle and Granger (1987) approach using two-step residual-based estimation. First, an error term (ECM_t) is generated using normalized long run coefficients from Panel B. Then, I replace the linear combination of lagged-level variables in Equation (3) by the lagged error term (ECM_{t-1}) and estimate the new model one more time with the same optimum number of lags and test the significance of the estimated coefficient of ECM_{t-1}. A significant and negative coefficient of ECM_{t-1} supports the cointegration. Banerjee et al. (1998) show that the distribution of t-statistic for testing the ECM_{t-1} coefficient is non-standard and tabulate new critical values for t-statistic. Pesaran et al. (2001) show that in the ARDL approach, like the F-test, this t-test has upper and lower bound critical values that they tabulated. Since the estimated lagged error term (ECM_{t-1}) carries a negative and significant coefficient in Australia, Estonia, Latvia, and Poland, in these countries, there will be a long run relationship between variables. However, still in Japan and Hungary cointegration is rejected.

Panel C includes additional diagnostic statistics. The Lagrange Multiplier (LM) statistic judges the existence of residual serial correlation and follows a Chi-square (χ^2) distribution with one degree of freedom. Given the calculated LM statistics, it appears that the optimum model is autocorrelation free in all countries except for Latvia and Poland. To test if the optimum model is correctly specified, Ramsey's RESET test is performed. This statistic is also distributed as χ^2 with one degree of freedom. Considering the critical values of 3.48 (2.70) at 5% (10%) level of significance, the linear model is misspecified at usual significant levels only in Japan, Poland, and Russia. Moreover, the structural stability of estimated long run and short run coefficients is judged by the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMSQ) tests to the residuals of the optimum model which is proposed by Brown et al. (1975). According to Bahmani-Oskooee et al. (2005) for stability, the plots must stay within the 5% critical upper and lower bounds in the sample period indicated by two straight lines. CUSUM and CUSUMSQ test results indicate the stability of estimates in the linear model for all countries. Finally, the adjusted R^2 reflects the goodness of fit.

As discussed earlier, my dissertation aims to assess the asymmetric effect of exchange rate changes on domestic output. Therefore, I estimate the nonlinear model outlined by Equation (5) and report the results in section II of the tables. From the short run results in Panel A, I gather that first, either exchange rate appreciation (ΔPOS) or depreciation (ΔNEG) carry at least one significant coefficient in all countries while in the linear model, exchange rate change has no effect on output in Japan and Hungary. Second, there is short run adjustment asymmetry in Australia, Japan, Czech Republic, Estonia, Hungary, and Latvia because of different lags orders in optimum models for ΔPOS (currency appreciation) and ΔNEG (currency depreciation) variables. Third, the short run asymmetry effect of exchange rate changes on output exists for all countries, since the size or the sign of the contemporaneous short run coefficients are different. Finally, according to Wald-S in Panel C, the cumulative effect of exchange rate appreciations is statistically different than that of depreciation in six countries. This supports the evidence of the short run impact asymmetry in most of countries.

From Panel B that reports the long run estimates, for all countries except for Lithuania at least one of the POS or NEG or both variables carries significant coefficient, which implies that in seven countries, exchange rate appreciation or depreciation affect output in the long run while in the linear model the exchange rate has significant coefficient only in three countries (Czech Republic, Poland, and Russia). In the long run, exchange rate appreciation is contractionary in most of the countries through the adverse effect on their aggregate demand which outweighs the decrease in aggregate supply. However, it is expansionary in Czech Republic and Estonia since expansion in aggregate supply as a result of a decrease in cost of imported inputs, more than offsets the decrease in aggregate demand. Considering the long run effects of depreciation, there is evidence of contractionary depreciation in Japan and Estonia in the nonlinear model which is different from the findings in a linear model that exchange rate has no effect on output. On the contrary, depreciation is expansionary in Latvia, Poland, and Russia which supports the traditional theory of expansionary devaluation and opposes the contractionary devaluation hypothesis in developing countries. In Australia, Czech Republic, and Hungary currency depreciation does not affect output in the long run.

In order to test the long run asymmetry effect exchange rate changes, I perform wald test for equality of POS and NEG coefficients. These test statistics denoted by Wald-L in Panel C are significant in Japan, Czech Republic, Poland, and Russia supporting that long run asymmetry effects do exist in these countries.

Once again in order to verify the long run relationship between variables, first, I employ F-test for joint significance of long run coefficients. The test results in Panel C reveal that in the long run, variable are cointegrated in all countries except for Australia and Estonia. However, when I check cointegration by the alternative method (negative and significant coefficient obtained for ECM_{t-1}) findings show that overall for all countries cointegration is supported.

Considering other test statistics for the nonlinear model, LM and RESET statistics are insignificant in most of the countries which imply optimum models are autocorrelation free and correctly specified. According to CUSUM and CUSUMSQ test results, like the linear model, all estimates are stable over our study period. Finally, adjusted R^2 is still high for emerging countries and for Australia and Japan it shows the better goodness of fit in the nonlinear model.

4.2 Bivariate Model Results

In the previous section, I analyzed the asymmetry effect of exchange rate changes on nine countries (Australia, Japan, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, and Russia) using quarterly data. However, for many other countries, quarterly data for all the variables mentioned in the multivariate model are not available. Therefore, I use annual data on real GDP and the real effective exchange rate which is available for a total of 68 countries to test the asymmetry assumption for these countries. Therefore, in this section, I analyze the results of a bivariate model specification where the real effective exchange rate is the only explanatory variable and error term captures all other determinants of domestic output. Similar to multivariate model, I follow Pesaran *et al.* (2001) approach to estimate a bivariate linear ARDL model, and then I employ Shin et al. (2014) method and estimate a bivariate nonlinear ARDL model to test the asymmetry effect of exchange rate changes on output.

Since I used annual data for these countries, I impose a maximum of four lags to select the optimum model based on Akaike's Information Criterion (AIC). The full information estimate of the optimum linear and nonlinear models for each country are reported in Table 10.

From the results of the linear model in panel A, for 37 countries the real effective exchange rate carries at least one significant coefficient in the short run. Considering the short run impact of the real effective exchange rate, results indicate that in 20 countries exchange rate depreciation is expansionary while in the remaining 17 countries it is contractionary. From Panel B, the short run effects last to the long run in 21 countries. I perform both cointegration tests (F-test and significant negative coefficient associated with ECM_{t-1}) to check if the long run relationship between exchange rate and output for these countries is meaningful. The test results support the meaningful long run coefficient only in Belize, Finland, France, Japan, Malawi, Malaysia, Norway, Singapore, and Uganda. In all countries except for Japan, exchange rate depreciation is expansionary.

From the results of the nonlinear model in Panel A, either exchange rate appreciation (ΔPOS) or depreciation (ΔNEG) carry at least one significant coefficient in 48 countries while in the linear model exchange rate changes have short run effects in 37 countries. Furthermore, there is evidence of short run adjustment asymmetry in 29 countries[6] since in optimum models for these countries have a different of lags for ΔPOS and ΔNEG variables. Moreover, short run asymmetry effect of exchange rate changes on output exists for all countries except for Tunisia, since the short run coefficients attached to ΔPOS and ΔNEG variables at the same lag are different in the size or sign. Finally, to verify the short run impact asymmetry of exchange rate changes on output, I perform Wald test on equality of summation of the short run coefficients attached to ΔPOS with that of ΔNEG and provide the results in Panel C (denoted by Wald-S). Therefore, I find the evidence of short run impact asymmetry effects in 22 countries including Bahrain, Cameroon, Chile, China, Cyprus, Denmark, Dominica, Ecuador, Fiji, Finland, Greece, Indonesia, Japan, Malawi,

[6] Antigua and Barbuda, Austria, Belize, Bolivia, Cameroon, Cyprus, Denmark, Dominica, Ecuador, Greece, Iceland, India, Indonesia, Ireland, Israel, Japan, Malawi, Malaysia, Malta, Mexico, New Zealand, Norway, Spain, St. Lucia, St. Vincent and the Grenadines, Sweden, Switzerland, United States, and Venezuela.

Malaysia, Mexico, Paraguay, Philippines, Sweden, Trinidad and Tobago, United Kingdom, and Venezuela.

From Panel B, I find the significant long run effect of either depreciation on appreciation for 38 countries. In order to verify if these long run coefficients are meaningful, I need to check for the existence of cointegration. However, after performing cointegration tests, it is concluded that short run effects last into the long run for 24 countries including Antigua and Barbuda, Austria, Bolivia, Cameroon, Canada, Chile, Dominica, Fiji, Finland, France, Iran, Ireland, Japan, Malawi, Malaysia, Malta, Norway, Paraguay, Singapore, Spain, St. Vincent and the Grenadines, Sweden, Togo, and Uganda. According to the results of the Wald test in Panel C, long run asymmetry effects exist in all of them except for Bolivia, Malawi, and Singapore. Furthermore, among all these countries, in 11 cases exchange rate changes have no significant effect on output in the linear model. However, after relaxing the symmetric assumption by introducing nonlinearity into the model, either exchange rate appreciation or depreciation or both, affect output in the long run. Focusing on these 11 countries, exchange rate appreciation is expansionary in 9 countries while it does not affect output in Ireland and Spain. Moreover, depreciation is expansionary in Austria, Bolivia, Chile, Ireland, Malta, Paraguay, and Spain while it is contractionary only in Cameroon and has no effect in Antigua and Barbuda, Iran, and St. Vincent and the Grenadines. From the Wald test results in Panel C for long run coefficients, the results prove the asymmetry effects for all these countries except for Bolivia.

Chapter 5: Conclusion

In the literature, studies that engage in assessing the effects of exchange rate changes refer to "contractionary devaluation" and "contractionary depreciation" to explain how exchange rate fluctuations affect domestic output. Although the decrease in the value of domestic currency might have an expansionary effect on aggregate demand due to increase competitiveness, increase the production of exports and import-competing goods, the contractionary effects are likely as a result of increase in the cost of imported inputs and decline in aggregate supply. Therefore, the main question for policymakers is what the net effect of the exchange rate changes on output is, given that the purpose of devaluation is to boost output and employment. To answer this question, the combined effects of aggregate demand and aggregate supply channels determine the net result of exchange rate changes on domestic output. When the decline in aggregate supply outweighs the increase in aggregate demand, the net effect of devaluation will be contractionary. Otherwise, it is said to be expansionary. Several studies attempt to apply different methodologies to examine the response of output to exchange rate changes in developing and developed countries and they find mixed results in the sense that there is no consensus about the overall effect of exchange rate on output and results depend on countries under study, model specifications, research methodology, and other factors.

The common feature of most theoretical models and empirical studies in the literature is that all models assume that if exchange rate depreciation increases the output, its appreciation will necessarily lead to a reduction in output by the same amount. Therefore, exchange rate changes have a symmetric effect on output and that is called symmetry assumption. Perhaps, the mixed results are due to assuming a linear dynamic adjustment process in all previous models.

In this dissertation, I apply a new approach introduced by Shin et al. (2014) to investigate the asymmetry effects of exchange rate changes on output in a nonlinear modeling framework based on the ARDL approach. For demonstration purposes, I consider a sample of developed (Australia and Japan) and emerging countries (Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, and Russia) to test asymmetry effect of exchange rate depreciation and appreciation on output using quarterly data which is available only for these countries in a multivariate model. Using the linear model, I find that although exchange rate changes have a significant effect on output in the majority of countries but these short run effects do not translate into the long run for most countries. However, in the nonlinear model, for all countries (except for Lithuania) exchange rate changes have significant long run effects. Moreover, I find the evidence of short run asymmetry effects in Japan, Czech Republic, Estonia, Latvian, Lithuania, and Russia and long run asymmetry effects in Japan, Czech Republic, Poland, and Russia.

In the bivariate model, I include all the countries for which enough data is available for real GDP and the real effective exchange rate. Among the total of 68 countries, with the linear model, only in 37 countries exchange rate changes have at least one significant short run coefficient, while by using the nonlinear model this number increases to 48 countries. Moreover, there is evidence of short run asymmetry in all countries except for Tunisia. Regarding the long run effects, the numbers are still in favor of the nonlinear model. While only nine countries the short run effects last to the long run in the linear model, this number in the nonlinear model is 24 countries and long run asymmetry effects exists in all of them except for Bolivia, Malawi, and Singapore.

In summary, it can be concluded that irrespective of the model and methodology, the relationship between exchange rate changes and output is country-specific. Therefore, it is not possible to provide a general answer to the question of how countries will be affected by exchange rate changes. Moreover, in cases where the nature of the relationship between variables is possibly asymmetric, the use of linear models may be misleading. The higher number of significant coefficients in nonlinear model compare to that of in linear model is a reason for this claim.

Since exchange rate changes would affect domestic output and many other macroeconomic variables, policymakers use it as an instrument to stabilize the economy and achieve feasible economic growth in developed and developing countries. Therefore, it is essential to be aware of the effects of exchange rate changes in the short run as well as long run. For example, the currency depreciation may not have desirable outcomes at least in the short run. Then, the question is should policymakers leave devaluation behind only because of its undesirable side effects in the short run and ignore the effect of devaluations when they last into the long run?

Figure 1: Plot of Ln Y, LnREX, POS, and NEG for Australia

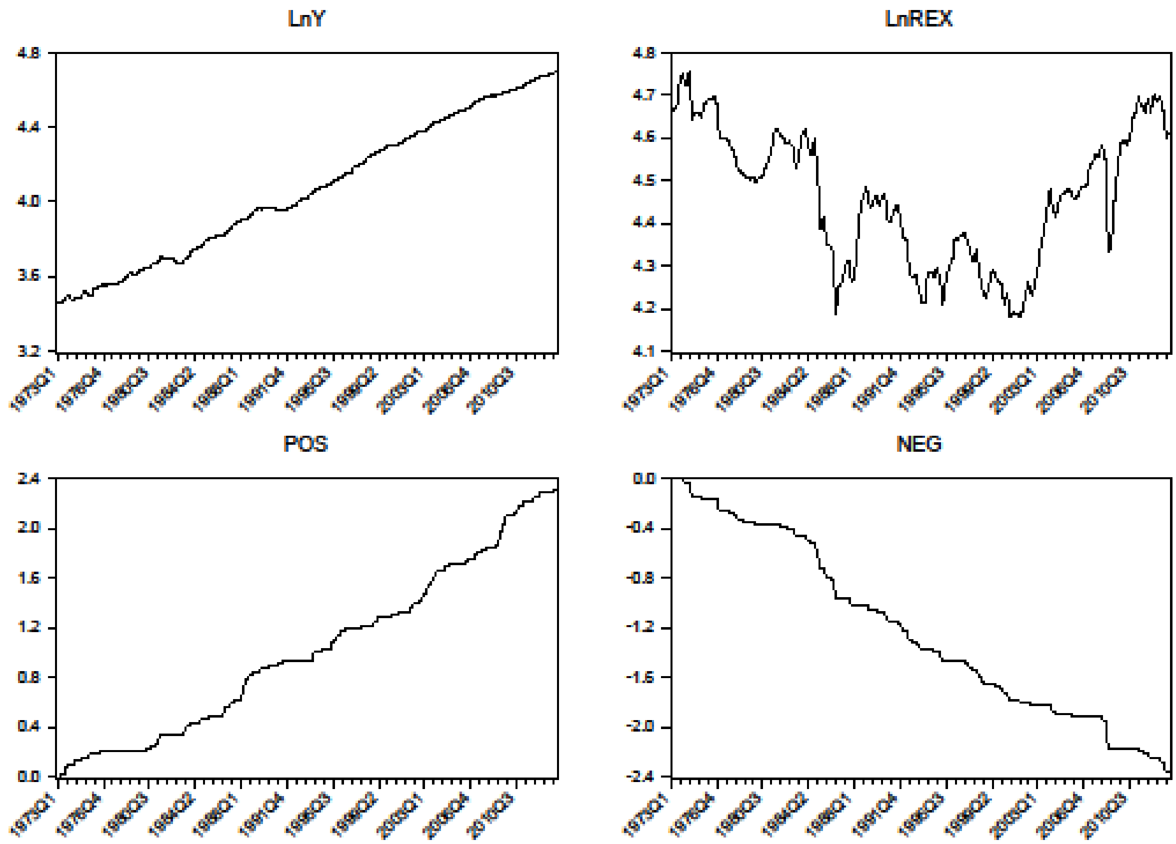

Figure 2: Plot of Ln Y, LnREX, POS, and NEG for Japan

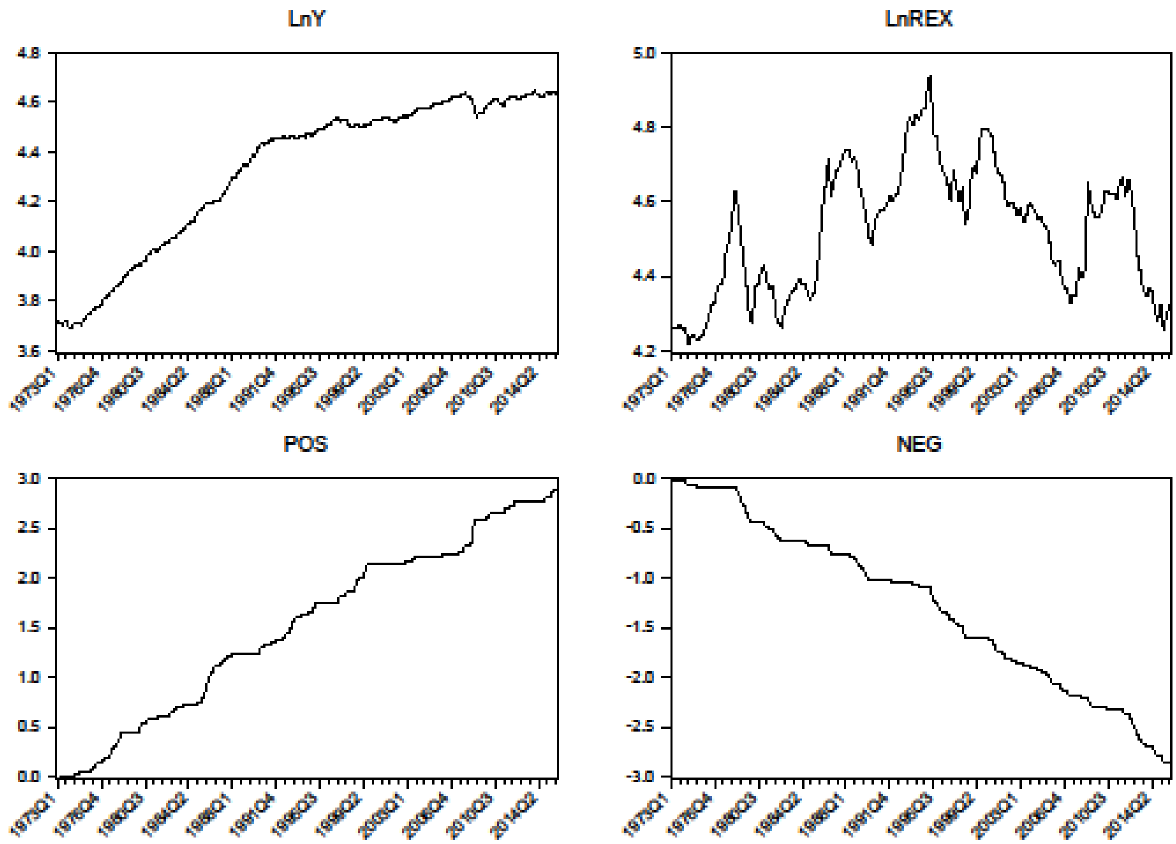

Figure 3: Plot of Ln Y, LnREX, POS, and NEG for Czech Republic

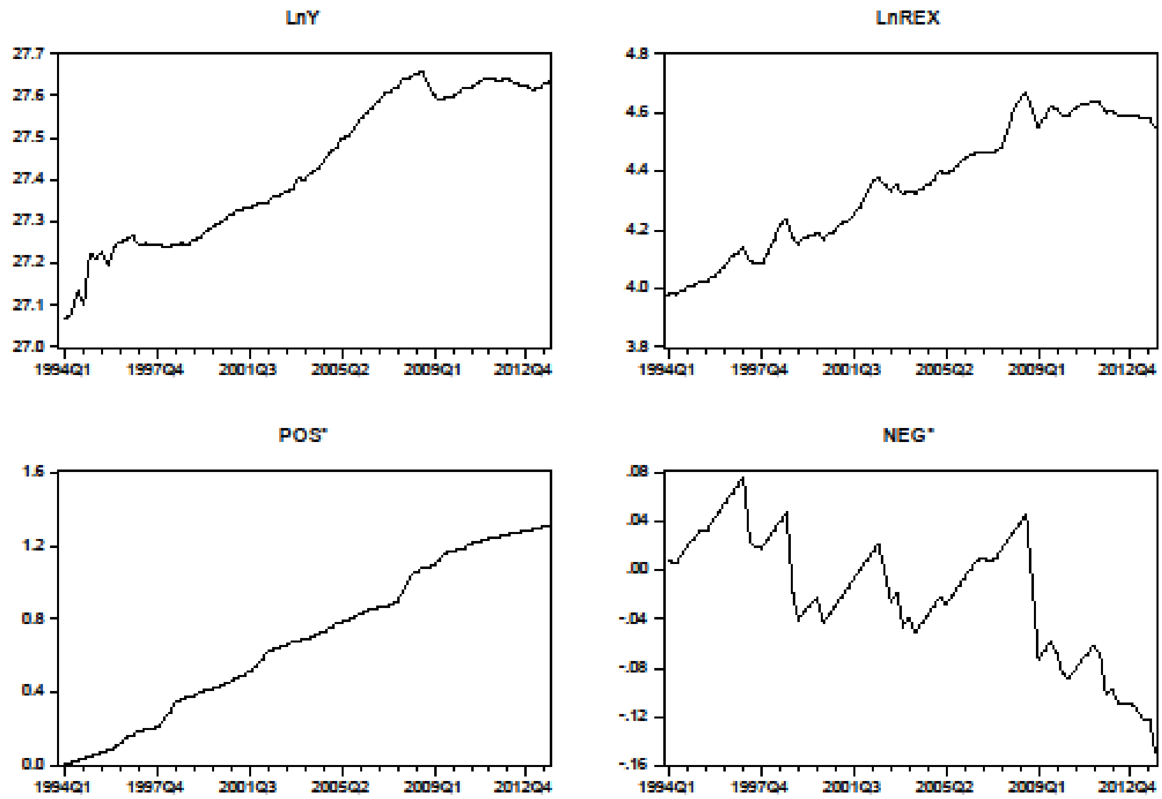

Figure 4: Plot of Ln Y, LnREX, POS, and NEG for Estonia

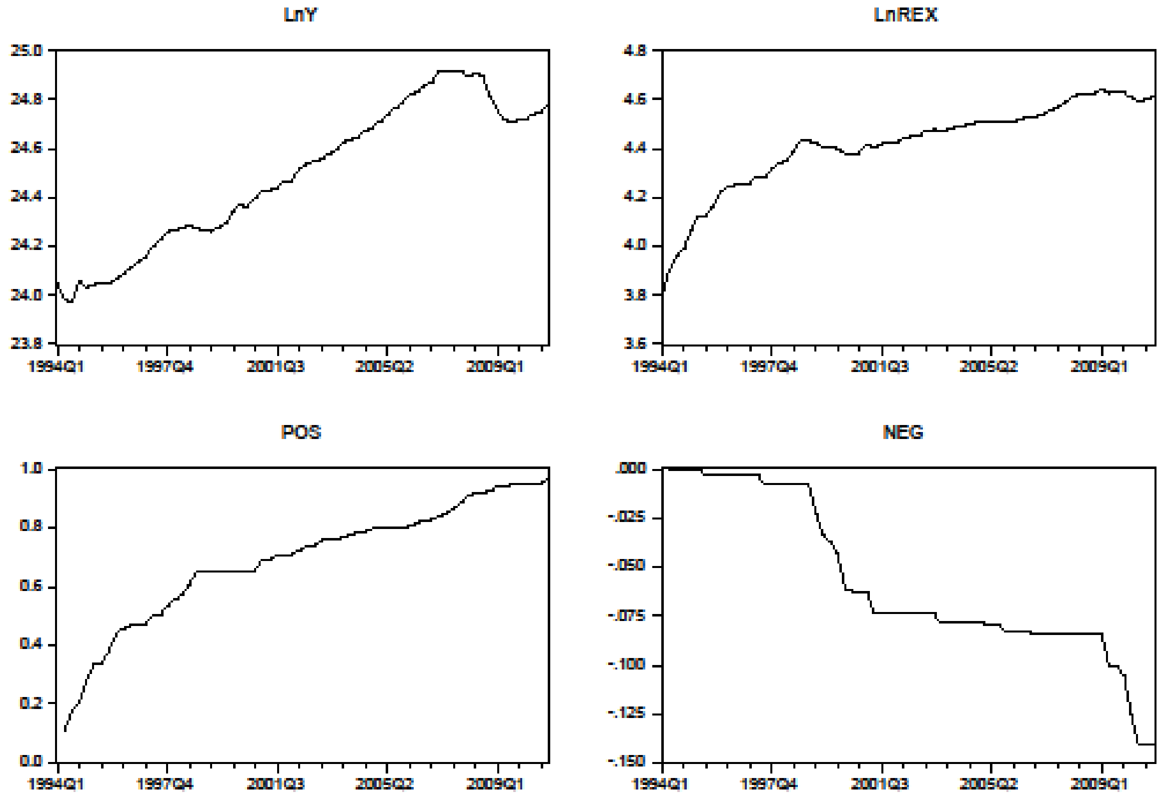

Figure 5: Plot of Ln Y, LnREX, POS, and NEG for Hungary

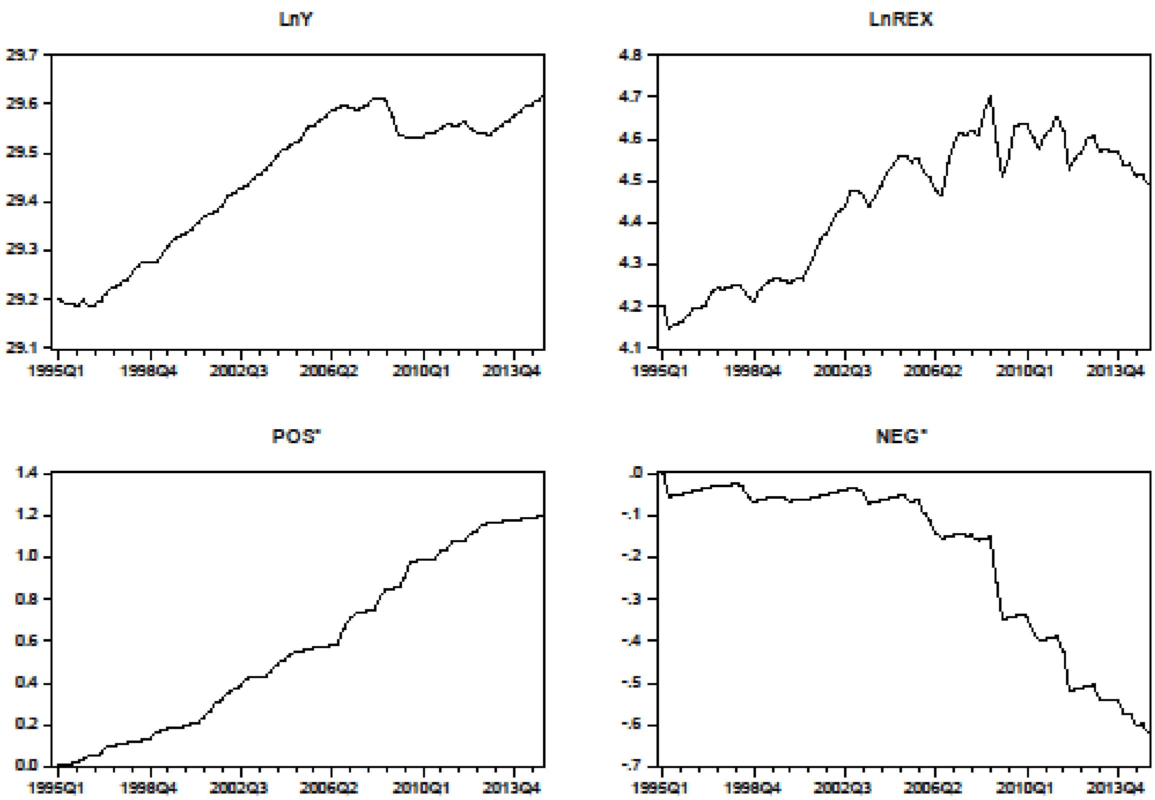

Figure 6: Plot of Ln Y, LnREX, POS, and NEG for Latvia

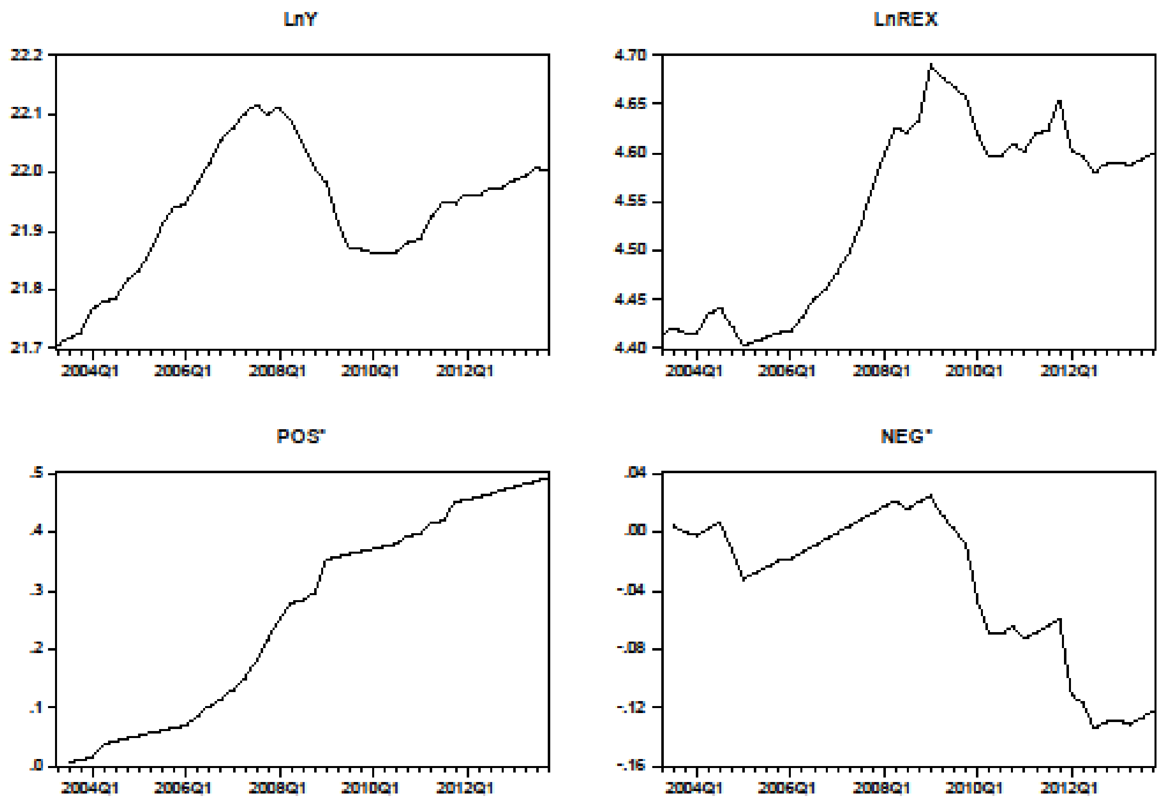

Figure 7: Plot of Ln Y, LnREX, POS, and NEG for Lithuania

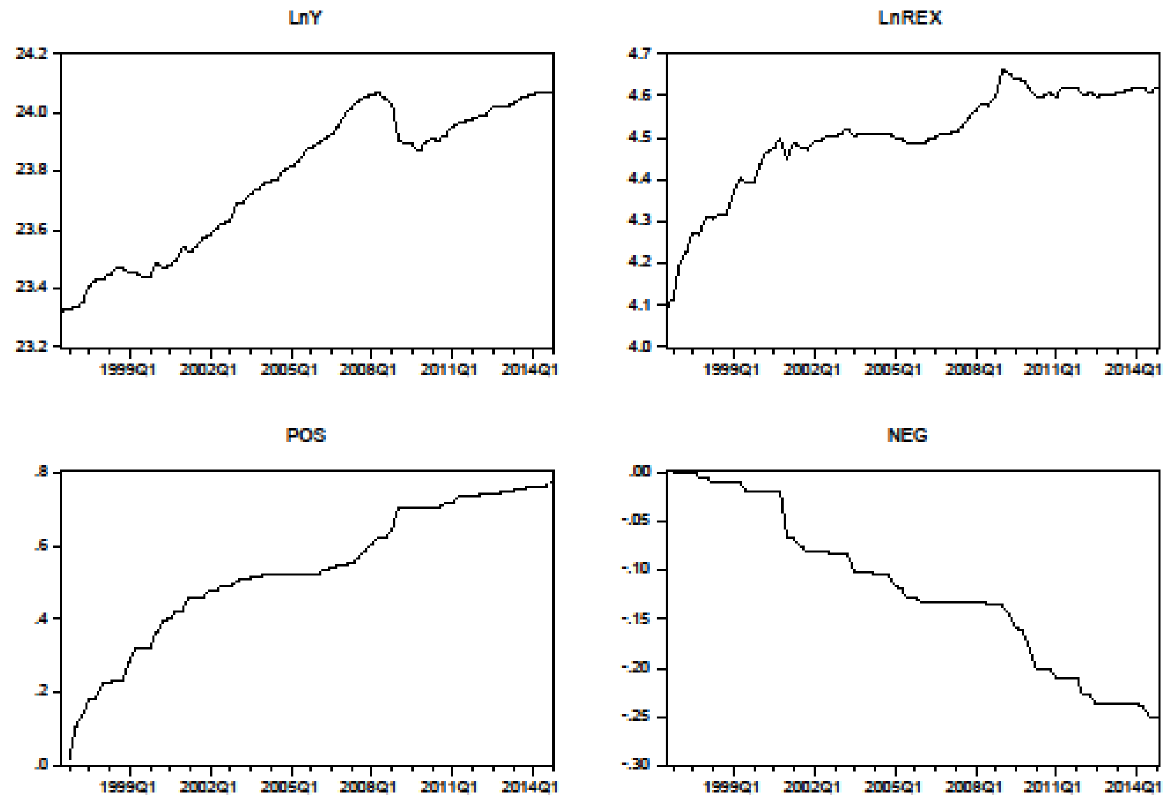

Figure 8: Plot of Ln Y, LnREX, POS, and NEG for Poland

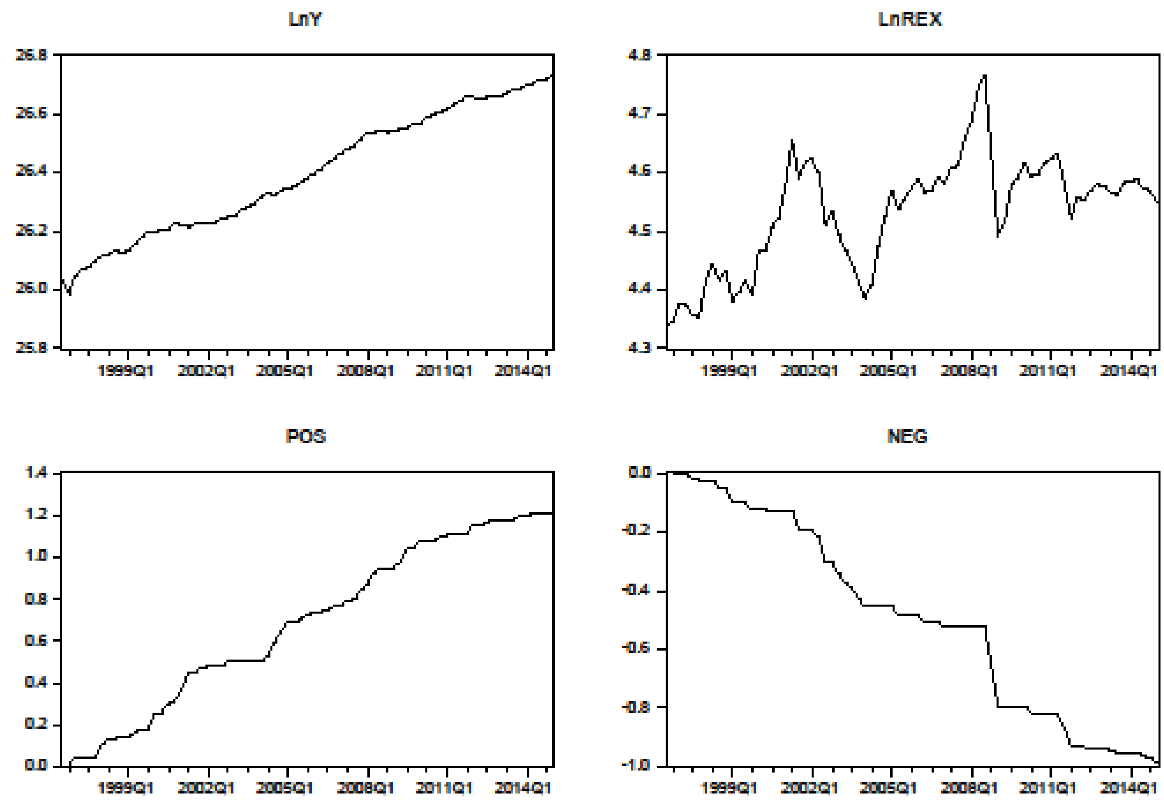

Figure 9: Plot of Ln Y, LnREX, POS, and NEG for Russia

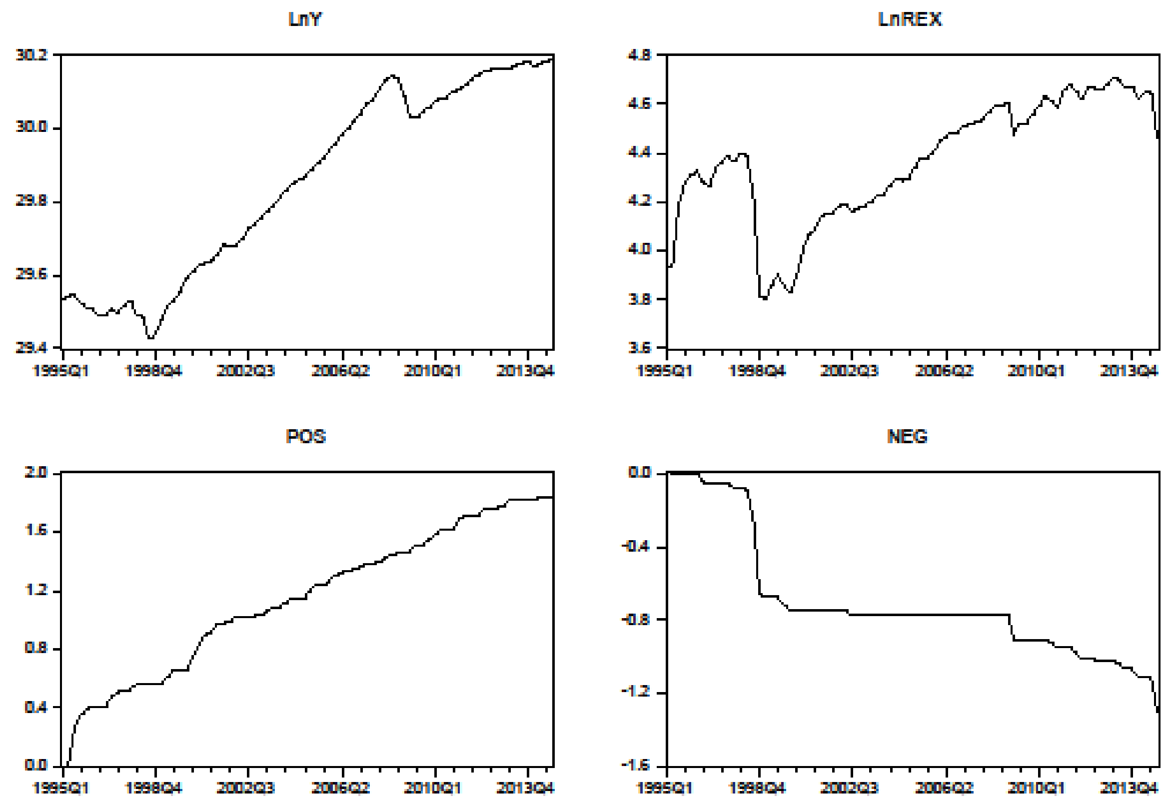

Table 1: Full information estimate of both linear and nonlinear models for Australia

I. Linear ARDL Model								
Panel A: Short run Estimates								
Lag order	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
ΔLnY	-	0.08 (0.98)	0.08 (1.02)	0.19** (2.49)				
ΔLnM	0.02 (1.15)							
ΔLnG	0.11** (2.91)	0.02 (0.50)	-0.09** (2.57)	-0.05 (1.26)	0.02 (0.55)	0.08** (2.12)	0.02 (0.61)	-0.10** (2.79)
ΔLnW	-0.04 (0.58)							
$\Delta LnOP$	0.00 (0.48)							
$\Delta LnREX$	0.04** (2.55)							
Panel B: Long run Estimates								
$\boldsymbol{Constant}$	$\boldsymbol{Trend}$	$\boldsymbol{LnM}$	$\boldsymbol{LnG}$	$\boldsymbol{LnW}$	$\boldsymbol{LnOP}$	$\boldsymbol{LnREX}$		
1.93 (0.29)	0.01** (4.53)	0.01 (0.10)	0.08 (0.28)	-0.16** (2.57)	-0.01 (0.77)	-0.04 (0.70)		
Panel C: Diagnostic Statistics								
$\boldsymbol{F}$	$\boldsymbol{ECM_{t-1}}$	$\boldsymbol{LM}$	$\boldsymbol{RESET}$	$\boldsymbol{\bar{R}^2}$	$\boldsymbol{CUSUM}(\boldsymbol{CUSUMSQ})$			
1.51	-0.16* (4.23)	2.95	0.24	0.21	S (U)			

Table 1 continued

II.Non-linear ARDL Model								
Panel A: Short run Estimates								
Lag order	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
ΔLnY	-	0.06 (0.70)	0.08 (1.03)	0.20** (2.67)				
ΔLnM	0.02 (1.14)							
ΔLnG	0.14** (3.74)	0.03 (0.84)	-0.09** (2.35)	-0.04 (0.96)	0.03 (0.74)	0.07* (1.93)	0.02 (0.52)	-0.10** (2.75)
ΔLnW	-0.03 (0.53)							
$\Delta LnOP$	0.00 (0.51)							
ΔPOS	0.02 (0.44)	0.10** (2.64)	0.05 (1.37)					
ΔNEG	0.06** (2.37)	-0.04* (1.65)	0.01 (0.44)	0.06** (2.34)	0.05** (2.04)			
Panel B: Long run Estimates								
$\boldsymbol{Constant}$	$\boldsymbol{Trend}$	$\boldsymbol{LnM}$	$\boldsymbol{LnG}$	$\boldsymbol{LnW}$	$\boldsymbol{LnOP}$	$\boldsymbol{POS}$	$\boldsymbol{NEG}$	
-2.68 (0.42)	0.01** (3.55)	0.04 (0.65)	0.24 (0.86)	-0.21** (3.77)	-0.01 (0.77)	-0.10* (1.71)	-0.04 (0.56)	
Panel C: Diagnostic Statistics								
$\boldsymbol{F}$	$\boldsymbol{ECM_{t-1}}$	$\boldsymbol{LM}$	$\boldsymbol{RESET}$	$\boldsymbol{\bar{R}^2}$	$\boldsymbol{CUSUM(CUSUMSQ)}$		$\boldsymbol{Wald-S}$	$\boldsymbol{Wald-L}$
2.42	-0.18** (5.13)	1.59	1.71	0.26	S (S)		0.02	0.90

Notes:

a. Numbers inside 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=5), the upper bound critical value of the F test is 3.79 (4.25). These come from Pesaran et al. (2001, Table CI, Case V, p. 301).

c. Number inside the parenthesis 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 -4.21 (-4.52) when k=5 and these come from Pesaran et al. (2001, Table CII, Case V, p. 304). In the nonlinear model where k=6, these critical values change to -4.37 (-4.69).

d. LM is Lagrange Multiplier test of residual serial correlation. It is distributed as χ2 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 χ2 distribution with one degree of freedom.

e. RESET is Ramsey's test for misspecification. It is distributed as χ2 with one degree of freedom.

Table 2: Full information estimate of both linear and nonlinear models for Japan

I. Linear ARDL Model								
Panel A: Short run Estimates								
Lag order	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
ΔLnY	-							
ΔLnM	-0.19 (1.45)	0.32** (2.71)	-0.36** (3.00)	0.35** (2.87)	0.06 (0.50)	0.03 (0.28)	-0.06 (0.48)	0.29** (2.93)
ΔLnG	0.02 (1.15)							
ΔLnW	1.06** (7.02)							
$\Delta LnOP$	0.00 (0.73)							
$\Delta LnREX$	-0.01 (0.36)							
Panel B: Long run Estimates								
$\boldsymbol{Constant}$	$\boldsymbol{LnM}$	$\boldsymbol{LnG}$	$\boldsymbol{LnW}$	$\boldsymbol{LnOP}$	$\boldsymbol{LnREX}$			
-18.77* (1.83)	0.49 (1.17)	0.32 (1.18)	-0.79 (0.47)	-0.07 (1.37)	-0.02 (0.10)			
Panel C: Diagnostic Statistics								
$\boldsymbol{F}$	$\boldsymbol{ECM_{t-1}}$	$\boldsymbol{LM}$	$\boldsymbol{RESET}$	$\boldsymbol{\bar{R}^2}$	$\boldsymbol{CUSUM(CUSUMSQ)}$			
0.70	-0.03 (2.27)	0.01	10.75**	0.44	S (S)			

Table 2 continued

II.Non-linear ARDL Model

Panel A: Short run Estimates

Lag order	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
ΔLnY	-							
ΔLnM	-0.18	0.35**	-0.39**	0.21*	0.02	0.17	-0.24**	
	(1.41)	(2.32)	(2.62)	(1.67)	(0.19)	(1.43)	(2.45)	
ΔLnG	0.03	0.01	0.06**	0.07**				
	(1.56)	(0.33)	(3.11)	(3.90)				
ΔLnW	1.05**	-0.35**	-0.02	-0.14	-0.18*	-0.32**		
	(6.67)	(2.17)	(0.11)	(1.16)	(1.87)	(3.40)		
$\Delta LnOP$	-0.01							
	(1.57)							
ΔPOS	-0.04	-0.06**						
	(1.50)	(3.04)						
ΔNEG	0.00							
	(0.19)							

Panel B: Long run Estimates

$\boldsymbol{Constant}$	$\boldsymbol{LnM}$	$\boldsymbol{LnG}$	$\boldsymbol{LnW}$	$\boldsymbol{LnOP}$	$\boldsymbol{POS}$	$\boldsymbol{NEG}$
-20.73**	0.55**	0.04	1.31**	-0.04**	-0.18**	0.13**
(11.41)	(8.24)	(1.00)	(6.20)	(4.75)	(4.61)	(4.28)

Panel C: Diagnostic Statistics

$\boldsymbol{F}$	$\boldsymbol{ECM_{t-1}}$	$\boldsymbol{LM}$	$\boldsymbol{RESET}$	$\boldsymbol{\bar{R}^2}$	$\boldsymbol{CUSUM(CUSUMSQ)}$	$\boldsymbol{Wald-S}$	$\boldsymbol{Wald-L}$
5.19**	-0.20**	0.19	2.10	0.55	S(S)	3.78*	98.14**
	(6.23)						

Notes:

a. Numbers inside 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=5), the upper bound critical value of the F test is 3.35 (3.79). These come from Pesaran et al. (2001, Table CI, Case III ,p. 300).

c. Number inside the parenthesis 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 -3.86 (-4.19) when k=5 and these come from Pesaran et al. (2001, Table CII, Case III, p. 303). In the nonlinear model where k=6, these critical values change to -4.04 (-4.38).

d. LM is Lagrange Multiplier test of residual serial correlation. It is distributed as $\chi 2$ 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 $\chi 2$ distribution with one degree of freedom.

e. RESET is Ramsey's test for misspecification. It is distributed as $\chi 2$ with one degree of freedom.

Table 3: Full information estimate of both linear and nonlinear models for Czech Republic

I. Linear ARDL Model								
Panel A: Short run Estimates								
Lag order	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
ΔLnY	-	-0.87** (5.92)	-0.82** (6.13)	-0.77** (5.86)	-0.22** (2.15)	-0.21** (2.48)		
ΔLnM	0.19** (2.41)							
ΔLnG	0.03 (0.69)	-0.34** (6.68)	-0.14** (2.78)	-0.01 (0.38)	0.04 (1.16)			
ΔLnW	0.38** (5.03)	0.26** (2.51)	0.32** (3.22)	0.24** (2.77)	-0.16** (2.07)	-0.22** (2.77)	-0.48** (6.15)	-0.23** (3.07)
$\Delta LnOP$	0.03** (3.40)	0.07** (4.66)	0.10** (6.61)	0.06** (4.11)	0.05** (4.52)	0.06** (4.67)		
$\Delta LnREX$	0.03 (0.57)	0.46** (5.71)	0.43** (5.00)	0.41** (4.89)	0.19** (3.01)	0.03 (0.57)	0.25** (4.14)	
Panel B: Long run Estimates								
$\boldsymbol{Constant}$	$\boldsymbol{Trend}$	$\boldsymbol{LnM}$	$\boldsymbol{LnG}$	$\boldsymbol{LnW}$	$\boldsymbol{LnOP}$	$\boldsymbol{LnREX}$		
37.59** (4.21)	-0.02** (4.12)	0.28 (1.54)	-1.02** (2.88)	0.52** (3.10)	0.25** (4.95)	1.31** (3.05)		
Panel C: Diagnostic Statistics								
$\boldsymbol{F}$	$\boldsymbol{ECM_{t-1}}$	$\boldsymbol{LM}$	$\boldsymbol{RESET}$	$\boldsymbol{\bar{R}^2}$	$\boldsymbol{CUSUM(CUSUMSQ)}$			
8.05**	0.36** (7.47)	0.65	1.22	0.99	S (S)			

Table 3 continued

II.Non-linear ARDL Model								
Panel A: short run estimates								
Lag order	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
ΔLnY	-	-1.72** (6.62)	-2.13** (6.76)	-2.18** (6.91)	-1.32** (4.59)	-1.10** (5.27)	-0.54** (4.03)	
ΔLnM	0.10 (1.09)	0.66** (4.65)	0.69** (5.25)	0.55** (5.44)	0.33** (3.37)	0.34** (3.51)	0.23** (2.72)	0.19** (2.65)
ΔLnG	0.09** (2.08)	-0.37** (6.33)	-0.21** (3.43)	-0.09** (2.16)				
ΔLnW	0.46** (5.63)	0.98** (5.10)	0.84** (4.93)	0.39** (3.05)	-0.08 (0.76)	-0.10 (1.01)	-0.35** (3.38)	-0.14 (1.59)
$\Delta LnOP$	0.01 (1.25)	0.17** (6.22)	0.21** (6.92)	0.17** (6.00)	0.17** (6.29)	0.13** (5.77)	0.06** (3.75)	0.04** (3.38)
ΔPOS	-0.01 (0.13)							
ΔNEG	0.39** (3.18)	0.48** (3.79)	0.70** (5.23)	0.59** (4.58)	0.41** (3.05)	0.39** (3.03)	0.27** (2.94)	
Panel B: long run estimates								
$\boldsymbol{Constant}$	$\boldsymbol{Trend}$	$\boldsymbol{LnM}$	$\boldsymbol{LnG}$	$\boldsymbol{LnW}$	$\boldsymbol{LnOP}$	$\boldsymbol{POS}$	$\boldsymbol{NEG}$	
17.81** (2.84)	-0.03** (2.84)	0.94** (2.57)	-0.82** (2.47)	0.87** (2.54)	0.37** (3.90)	0.51** (2.98)	-0.42 (0.89)	
Panel C: Diagnostic Statistics								
$\boldsymbol{F}$	$\boldsymbol{ECM_{t-1}}$	$\boldsymbol{LM}$	$\boldsymbol{RESET}$	$\boldsymbol{\bar{R}^2}$	$\boldsymbol{CUSUM(CUSUMSQ)}$		$\boldsymbol{Wald-S}$	$\boldsymbol{Wald-L}$
5.32**	0.56** (7.14)	1.99	3.24	0.99	S (S)		15.1**	5.45**

Notes:

a. Numbers inside 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=5), the upper bound critical value of the F test is 3.79 (4.25). These come from Pesaran et al. (2001, Table CI, Case V, p. 301).

c. Number inside the parenthesis 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 -4.21 (-4.52) when k=5 and these come from Pesaran et al. (2001, Table CII, Case V, p. 304). In the nonlinear model where k=6, these critical values change to -4.37 (-4.69).

d. LM is Lagrange Multiplier test of residual serial correlation. It is distributed as $\chi 2$ 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 $\chi 2$ distribution with one degree of freedom.

e. RESET is Ramsey's test for misspecification. It is distributed as $\chi 2$ with one degree of freedom.

Table 4: Full information estimate of both linear and nonlinear models for Estonia

I. Linear ARDL Model								
Panel A: Short run Estimates								
Lag order	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
ΔLnY	-	-0.09 (0.61)	0.20 (1.26)	0.45** (2.73)	1.00** (6.15)	0.54** (3.03)	0.55** (3.68)	
ΔLnM	0.03 (0.34)	0.21** (2.21)	0.37** (3.71)	0.16 (1.48)	-0.37** (2.99)	-0.32** (2.88)		
ΔLnG	-0.45** (4.07)	-0.30** (2.79)	-0.44** (4.25)	-0.55** (5.36)	-0.41** (3.83)	-0.11 (1.17)	-0.08 (1.08)	-0.12* (1.67)
$\Delta LnOP$	0.06** (2.93)	-0.02 (0.85)	0.03 (1.15)	-0.03 (1.20)	-0.02 (0.90)	-0.03 (0.98)	-0.06** (2.62)	-0.04* (1.95)
$\Delta LnREX$	0.46* (1.67)	-0.10 (0.41)	0.53** (2.10)	0.38* (1.79)	-0.39** (1.99)	0.68** (3.51)	0.79** (3.36)	0.29 (1.29)
Panel B: Long run Estimates								
$\boldsymbol{Constant}$	$\boldsymbol{LnM}$	$\boldsymbol{LnG}$	$\boldsymbol{LnOP}$	$\boldsymbol{LnREX}$				
41.35** (1.68)	0.68** (2.15)	-2.07 (1.35)	0.20 (0.85)	2.86 (1.62)				
Panel C: Diagnostic Statistics								
$\boldsymbol{F}$	$\boldsymbol{ECM_{t-1}}$	$\boldsymbol{LM}$	$\boldsymbol{RESET}$	$\boldsymbol{\bar{R}^2}$	$\boldsymbol{CUSUM(CUSUMSQ)}$			
2.83	-0.31** (4.94)	1.46	0.23	0.96	S (U)			

Table 4 continued

II.Non-linear ARDL Model								
Panel A: Short run Estimates								
Lag order	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
ΔLnY	-	0.02	0.39**	0.78**	0.92**	0.72**	0.93**	
		(0.22)	(3.33)	(5.39)	(8.41)	(4.94)	(7.40)	
ΔLnM	-0.29**	-0.10	0.34**	0.38**	-0.14	-0.32**	-0.15*	
	(3.96)	(1.27)	(4.73)	(4.49)	(1.59)	(3.32)	(1.68)	
ΔLnG	-0.46**	0.05	-0.49**	-0.79**	-0.70**	-0.27**	0.11*	
	(5.74)	(0.55)	(5.91)	(9.81)	(6.95)	(3.41)	(1.85)	
$\Delta LnOP$	0.10**	-0.09**	-0.07**	-0.09**	-0.06**	0.01	-0.10**	-0.12**
	(7.12)	(4.75)	(3.68)	(4.05)	(3.32)	(0.28)	(5.27)	(6.34)
ΔPOS	0.04	-1.41**	0.34**	0.35**	-0.45**	0.19	1.05**	0.47**
	(0.19)	(5.56)	(2.01)	(2.00)	(3.10)	(1.28)	(6.13)	(2.88)
ΔNEG	1.60**	0.03	1.91**	0.49	0.19	3.81**	1.71**	
	(3.10)	(0.05)	(2.89)	(0.76)	(0.29)	(6.45)	(2.66)	
Panel B: Long run Estimates								
$\boldsymbol{Constant}$	$\boldsymbol{LnM}$	$\boldsymbol{LnG}$	$\boldsymbol{LnOP}$	$\boldsymbol{POS}$	$\boldsymbol{NEG}$			
62.51**	0.25	-2.10**	0.40**	3.43**	3.69**			
(3.22)	(0.97)	(2.69)	(2.30)	(2.78)	(3.34)			
Panel C: Diagnostic Statistics								
$\boldsymbol{F}$	$\boldsymbol{ECM_{t-1}}$	$\boldsymbol{LM}$	$\boldsymbol{RESET}$	$\boldsymbol{\bar{R}^2}$	$\boldsymbol{CUSUM(CUSUMSQ)}$		$\boldsymbol{Wald-S}$	$\boldsymbol{Wald-L}$
3.35	-0.55**	7.18	0.02	0.99	S(S)		10.9**	0.08
	(8.38)							

Notes:

a. Due to lack of data on wage rate, it had to be excluded.

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

c. At the 10% (5%) significance level when there is one exogenous variable (k=4), the upper bound critical value of the F test is 3.52 (4.01). These come from Pesaran et al. (2001, Table CI, Case III, p. 300).

d. Number inside the parenthesis 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 -3.66 (-3.99) when k=4 and these come from Pesaran et al. (2001, Table CII, Case III, p. 303). In the nonlinear model where k=5, these critical values change to -3.86 (-4.19).

e. LM is Lagrange Multiplier test of residual serial correlation. It is distributed as $\chi 2$ 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 $\chi 2$ distribution with one degree of freedom.

f. RESET is Ramsey's test for misspecification. It is distributed as $\chi 2$ with one degree of freedom.

Table 5: Full information estimate of both linear and nonlinear models for Hungary

I. Linear ARDL Model								
Panel A: Short run Estimates								
Lag order	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
ΔLnY	-	-0.12 (0.97)	-0.20** (2.46)	-0.31** (3.90)	0.49** (5.43)	-0.21** (2.10)		
ΔLnM	-0.03 (0.80)							
ΔLnG	0.03 (1.39)							
ΔLnW	-0.01 (0.09)	0.23** (4.22)	0.24** (3.99)	0.12* (1.89)				
$\Delta LnOP$	0.02** (2.57)	0.03** (3.35)						
$\Delta LnREX$	-0.06 (1.46)							
Panel B: Long run Estimates								
$\boldsymbol{Constant}$	$\boldsymbol{Trend}$	$\boldsymbol{LnM}$	$\boldsymbol{LnG}$	$\boldsymbol{LnW}$	$\boldsymbol{LnOP}$	$\boldsymbol{LnREX}$		
13.57** (2.12)	-0.01* (1.75)	0.66** (2.14)	-0.21 (0.80)	0.09 (0.45)	0.04 (0.80)	0.37 (1.52)		
Panel C: Diagnostic Statistics								
$\boldsymbol{F}$	$\boldsymbol{ECM_{t-1}}$	$\boldsymbol{LM}$	$\boldsymbol{RESET}$	$\boldsymbol{\bar{R}^2}$	$\boldsymbol{CUSUM(CUSUMSQ)}$			
1.39	0.15 (3.83)	0.00	0.03	0.99	S(S)			

Table 5 continued

II.Non-linear ARDL Model								
Panel A: Short run Estimates								
Lag order	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
ΔLnY	-	-0.29** (3.23)	-0.22** (2.50)	-0.25** (2.61)	0.46** (5.31)			
ΔLnM	-0.13** (2.88)	-0.04 (0.91)	0.13** (3.26)	0.20** (4.77)	0.13** (3.54)	0.00 (0.11)	-0.12** (3.28)	-0.15** (4.49)
ΔLnG	0.03 (0.95)	-0.30** (4.95)	-0.35** (5.79)	-0.37** (6.08)	-0.30** (5.95)	-0.23** (5.77)	-0.09** (3.57)	
ΔLnW	-0.04 (0.53)	-0.04 (0.75)	0.10* (2.47)	0.16** (2.87)	0.05 (0.78)			
$\Delta LnOP$	0.03** (5.20)	-0.01 (1.43)	-0.04** (4.01)	-0.03** (3.44)	-0.05** (5.21)	-0.01 (1.19)	-0.03** (3.02)	-0.02** (3.00)
ΔPOS	-0.33** (5.81)	-0.11** (2.08)	0.05 (0.91)	-0.16** (2.69)	-0.29** (4.28)			
ΔNEG	0.11** (2.16)	0.26** (4.88)	0.18** (3.11)	0.23** (3.89)	0.26** (3.67)	0.03 (0.42)	-0.10* (1.84)	
Panel B: Long run Estimates								
$\boldsymbol{Constant}$	$\boldsymbol{Trend}$	$\boldsymbol{LnM}$	$\boldsymbol{LnG}$	$\boldsymbol{LnW}$	$\boldsymbol{LnOP}$	$\boldsymbol{POS}$	$\boldsymbol{NEG}$	
10.59 (0.85)	0.01 (1.37)	-0.11 (0.45)	0.81 (1.34)	-0.06 (0.39)	0.10 (1.52)	-0.77** (2.20)	0.09 (0.18)	
Panel C: Diagnostic Statistics								
$\boldsymbol{F}$	$\boldsymbol{ECM_{t-1}}$	$\boldsymbol{LM}$	$\boldsymbol{RESET}$	$\boldsymbol{\bar{R}^2}$	$\boldsymbol{CUSUM(CUSUMSQ)}$		$\boldsymbol{Wald-S}$	$\boldsymbol{Wald-L}$
3.77*	-0.48** (8.45)	1.37	4.60**	0.996	S (S)		2.20	1.58

Notes:

a. Numbers inside 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=5), the upper bound critical value of the F test is 3.79 (4.25). These come from Pesaran et al. (2001, Table CI, Case V, p. 301).

c. Number inside the parenthesis 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 -4.21 (-4.52) when k=5 and these come from Pesaran et al. (2001, Table CII, Case V, p. 304). In the nonlinear model where k=6, these critical values change to -4.37 (-4.69).

d. LM is Lagrange Multiplier test of residual serial correlation. It is distributed as $\chi 2$ 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 $\chi 2$ distribution with one degree of freedom.

e. RESET is Ramsey's test for misspecification. It is distributed as $\chi 2$ with one degree of freedom.

Table 6: Full information estimate of both linear and nonlinear models for Latvia

I. Linear ARDL Model								
Panel A: Short run Estimates								
Lag order	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
ΔLnY	-	2.50** (7.59)	3.79** (8.23)	3.22** (7.47)	1.49** (10.77)			
ΔLnM	-0.19** (4.37)	-5.56** (8.14)	-3.68** (7.87)	-0.99** (4.08)	-0.72** (5.97)			
ΔLnG	1.42** (7.38)	-8.90** (8.04)	-6.71** (7.82)	-2.40** (7.34)				
ΔLnW	-0.34* (1.80)	4.59** (6.80)	-1.81** (7.52)	-8.72** (8.45)	-4.38** (6.98)			
$\Delta LnOP$	0.51** (7.22)	-0.96** (7.67)	-0.24** (4.36)	-0.43** (7.55)	-0.30** (5.49)			
$\Delta LnREX$	-3.33** (7.41)	-3.33** (6.97)	-6.55** (8.54)	-9.67** (8.02)	-1.80** (4.50)			
Panel B: Long run Estimates								
$\boldsymbol{Constant}$	$\boldsymbol{LnM}$	$\boldsymbol{LnG}$	$\boldsymbol{LnW}$	$\boldsymbol{LnOP}$	$\boldsymbol{LnREX}$			
-60.09** (7.52)	1.26** (12.04)	2.86** (10.84)	-1.32** (6.57)	0.41** (7.08)	0.02 (0.06)			
Panel C: Diagnostic Statistics								
$\boldsymbol{F}$	$\boldsymbol{ECM_{t-1}}$	$\boldsymbol{LM}$	$\boldsymbol{RESET}$	$\boldsymbol{\bar{R}^2}$	$\boldsymbol{CUSUM}(\boldsymbol{CUSUMSQ})$			
2.79	-4.34** (8.06)	12.90**	0.87	0.997	S (S)			

Table 6 continued

II.Non-linear ARDL Model

Panel A: Short run Estimates

Lag order	0	1	2	3	4	5	6	7
ΔLnY	-	-1.38** (10.71)	-0.67** (10.48)	-0.77** (8.07)				
ΔLnM	0.07** (1.99)	-1.03** (12.54)	-1.75** (7.91)	-0.60** (5.61)				
ΔLnG	-0.33** (3.87)							
ΔLnW	0.95** (5.68)	1.62** (9.31)	0.30* (1.68)	-0.58** (4.31)				
$\Delta LnOP$	0.03* (1.95)	-0.17** (6.08)	-0.02 (0.93)	-0.10** (4.44)				
ΔPOS	-1.58** (5.42)	-1.59** (4.87)						
ΔNEG	1.35** (5.28)	0.41 (1.56)	-0.01 (0.04)	-0.93** (3.24)				

Panel B: Long run estimates

$Constant$	LnM	LnG	LnW	$LnOP$	POS	NEG
45.13** (2.23)	-3.04* (1.77)	1.37 (1.41)	4.55** (1.99)	-0.52 (1.19)	-4.08** (2.22)	-4.67** (2.04)

Panel C: Diagnostic Statistics

F	ECM_{t-1}	LM	$RESET$	$\bar{R}^2$	$CUSUM(CUSUMSQ)$	$Wald-S$	$Wald-L$
13.58**	0.24** (13.26)	0.71	2.47	0.99	S(S)	8.48**	0.27

Notes:

a. Numbers inside 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=5), the upper bound critical value of the F test is 3.35 (3.79). These come from Pesaran et al. (2001, Table CI, Case III, p. 300).

c. Number inside the parenthesis 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 -3.86 (-4.19) when k=5 and these come from Pesaran et al. (2001, Table CII, Case III, p. 303). In the nonlinear model where k=6, these critical values change to -4.04 (-4.38).

d. LM is Lagrange Multiplier test of residual serial correlation. It is distributed as $\chi 2$ 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 $\chi 2$ distribution with one degree of freedom.

e. RESET is Ramsey's test for misspecification. It is distributed as $\chi 2$ with one degree of freedom.

Table 7: Full information estimate of both linear and nonlinear models for Lithuania

I. Linear ARDL Model								
Panel A: Short run Estimates								
Lag order	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
ΔLnY	-	1.45** (6.12)	0.62** (3.67)	0.07 (0.54)	0.59** (5.07)	0.22* (1.68)	0.15 (1.09)	0.28** (2.13)
ΔLnM	0.26* (1.96)	0.07 (0.35)	1.04** (4.88)	1.35** (5.30)	1.50** (6.29)	1.07** (5.11)	0.71** (4.72)	0.45** (4.12)
ΔLnG	-0.08 (1.63)	1.09** (6.27)	1.05** (6.36)	0.68** (4.39)	0.35** (2.89)	0.02 (0.16)	-0.20** (2.28)	-0.10 (1.58)
ΔLnW	-0.06 (0.72)	-0.22** (2.09)	-0.22** (1.97)	-0.05 (0.48)	0.36** (3.80)	-0.05 (0.54)	0.00 (0.03)	0.30** (3.33)
$\Delta LnOP$	-0.09** (3.15)	0.10** (3.67)	0.09** (3.21)	0.05* (1.94)	0.08** (3.34)	0.09** (2.72)	0.09** (3.09)	0.10** (3.98)
$\Delta LnREX$	0.27 (0.88)	1.92** (5.40)	2.10** (5.08)	1.90** (5.46)	2.95** (8.12)	2.35** (5.97)	1.70** (4.90)	1.24** (4.45)
Panel B: Long run Estimates								
$\boldsymbol{Constant}$	$\boldsymbol{LnM}$	$\boldsymbol{LnG}$	$\boldsymbol{LnW}$	$\boldsymbol{LnOP}$	$\boldsymbol{LnREX}$			
21.42** (13.02)	0.54** (5.20)	-0.57** (5.65)	0.34** (7.13)	-0.06 (1.18)	0.11 (0.50)			
Panel C: Diagnostic Statistics								
$\boldsymbol{F}$	$\boldsymbol{ECM_{t-1}}$	$\boldsymbol{LM}$	$\boldsymbol{RESET}$	$\boldsymbol{\bar{R}^2}$	$\boldsymbol{CUSUM(CUSUMSQ)}$			
5.20**	-2.24** (7.31)	2.19	0.82	0.98	S (S)			

Table 7 continued

II.Non-linear ARDL Model								
Panel A: Short run Estimates								
Lag order	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
ΔLnY	-	1.38**	0.69**	0.04	0.53**	0.01	0.14**	0.44**
		(32.45)	(17.20)	(1.21)	(22.82)	(0.27)	(6.22)	(18.21)
ΔLnM	-0.06**	-0.15**	0.96**	1.49**	1.26**	1.07**	0.48**	
	(2.64)	(3.55)	(26.60)	(30.29)	(29.46)	(26.69)	(18.90)	
ΔLnG	0.05**	0.16**	0.08**	-0.13**	-0.49**	-0.70**	-0.65**	-0.30**
	(5.99)	(10.37)	(4.24)	(5.97)	(20.47)	(27.28)	(26.39)	(17.01)
ΔLnW	-0.11**	0.01	0.02	0.18**	0.71**	0.09**	-0.15**	
	(7.01)	(0.45)	(0.74)	(8.09)	(28.70)	(3.43)	(9.03)	
$\Delta LnOP$	-0.14**	-0.03**	-0.01	-0.04**	-0.10**	0.02**	0.13**	0.02**
	(25.48)	(5.68)	(1.26)	(7.05)	(14.55)	(3.64)	(20.92)	(3.71)
ΔPOS	-0.36**	1.19**	2.57**	0.23**	1.62**	1.75**	0.77**	0.67**
	(4.51)	(18.19)	(20.16)	(2.73)	(22.14)	(15.34)	(7.95)	(8.46)
ΔNEG	-1.79**	2.89**	2.74**	5.13**	3.25**	2.23**	1.75**	2.56**
	(15.52)	(29.77)	(25.35)	(46.86)	(26.44)	(24.87)	(20.86)	(24.92)
Panel B: Long run Estimates								
$\boldsymbol{Constant}$	$\boldsymbol{LnM}$	$\boldsymbol{LnG}$	$\boldsymbol{LnW}$	$\boldsymbol{LnOP}$	$\boldsymbol{POS}$	$\boldsymbol{NEG}$		
15.53**	0.45**	-0.15	0.18**	-0.04*	0.08	-0.07		
(5.93)	(6.94)	(0.86)	(3.09)	(1.77)	(0.88)	(0.32)		
Panel C: Diagnostic Statistics								
$\boldsymbol{F}$	$\boldsymbol{ECM_{t-1}}$	$\boldsymbol{LM}$	$\boldsymbol{RESET}$	$\boldsymbol{\bar{R}^2}$	$\boldsymbol{CUSUM(CUSUMSQ)}$		$\boldsymbol{Wald-S}$	$\boldsymbol{Wald-L}$
66.30**	-1.92**	0.14	0.77	0.99	S(S)		9.96**	0.35
	(38.54)							

Notes:

a. Numbers inside 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=5), the upper bound critical value of the F test is 3.35 (3.79). These come from Pesaran et al. (2001, Table CI, Case III, p. 300).

c. Number inside the parenthesis 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 -3.86 (-4.19) when k=5 and these come from Pesaran et al. (2001, Table CII, Case III, p. 303). In the nonlinear model where k=6, these critical values change to -4.04 (-4.38).

d. LM is Lagrange Multiplier test of residual serial correlation. It is distributed as χ2 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 χ2 distribution with one degree of freedom.

e. RESET is Ramsey's test for misspecification. It is distributed as χ2 with one degree of freedom.

Table 8: Full information estimate of both linear and nonlinear models for Poland

I. Linear ARDL Model								
Panel A: Short run Estimates								
Lag order	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
ΔLnY	-	0.05	0.13	0.54**	1.02**	0.44**	0.38**	
		(0.34)	(1.27)	(4.82)	(10.46)	(3.17)	(3.50)	
ΔLnM	0.26**	-0.32**	-0.28**	-0.06	0.08	-0.14**	-0.20**	0.17**
	(4.42)	(5.56)	(3.36)	(0.88)	(1.47)	(2.75)	(4.28)	(3.56)
ΔLnG	0.16**	0.03	-0.01	0.00	-0.06	-0.01	0.04	
	(3.65)	(0.67)	(0.15)	(0.11)	(1.32)	(0.38)	(1.46)	
ΔLnW	0.76**	0.81**	0.19	-0.32**	-0.30**			
	(7.29)	(6.26)	(1.41)	(2.99)	(2.91)			
$\Delta LnOP$	0.02**	-0.04**	-0.02**	-0.04**	-0.05**	-0.06**	-0.02*	-0.03**
	(2.59)	(3.51)	(1.98)	(3.90)	(4.40)	(5.56)	(1.72)	(2.91)
$\Delta LnREX$	-0.11**	0.13**	0.11**	0.06*	0.20**	0.17**	0.03	0.12**
	(4.26)	(2.74)	(3.33)	(1.78)	(5.82)	(5.09)	(0.81)	(4.00)
Panel B: Long run Estimates								
$\boldsymbol{Constant}$	$\boldsymbol{LnM}$	$\boldsymbol{LnG}$	$\boldsymbol{LnW}$	$\boldsymbol{LnOP}$	$\boldsymbol{LnREX}$			
16.42**	0.11	0.28**	0.28**	0.06**	-0.27**			
(11.15)	(1.07)	(2.78)	(2.34)	(4.25)	(3.46)			
Panel C: Diagnostic Statistics								
$\boldsymbol{F}$	$\boldsymbol{ECM_{t-1}}$	$\boldsymbol{LM}$	$\boldsymbol{RESET}$	$\boldsymbol{\bar{R}^2}$	$\boldsymbol{CUSUM(CUSUMSQ)}$			
3.13	-1.04**	11.92**	5.12**	0.998	S (S)			
	(5.36)							

Table 8 continued

II.Non-linear ARDL Model								
Panel A: short run Estimates								
Lag order	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
ΔLnY	-	0.02 (0.20)	-0.29** (5.12)	0.47** (9.80)	1.06** (23.65)	1.23** (11.63)	0.71** (9.86)	-0.10** (2.19)
ΔLnM	0.26** (8.78)	0.03 (0.88)	-0.21** (4.58)	-0.29** (6.80)	0.10** (3.01)	0.02 (0.84)	0.06 (1.60)	0.17** (5.11)
ΔLnG	0.13** (7.28)	-0.89** (11.58)	-0.69** (12.72)	-0.64** (12.61)	-0.58** (12.37)	-0.47** (10.80)	-0.22** (7.59)	-0.06** (4.11)
ΔLnW	0.70** (17.30)	0.70** (10.66)	0.52** (7.11)	-0.46** (9.15)	-1.22** (13.19)	-0.76** (8.71)		
$\Delta LnOP$	0.01** (2.71)	-0.12** (12.84)	-0.10** (10.97)	-0.06** (11.46)	-0.07** (12.27)	-0.09** (15.54)	-0.08** (11.19)	-0.08** (9.94)
ΔPOS	-0.12** (2.87)	0.44** (7.94)	0.21** (5.68)	0.26** (7.85)	0.57** (13.26)	0.36** (8.91)	0.16** (3.72)	0.26** (8.45)
ΔNEG	-0.17** (6.93)	0.46** (11.31)	0.29** (12.61)	0.18** (7.10)	0.20** (8.15)	0.31** (13.61)	0.44** (9.95)	0.20** (7.37)
Panel B: Long run Estimates								
$\boldsymbol{Constant}$	$\boldsymbol{LnM}$	$\boldsymbol{LnG}$	$\boldsymbol{LnW}$	$\boldsymbol{LnOP}$	$\boldsymbol{POS}$	$\boldsymbol{NEG}$		
9.88** (5.54)	-0.04 (0.66)	0.63** (5.39)	0.45** (6.64)	0.07** (9.99)	-0.45** (6.14)	-0.22** (10.77)		
Panel C: Diagnostic Statistics								
$\boldsymbol{F}$	$\boldsymbol{ECM_{t-1}}$	$\boldsymbol{LM}$	$\boldsymbol{RESET}$	$\boldsymbol{\bar{R}^2}$	$\boldsymbol{CUSUM(CUSUMSQ)}$		$\boldsymbol{Wald-S}$	$\boldsymbol{Wald-L}$
11.09**	-2.20** (14.36)	34.92**	2.49	0.99	S(S)		0.73	12.7**

Notes:

a. Numbers inside 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=5), the upper bound critical value of the F test is 3.35 (3.79). These come from Pesaran et al. (2001, Table CI, Case III, p. 300).

c. Number inside the parenthesis 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 -3.86 (-4.19) when k=5 and these come from Pesaran et al. (2001, Table CII, Case III, p. 303). In the nonlinear model where k=6, these critical values change to -4.04 (-4.38).

d. LM is Lagrange Multiplier test of residual serial correlation. It is distributed as $\chi 2$ 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 $\chi 2$ distribution with one degree of freedom.

e. RESET is Ramsey's test for misspecification. It is distributed as $\chi 2$ with one degree of freedom.

Table 9: Full information estimate of both linear and nonlinear models for Russia

I. Linear ARDL Model								
Panel A: Short run Estimates								
Lag order	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
ΔLnY	-	-0.34**	-0.46**	-0.18**	0.18**	-0.31**	-0.31**	-0.67**
		(3.89)	(5.04)	(1.97)	(2.27)	(3.31)	(3.88)	(7.84)
ΔLnM	0.14**	0.02	-0.02	-0.11**	-0.01	-0.04	0.03	0.13**
	(4.00)	(0.55)	(0.52)	(3.46)	(0.36)	(1.34)	(1.04)	(4.74)
ΔLnG	0.03	0.22**	0.29**	0.30**	0.20**	0.22**		
	(0.92)	(5.86)	(7.16)	(7.42)	(5.00)	(6.74)		
$\Delta LnOP$	0.05**	0.05**	0.07**	0.06**	0.00	0.01	0.01	0.05**
	(4.78)	(4.74)	(5.30)	(4.78)	(0.02)	(0.93)	(1.00)	(4.49)
$\Delta LnREX$	-0.08**	0.00	-0.13**	-0.05*	0.09**	0.05*	-0.06**	
	(2.42)	(0.13)	(3.69)	(1.84)	(3.08)	(1.79)	(2.04)	
Panel B: Long run Estimates								
$\boldsymbol{Constant}$	$\boldsymbol{Trend}$	$\boldsymbol{LnM}$	$\boldsymbol{LnG}$	$\boldsymbol{LnOP}$	$\boldsymbol{LnREX}$			
29.89**	0.20**	0.82**	-0.83	0.03	-0.27**			
(3.82)	(2.15)	(2.76)	(1.48)	(0.28)	(2.04)			
Panel C: Diagnostic Statistics								
$\boldsymbol{F}$	$\boldsymbol{ECM_{t-1}}$	$\boldsymbol{LM}$	$\boldsymbol{RESET}$	$\boldsymbol{\bar{R}^2}$	$\boldsymbol{CUSUM(CUSUMSQ)}$			
7.35**	-0.31**	3.70	5.64**	0.99	S (S)			
	(7.73)							

Table 9 continued

II.Non-linear ARDL Model								
Panel A: Short run Estimates								
Lag order	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
ΔLnY	-	0.72**	0.28**	0.41**	0.34**	-0.36**	-0.34**	-0.81**
		(4.30)	(2.12)	(4.23)	(4.21)	(3.14)	(3.76)	(10.06)
ΔLnM	0.17**	-0.30**	-0.37**	-0.32**	-0.24**	-0.17**		
	(5.59)	(4.23)	(5.48)	(8.27)	(6.47)	(6.13)		
ΔLnG	-0.04	0.00	0.13**	0.02	0.02	0.06	-0.12**	-0.04
	(1.15)	(0.00)	(4.68)	(0.53)	(0.65)	(1.62)	(3.32)	(1.61)
$\Delta LnOP$	0.04**	-0.19**	-0.14**	-0.12**	-0.13**	-0.06**	-0.03**	0.04**
	(5.14)	(6.06)	(5.22)	(5.26)	(6.93)	(4.57)	(2.27)	(4.12)
ΔPOS	-0.30**	0.01	-0.43**	-0.10*	-0.08	-0.25**	-0.19**	-0.19**
	(5.59)	(0.11)	(7.02)	(1.67)	(1.14)	(3.81)	(3.47)	(3.14)
ΔNEG	-0.14**	0.46**	0.40**	0.35**	0.49**	0.33**	0.12**	0.15**
	(4.49)	(6.02)	(5.11)	(4.79)	(7.59)	(6.65)	(3.20)	(3.76)
Panel B: Long run Estimates								
$\boldsymbol{Constant}$	$\boldsymbol{Trend}$	$\boldsymbol{LnM}$	$\boldsymbol{LnG}$	$\boldsymbol{LnOP}$	$\boldsymbol{POS}$	$\boldsymbol{NEG}$		
20.07**	-0.01**	0.46**	-0.15**	0.18**	-0.14**	-0.43**		
(18.71)	(12.76)	(10.40)	(2.03)	(6.94)	(2.66)	(12.37)		
Panel C: Diagnostic Statistics								
$\boldsymbol{F}$	$\boldsymbol{ECM_{t-1}}$	$\boldsymbol{LM}$	$\boldsymbol{RESET}$	$\boldsymbol{\bar{R}^2}$	$\boldsymbol{CUSUM(CUSUMSQ)}$		$\boldsymbol{Wald-S}$	$\boldsymbol{Wald-L}$
10.00**	-1.50**	0.19	10.45**	0.998	S (S)		17.8**	19.9**
	(8.65)							

Notes:

a. Due to lack of data on wage rate, it had to be excluded.
b. Numbers inside parentheses are t-ratios. **, * denote significance at the 5% and 10% levels, respectively.
c. At the 10% (5%) significance level when there is one exogenous variable (k=4), the upper bound critical value of the F test is 3.52 (4.01). These come from Pesaran et al. (2001, Table CI, Case III, p. 300).
d. Number inside the parenthesis 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 -3.66 (-3.99) when k=4 and these come from Pesaran et al. (2001, Table CII, Case III, p. 303). In the nonlinear model where k=5, these critical values change to -3.86 (-4.19).
e. LM is Lagrange Multiplier test of residual serial correlation. It is distributed as $\chi 2$ 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 $\chi 2$ distribution with one degree of freedom.
   RESET is Ramsey's test for misspecification. It is distributed as $\chi 2$ with one degree of freedom.

Table 10: Full information estimates of both linear (L-ARDL) and nonlinear (NL-ARDL) models for bivariate model

	Antigua and Barbuda		Australia		Austria	
	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}						
$\Delta LnREX_t$	-.20 (1.00)		.00 (.12)		.04 (.30)	
$\Delta LnREX_{t-1}$					-.17 (1.31)	
$\Delta LnREX_{t-2}$					-.04 (.31)	
$\Delta LnREX_{t-3}$					.32 (2.40)**	
$\Delta LnREX_{t-4}$						
ΔPOS_t		.30 (0.51)		.02 (.50)		.27 (1.24)
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)
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)**
$LnREX_t$	-.46 (0.25)		-1276.1 (.00)		2.05 (.46)	
POS_t		7.52 (2.37)**		-1.16 (.24)		1.67 (6.31)**
NEG_t		2.02 (1.54)		-2.05 (.43)		-.60 (1.76)*
Panel C: Diagnostic Statistics						
F	1.37	4.41	2.01	1.29	1.03	2.77
ECM_{t-1}	-.06 (1.56)	-.25 (3.77)**	.00 (1.92)	-.02 (1.91)	-.02 (1.45)	-.37 (2.95)*
LM	.14	.47	.08	.07	2.67	.84
RESET	.59	1.45	.70	1.34	1.97	.37
CUSUM	S	S	S	S	S	S
CUSUMSQ	S	S	U	U	S	S
Wald-L		5.80 **		1.09		557.11**
Wald-S		2.08		.21		.04
Adjusted R^2	.07	.30	.08	.06	.16	.32

Notes:

a. Numbers inside 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 sizes (n=35).
c. Number inside the parenthesis 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 Lagrange Multiplier test of residual serial correlation. It is distributed as $\chi 2$ 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 $\chi 2$ distribution with one degree of freedom.
e. RESET is Ramsey's test for misspecification. It is distributed as $\chi 2$ with one degree of freedom.

Table 10 continued

	Bahrain		Belgium		Belize	
	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)
ΔLnY_{t-2}					-.39 (2.97)**	-.27 (2.30)**
ΔLnY_{t-3}					.16 (1.24)	.29 (2.71)**
ΔLnY_{t-4}						
$\Delta LnREX_t$	-.09(.90)		.01 (.10)		-.04 (.29)	
$\Delta LnREX_{t-1}$					-.85 (4.49)**	
$\Delta LnREX_{t-2}$					-.48 (2.50)**	
$\Delta LnREX_{t-3}$					-.53 (3.20)**	
$\Delta LnREX_{t-4}$						
ΔPOS_t		.81 (2.47)**		.17 (.83)		-.17 (.71)
ΔPOS_{t-1}						-1.24 (2.93)**
ΔPOS_{t-2}						-.76 (1.97)*
ΔPOS_{t-3}						
ΔPOS_{t-4}						
ΔNEG_t		-.32 (2.06)**		0.00 (0.02)		.18 (.88)
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	13.50 (8.40)**	2.88 (25.21)**	8.83 (.67)	3.85 (45.10)**	63.98 (2.57)**	1.88 (1.87)*
$LnREX_t$	-1.85 (5.69)**		-.69 (.24)		-13.09(2.38)**	
POS_t		1.12 (2.33)**		1.32 (4.17)**		22.86 (1.35)
NEG_t		-.98 (5.53)**		-.38 (1.60)		9.36 (1.01)
Panel C: Diagnostic Statistics						
F	3.34	2.88	2.98	2.72	11.00**	11.34**
ECM_{t-1}	-.08 (2.50)	-.22 (2.69)	-.02 (2.47)	-.21 (2.61)	.06 (4.80)**	-.07 (6.17)**
LM	.08	.14	.13	.28	3.72*	.39
RESET	.25	.15	.35	.04	2.29	4.23**
CUSUM	S	S	S	S	S	S
CUSUMSQ	U	U	S	S	S	S
Wald-L		14.82**		61.32**		2.99*
Wald-S		3.81**		.02		1.62
Adjusted R^2	.11	.18	.09	.08	.61	.78

Notes:

a. Numbers inside 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 sizes (n=35).
c. Number inside the parenthesis 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 Lagrange Multiplier test of residual serial correlation. It is distributed as $\chi2$ 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 $\chi2$ distribution with one degree of freedom.
e. RESET is Ramsey's test for misspecification. It is distributed as $\chi2$ with one degree of freedom.

Table 10 continued

	Bolivia		Brazil		Burundi	
	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL
Panel A: Short Run Estimates						
ΔLnY_t						
ΔLnY_{t-1}	.43 (2.54)**		.10 (.58)		.34 (2.11)**	.40 (2.56)**
ΔLnY_{t-2}			.03 (.16)			
ΔLnY_{t-3}			-.39 (2.31)**			
ΔLnY_{t-4}						
$\Delta LnREX_t$	-.01 (1.13)		.09 (2.69)**		.00 (.05)	
$\Delta LnREX_{t-1}$	-.03 (2.48)**		-.06 (1.59)			
$\Delta LnREX_{t-2}$						
$\Delta LnREX_{t-3}$						
$\Delta LnREX_{t-4}$						
ΔPOS_t		.11 (3.13)**		.04 (.60)		.01 (.06)
ΔPOS_{t-1}		-.14 (2.59)**				
ΔPOS_{t-2}						
ΔPOS_{t-3}						
ΔPOS_{t-4}						
ΔNEG_t		-.05 (2.03)*		.12 (2.43)**		.05 (.40)
ΔNEG_{t-1}						
ΔNEG_{t-2}						
ΔNEG_{t-3}						
ΔNEG_{t-4}						
Panel B: Long Run Estimates						
Constant	-6.61 (.78)	1.74 (6.12)**	2.83 (.12)	3.91 (24.06)**	3.27 (.26)	4.03 (17.42)**
$LnREX_t$	1.89 (1.21)		-1.50 (.16)		.42 (.13)	
POS_t		.71 (1.90)*		.24 (1.45)		.78 (1.10)
NEG_t		-1.17 (2.70)**		-.28 (1.47)		.18 (.51)
Panel C: Diagnostic Statistics						
F	3.33	24.90**	.08	1.78	1.46	1.96
ECM_{t-1}	.01 (2.63)	-.03 (8.00)**	.00 (.41)	-.19 (2.31)	-.03 (1.47)	-.13 (2.39)
LM	.13	4.60**	.98	.26	.01	.49
RESET	.14	3.31*	.28	1.26	5.94**	4.95**
CUSUM	S	S	S	S	S	U
CUSUMSQ	U	S	S	S	S	S
Wald-L		1.21		86.26**		6.19**
Wald-S		.17		.51		.10
Adjusted R^2	.73	.77	.21	.26	.11	.17

Notes:

a. Numbers inside 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 sizes (n=35).
c. Number inside the parenthesis next to ECMt-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 Lagrange Multiplier test of residual serial correlation. It is distributed as $\chi 2$ 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 $\chi 2$ distribution with one degree of freedom.
e. RESET is Ramsey's test for misspecification. It is distributed as $\chi 2$ with one degree of freedom.

Table 10 continued

	Cameroon		Canada		Chile	
	L-ARDL	**NL-ARDL**	**L-ARDL**	**NL-ARDL**	**L-ARDL**	**NL-ARDL**
Panel A: Short Run Estimates						
ΔLnY_t						
ΔLnY_{t-1}	.56 (5.55)**			.32 (2.34)**		.16 (1.37)
ΔLnY_{t-2}						-.08(.97)
ΔLnY_{t-3}						.09 (1.06)
ΔLnY_{t-4}						
$\Delta LnREX_t$	-.09 (1.95)*		-.03 (.65)		.34 (4.10)**	
$\Delta LnREX_{t-1}$						
$\Delta LnREX_{t-2}$						
$\Delta LnREX_{t-3}$						
$\Delta LnREX_{t-4}$						
ΔPOS_t		-.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		-.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	22.80 (1.49)	3.40 (25.73)**	14.30 (2.73)**	3.69 (51.50)**	9.88 (2.29)**	3.20 (11.29)**
$LnREX_t$	-3.85 (1.21)		-1.97 (1.78)*		-.94 (1.01)	
POS_t		4.42 (6.16)**		.34 (1.83)*		1.46 (4.90)**
NEG_t		2.09 (4.66)**		-.73 (5.18)**		-.53 (1.99)*
Panel C: Diagnostic Statistics						
F	7.24**	43.87**	3.90	3.78	14.68**	8.47**
ECM_{t-1}	-.02 (3.86)**	.11 (12.09)**	-.03 (2.64)	-.21 (3.43)*	-.03 (2.48)	-.14 (5.00)**
LM	.03	.20	2.21	.16	5.49*	.33
RESET	.30	6.89**	1.11	3.57*	.91	1.22
CUSUM	U	S	S	S	U	S
CUSUMSQ	U	S	S	S	S	S
Wald-L		56.40**		231.10**		122.63**
Wald-S		2.80*		.28		8.22**
Adjusted R^2	.72	.91	.10	.24	.34	.65

Notes:

a. Numbers inside 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 sizes (n=35).

c. Number inside the parenthesis next to ECMt-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 Lagrange Multiplier test of residual serial correlation. It is distributed as χ2 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 χ2 distribution with one degree of freedom.

e. RESET is Ramsey's test for misspecification. It is distributed as χ2 with one degree of freedom.

Table 10 continued

	China		Colombia		Costa Rica	
	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)
ΔLnY_{t-2}	-.33 (1.68)*				-.36 (2.73)**	-.50 (2.66)**
ΔLnY_{t-3}						-.38 (1.85)*
ΔLnY_{t-4}						
$\Delta LnREX_t$	-.04 (1.07)		.06 (.86)		-.06 (.69)	
$\Delta LnREX_{t-1}$						
$\Delta LnREX_{t-2}$						
$\Delta LnREX_{t-3}$						
$\Delta LnREX_{t-4}$						
ΔPOS_t		-.53 (4.71)**		.16 (.89)		.31 (1.57)
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)
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)**
$LnREX_t$	-3.31 (.40)		.34 (.18)		10.42 (.83)	
POS_t		3.74 (7.15)**		.52 (1.86)*		1.38 (1.32)
NEG_t		.57 (1.52)		-.14 (.43)		-1.76 (1.27)
Panel C: Diagnostic Statistics						
F	.13	2.89	.25	1.23	1.27	.82
ECM_{t-1}	.00 (.35)	.03 (2.19)	-.01 (.50)	-.14 (1.81)	0.01 (1.62)	-.09 (1.67)
LM	1.24	2.08	.05	.77	1.19	3.09*
RESET	.53	1.87	8.69**	.31	3.61*	.23
CUSUM	S	S	S	S	S	S
CUSUMSQ	U	S	U	U	S	S
Wald-L		73.19**		28.80**		28.74**
Wald-S		26.14**		.31		.79
Adjusted R^2	.08	.42	.11	.17	.14	.36

Notes:

a. Numbers inside 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 sizes (n=35).

c. Number inside the parenthesis next to ECMt-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 Lagrange Multiplier test of residual serial correlation. It is distributed as $\chi 2$ 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 $\chi 2$ distribution with one degree of freedom.

e. RESET is Ramsey's test for misspecification. It is distributed as $\chi 2$ with one degree of freedom.

Table 10 continued

	Cote d'Ivoire		Cyprus		Denmark	
	L-ARDL	**NL-ARDL**	**L-ARDL**	**NL-ARDL**	**L-ARDL**	**NL-ARDL**
Panel A: Short Run Estimates						
ΔLnY_t						
ΔLnY_{t-1}	.39 (2.16)**	.40 (2.34)**				
ΔLnY_{t-2}						
ΔLnY_{t-3}						
ΔLnY_{t-4}						
$\Delta LnREX_t$	-.02 (.30)		.11 (.69)		-.08 (.69)	
$\Delta LnREX_{t-1}$						
$\Delta LnREX_{t-2}$						
$\Delta LnREX_{t-3}$						
$\Delta LnREX_{t-4}$						
ΔPOS_t		.04 (.29)		.58 (1.77)*		-.34 (1.69)*
ΔPOS_{t-1}				.17 (.57)		-.40 (2.09)**
ΔPOS_{t-2}				.35 (1.20)		
ΔPOS_{t-3}				.80 (2.37)**		
ΔPOS_{t-4}						
ΔNEG_t		-.04 (.60)		-.60 (2.00)*		.10 (.52)
ΔNEG_{t-1}						.56 (2.62)**
ΔNEG_{t-2}						.31 (1.47)
ΔNEG_{t-3}						
ΔNEG_{t-4}						
Panel B: Long Run Estimates						
Constant	-27.63 (.14)	4.01 (11.27)**	12.31 (1.41)	5.55 (.82)	-704.35 (.03)	4.38 (13.25)**
$LnREX_t$	6.46 (.16)		-1.66 (.87)		151.17(.03)	
POS_t		-.30 (.12)		-15.37 (.30)		-.91(.58)
NEG_t		-1.05 (.43)		-3.39 (.43)		-2.53 (1.42)
Panel C: Diagnostic Statistics						
F	.81	1.29	12.27**	11.30**	2.20	3.02
ECM_{t-1}	.01 (1.22)	-.07 (1.83)	-.05 (4.86)**	-.02 (6.08)**	.00 (2.12)	-.12 (3.09)
LM	1.06	.40	.39	.00	.58	.06
RESET	8.44**	5.83**	.63	.25	.22	1.55
CUSUM	S	S	S	S	S	S
CUSUMSQ	U	U	S	S	S	S
Wald-L		3.94**		.06		25.14**
Wald-S		.43		6.41**		8.43**
Adjusted R^2	.13	.16	.39	.52	.05	.19

Notes:

a. Numbers inside 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 sizes (n=35).

c. Number inside the parenthesis next to ECMt-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 Lagrange Multiplier test of residual serial correlation. It is distributed as $\chi 2$ 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 $\chi 2$ distribution with one degree of freedom.

e. RESET is Ramsey's test for misspecification. It is distributed as $\chi 2$ with one degree of freedom.

Table 10 continued

	Dominica		Dominican Republic		Ecuador	
	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)	-.39 (1.89)*	-.54 (3.31)**
ΔLnY_{t-2}		.00 (.03)	-.49 (2.78)**	-.41 (2.32)**		
ΔLnY_{t-3}		.45 (3.71)**				
ΔLnY_{t-4}						
$\Delta LnREX_t$	-.75 (3.11)**		.16 (2.76)**		.09 (1.85)*	
$\Delta LnREX_{t-1}$	.29 (1.28)		.04 (.78)			
$\Delta LnREX_{t-2}$			.11 (2.15)**			
$\Delta LnREX_{t-3}$						
$\Delta LnREX_{t-4}$						
ΔPOS_t		-1.43 (3.33)**		.15 (1.28)		-.11 (1.29)
ΔPOS_{t-1}		-.63 (2.04)*				-.10 (1.40)
ΔPOS_{t-2}		-.57 (2.24)**				
ΔPOS_{t-3}		.55 (2.45)**				
ΔPOS_{t-4}						
ΔNEG_t		.13 (.49)		.12 (1.58)		.26 (4.19)**
ΔNEG_{t-1}		.77 (2.62)**				-.02 (.25)
ΔNEG_{t-2}						-.19 (2.98)**
ΔNEG_{t-3}						
ΔNEG_{t-4}						
Panel B: Long Run Estimates						
Constant	9.25 (6.66)**	3.93 (22.28)**	31.68 (.22)	4.24 (3.80)**	6.32 (.67)	4.49 (7.37)**
$LnREX_t$	-1.01 (3.42)**		-9.33 (.22)		-1.10 (.46)	
POS_t		.18 (.49)		2.68 (1.81)*		1.31 (1.94)*
NEG_t		-.84 (4.41)**		1.07 (.76)		.38 (.74)
Panel C: Diagnostic Statistics						
F	2.87	14.71**	.56	1.02	.91	1.93
ECM_{t-1}	-.09 (2.25)	-.60 (7.00)**	.00 (1.06)	-.06 (1.81)	.01 (.48)	-.08 (2.51)
LM	.00	.49	.54	.64	.10	.02
RESET	.00	.19	2.59	.02	4.48**	8.91**
CUSUM	S	S	S	S	S	S
CUSUMSQ	S	S	S	S	S	S
Wald-L		21.30**		15.23**		13.66**
Wald-S		7.95**		.03		3.10*
Adjusted R^2	.22	.73	.25	.19	.05	.40

Notes:

a. Numbers inside 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 sizes (n=35).

c. Number inside the parenthesis next to ECMt-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 Lagrange Multiplier test of residual serial correlation. It is distributed as $\chi 2$ 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 $\chi 2$ distribution with one degree of freedom.

e. RESET is Ramsey's test for misspecification. It is distributed as $\chi 2$ with one degree of freedom.

Table 10 continued

	Fiji		Finland		France	
	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL
Panel A: Short Run Estimates						
ΔLnY_t						
ΔLnY_{t-1}	-.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}						
$\Delta LnREX_t$	.17 (1.70)*		-.04 (.45)		-.20 (3.29)**	
$\Delta LnREX_{t-1}$						
$\Delta LnREX_{t-2}$						
$\Delta LnREX_{t-3}$						
$\Delta LnREX_{t-4}$						
ΔPOS_t		-.50 (1.40)		.28 (1.28)		.06 (.57)
ΔPOS_{t-1}				-.62 (2.85)**		
ΔPOS_{t-2}				-.48 (2.10)**		
ΔPOS_{t-3}						
ΔPOS_{t-4}						
ΔNEG_t		.32 (2.98)**		.26 (1.81)*		-.33 (3.25)**
ΔNEG_{t-1}				.23 (1.47)		
ΔNEG_{t-2}				.34 (2.16)**		
ΔNEG_{t-3}						
ΔNEG_{t-4}						
Panel B: Long Run Estimates						
Constant	11.06 (5.53)**	4.12 (54.36)**	17.72 (3.13)**	3.82 (59.68)**	21.54 (5.09)**	3.77 (71.97)**
$LnREX_t$	-1.30 (3.20)**		-2.81 (2.35)**		-3.63 (3.97)**	
POS_t		.73 (1.98)*		1.07 (4.42)**		.50 (1.45)
NEG_t		-.54 (2.88)**		-.11 (.63)		-1.07 (4.35)**
Panel C: Diagnostic Statistics						
F	4.29	5.43*	5.41*	6.54**	11.99**	4.30
ECM_{t-1}	-.12 (2.86)	-.36 (4.10)**	-.05 (3.33)*	-.35 (4.57)**	-.05 (4.90)**	-.25 (3.57)*
LM	1.74	1.04	2.53	1.34	1.84	.04
RESET	.37	.09	.57	4.56**	.73	.57
CUSUM	S	S	S	S	S	S
CUSUMSQ	S	S	U	U	S	S
Wald-L		35.62**		238.32**		132.74**
Wald-S		4.05**		9.45**		2.35
Adjusted R^2	.37	.52	.35	.47	.37	.40

Notes:

a. Numbers inside 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 sizes (n=35).
c. Number inside the parenthesis next to ECMt-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 Lagrange Multiplier test of residual serial correlation. It is distributed as $\chi 2$ 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 $\chi 2$ distribution with one degree of freedom.
e. RESET is Ramsey's test for misspecification. It is distributed as $\chi 2$ with one degree of freedom.

Table 10 continued

	Germany		Greece		Grenada	
	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL
Panel A: Short Run Estimates						
ΔLnY_t	.26 (1.68)*	.37 (2.34)**	.49 (3.60)**	.47 (3.19)**		
ΔLnY_{t-1}	-.25 (1.66)*			.09 (.55)		
ΔLnY_{t-2}				.36 (2.40)**		
ΔLnY_{t-3}						
ΔLnY_{t-4}	-.05 (.51)		-.15 (1.11)		-.11 (.50)	
$\Delta LnREX_t$						
$\Delta LnREX_{t-1}$						
$\Delta LnREX_{t-2}$		-.02 (.07)		.23 (.69)		.15 (.35)
$\Delta LnREX_{t-3}$						
$\Delta LnREX_{t-4}$						
ΔPOS_t				-.47 (1.66)*		
ΔPOS_{t-1}						
ΔPOS_{t-2}						
ΔPOS_{t-3}						
ΔPOS_{t-4}		-.05 (.27)		-.25 (1.35)		-.24 (.54)
ΔNEG_t	.26 (1.68)*		.49 (3.60)**			
ΔNEG_{t-1}						
ΔNEG_{t-2}						
ΔNEG_{t-3}						
ΔNEG_{t-4}		.37 (2.34)**		.47 (3.19)**		
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)**
$LnREX_t$	-2.32 (98)		17.59 (.21)		5.59 (.29)	
POS_t		.86 (1.60)		.48 (1.07)		3.81 (1.59)
NEG_t		-.62 (1.59)		-.73 (1.20)		-.14 (.09)
Panel C: Diagnostic Statistics						
F	1.05	1.97	1.76	2.46	1.24	1.04
ECM_{t-1}	-.03 (1.45)	-.23 (2.47)	.01 (1.57)	-.17 (2.78)	-.02 (1.39)	-.03 (.90)
LM	.18	.33	.91	.00	.08	.00
RESET	.00	1.05	2.01	3.33*	.04	3.53*
CUSUM	S	S	U	S	S	S
CUSUMSQ	S	S	S	S	U	U
Wald-L		89.68**		25.69**		3.03*
Wald-S		.01		5.01**		.03
Adjusted R^2	.07	.10	.29	.35	.01	-.05

Notes:

a. Numbers inside 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 sizes (n=35).

c. Number inside the parenthesis next to ECMt-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 Lagrange Multiplier test of residual serial correlation. It is distributed as $\chi 2$ 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 $\chi 2$ distribution with one degree of freedom.

e. RESET is Ramsey's test for misspecification. It is distributed as $\chi 2$ with one degree of freedom.

Table 10 continued

	Iceland		India		Indonesia	
	L-ARDL	**NL-ARDL**	**L-ARDL**	**NL-ARDL**	**L-ARDL**	**NL-ARDL**
Panel A: Short Run Estimates						
ΔLnY_t						
ΔLnY_{t-1}	.32 (2.47)**	.22 (1.61)			.58 (3.88)**	
ΔLnY_{t-2}					-.35 (2.60)**	
ΔLnY_{t-3}						
ΔLnY_{t-4}						
$\Delta LnREX_t$	.21 (3.95)**		.06 (1.09)		.15 (6.45)**	
$\Delta LnREX_{t-1}$					-.06 (2.03)**	
$\Delta LnREX_{t-2}$						
$\Delta LnREX_{t-3}$						
$\Delta LnREX_{t-4}$						
ΔPOS_t		.12 (.74)		-.03 (.23)		-.14 (3.60)**
ΔPOS_{t-1}		-.03 (.24)				-.09 (2.25)**
ΔPOS_{t-2}		.45 (3.46)**				-.08 (2.01)**
ΔPOS_{t-3}		.25 (1.95)*				
ΔPOS_{t-4}						
ΔNEG_t		.13 (1.38)		.13 (1.45)		.22 (9.33)**
ΔNEG_{t-1}		.29 (3.10)**		.10 (1.14)		
ΔNEG_{t-2}				-.23 (2.59)**		
ΔNEG_{t-3}				.21 (2.51)**		
ΔNEG_{t-4}						
Panel B: Long Run Estimates						
Constant	-106.71 (.13)	1.72 (.33)	-1.39 (.18)	.49 (.20)	12.58 (3.27)**	5.22 (3.15)**
$LnREX_t$	24.89 (.14)		.23 (.18)		-2.40 (1.99)*	
POS_t		5.65 (.41)		2.73 (1.67)		.73 (1.30)
NEG_t		2.90 (.31)		.00 (.00)		.02 (.05)
Panel C: Diagnostic Statistics						
F	1.09	.63	5.53*	.91	2.67	5.37*
ECM_{t-1}	.00 (1.50)	.02 (1.42)	.02 (3.27)*	.03 (1.70)	.02 (2.32)	-.04 (4.13)**
LM	.09	.01	.69	.00	.02	.00
RESET	1.95	.20	.34	9.55**	19.99**	16.80**
CUSUM	S	S	S	S	U	S
CUSUMSQ	S	S	U	S	U	U
Wald-L		.35		6.83**		7.11**
Wald-S		1.49		.76		33.14**
Adjusted R^2	.37	.48	.24	.27	.54	.72

Notes:

a. Numbers inside 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 sizes (n=35).
c. Number inside the parenthesis next to ECMt-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 Lagrange Multiplier test of residual serial correlation. It is distributed as $\chi 2$ 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 $\chi 2$ distribution with one degree of freedom.
e. RESET is Ramsey's test for misspecification. It is distributed as $\chi 2$ with one degree of freedom.

Table 10 continued

	Iran		Ireland		Israel	
	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL
Panel A: Short Run Estimates						
ΔLnY_t						
ΔLnY_{t-1}	.33 (2.23)**	.37 (2.88)**	.89 (3.70)**	.96 (6.41)**		.39 (1.45)
ΔLnY_{t-2}	-.18 (1.16)	-.08 (.58)	-.45 (2.00)*			.20 (1.39)
ΔLnY_{t-3}	-.53 (3.46)**	-.32 (2.53)**				
ΔLnY_{t-4}						
$\Delta LnREX_t$	-.08 (2.21)**		-.37 (2.49)**		-.06 (.45)	
$\Delta LnREX_{t-1}$					-.20 (1.35)	
$\Delta LnREX_{t-2}$					.15 (1.17)	
$\Delta LnREX_{t-3}$					-.27 (2.01)**	
$\Delta LnREX_{t-4}$						
ΔPOS_t		-.07 (.71)		-.08 (.27)		.24 (.92)
ΔPOS_{t-1}						.06 (.29)
ΔPOS_{t-2}						-.32 (1.57)
ΔPOS_{t-3}						-.59 (3.07)**
ΔPOS_{t-4}						
ΔNEG_t		-.03 (.78)		-.52 (2.19)**		-.52 (1.69)*
ΔNEG_{t-1}				.50 (1.99)*		-.63 (3.13)**
ΔNEG_{t-2}				.62 (2.48)**		.49 (2.66)**
ΔNEG_{t-3}				.62 (2.31)**		
ΔNEG_{t-4}						
Panel B: Long Run Estimates						
Constant	.40 (.10)	3.37 (30.18)**	300.05 (.33)	3.38 (26.91)**	38.80 (1.13)	2.46 (10.16)**
$LnREX_t$	.59 (.81)		-62.78 (.32)		-7.06 (.99)	
POS_t		.25 (1.78)*		-.10 (.17)		1.07 (1.42)
NEG_t		-.19 (1.51)		-3.07 (5.32)**		-1.06 (1.64)
Panel C: Diagnostic Statistics						
F	4.16	5.54*	1.58	7.47**	.45	2.21
ECM_{t-1}	.05 (2.94)*	-.16 (4.24)**	.00 (1.77)	-.27 (4.95)**	-.02 (.96)	-.22 (2.67)
LM	2.30	2.95*	.40	.88	.13	1.46
RESET	1.52	1.76	.27	3.30*	7.39	5.76**
CUSUM	S	U	S	S	S	S
CUSUMSQ	U	U	U	S	U	S
Wald-L		13.94**		479.83**		106.24**
Wald-S		.08		2.31		.00
Adjusted R^2	.44	.55	.49	.66	.20	.54

Notes:

a. Numbers inside 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 sizes (n=35).
c. Number inside the parenthesis next to ECMt-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 Lagrange Multiplier test of residual serial correlation. It is distributed as $\chi 2$ 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 $\chi 2$ distribution with one degree of freedom.
e. RESET is Ramsey's test for misspecification. It is distributed as $\chi 2$ with one degree of freedom.

Table 10 continued

	Italy		Japan		Korea	
	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL
Panel A: Short Run Estimates						
ΔLnY_t						
ΔLnY_{t-1}				.33 (2.51)**		
ΔLnY_{t-2}						
ΔLnY_{t-3}						
ΔLnY_{t-4}						
$\Delta LnREX_t$	-.10 (1.70)*		.02 (.72)		-.03 (.65)	
$\Delta LnREX_{t-1}$			-.08 (2.54)**		.13 (3.33)**	
$\Delta LnREX_{t-2}$						
$\Delta LnREX_{t-3}$						
$\Delta LnREX_{t-4}$						
ΔPOS_t		-.04 (.28)		-.01 (.21)		-.14 (1.61)
ΔPOS_{t-1}				-.20 (3.37)**		-.17 (2.01)**
ΔPOS_{t-2}				.06 (.97)		.15 (1.95)*
ΔPOS_{t-3}				-.09 (1.74)*		
ΔPOS_{t-4}						
ΔNEG_t		-.17 (1.81)*		.08 (1.64)		.08 (1.92)*
ΔNEG_{t-1}						.17 (3.42)**
ΔNEG_{t-2}						-.15 (3.10)**
ΔNEG_{t-3}						
ΔNEG_{t-4}						
Panel B: Long Run Estimates						
Constant	7.92 (1.70)*	1.74 (.17)	.43 (.31)	3.77 (26.77)**	15.35 (2.42)**	-16.03 (.22)
$LnREX_t$	-.70 (.70)		.93 (3.02)**		-2.07 (1.49)	
POS_t		5.29 (.25)		.89 (6.89)**		13.15 (.24)
NEG_t		.93 (.15)		.54 (3.54)**		2.75 (.13)
Panel C: Diagnostic Statistics						
F	8.59**	4.91*	15.68**	3.29	13.88**	10.80**
ECM_{t-1}	-.05 (4.19)**	.01 (3.93)**	-.08 (5.49)**	-.15 (3.24)*	-.03 (5.33)**	.01 (5.85)**
LM	.43	.11	1.50	2.52	.13	.04
RESET	.29	.34	1.30	2.58	5.73**	.13
CUSUM	S	S	S	S	S	S
CUSUMSQ	S	S	S	S	U	S
Wald-L		.41		17.58**		.02
Wald-S		.35		3.37*		1.96
Adjusted R^2	.31	.33	.39	.44	.41	.61

Notes:

a. Numbers inside 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 sizes (n=35).

c. Number inside the parenthesis next to ECMt-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 Lagrange Multiplier test of residual serial correlation. It is distributed as $\chi 2$ 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 $\chi 2$ distribution with one degree of freedom.

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Table 10 continued

	Lesotho		Luxembourg		Malawi	
	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)
ΔLnY_{t-2}					.25 (1.67)*	.46 (2.63)**
ΔLnY_{t-3}					-.23 (1.54)	
ΔLnY_{t-4}						
$\Delta LnREX_t$	-.16 (.53)		-.11 (.70)		.11 (1.70)*	
$\Delta LnREX_{t-1}$					.04 (.51)	
$\Delta LnREX_{t-2}$					.24 (3.23)**	
$\Delta LnREX_{t-3}$						
$\Delta LnREX_{t-4}$						
ΔPOS_t		-.49 (.83)		-.23 (1.31)		.25 (1.69)
ΔPOS_{t-1}						.61 (3.95)**
ΔPOS_{t-2}						.39 (3.08)**
ΔPOS_{t-3}						
ΔPOS_{t-4}						
ΔNEG_t		.02 (.04)		.21 (.51)		-.08 (.90)
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)**
$LnREX_t$	-.63 (.78)		-5.09 (1.05)		-1.13 (6.12)**	
POS_t		-.38 (.26)		-3.56 (.72)		-1.76 (2.77)**
NEG_t		-.52 (.65)		-5.11 (1.34)		-1.46 (3.86)**
Panel C: Diagnostic Statistics						
F	1.78	1.23	2.27	1.01	4.42	9.28**
ECM_{t-1}	-.11 (1.92)	-.12 (1.92)	-.02 (1.73)	-.03 (1.73)	-.22 (3.04)*	-.37 (5.60)**
LM	.00	.03	.00	.15	1.60	1.79
RESET	.14	.01	4.08**	.48	3.41*	6.18**
CUSUM	S	S	S	S	S	S
CUSUMSQ	U	U	S	S	S	S
Wald-L		.06		.01		1.38
Wald-S		.59		.58		4.35**
Adjusted R^2	.05	.06	.06	.09	.44	.65

Notes:

a. Numbers inside 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 sizes (n=35).

c. Number inside the parenthesis next to ECMt-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 Lagrange Multiplier test of residual serial correlation. It is distributed as χ2 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 χ2 distribution with one degree of freedom.

e. RESET is Ramsey's test for misspecification. It is distributed as χ2 with one degree of freedom.

Table 10 continued

	Malaysia		Malta		Mexico	
	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL
Panel A: Short Run Estimates						
ΔLnY_t						
ΔLnY_{t-1}		.15 (1.23)	.31 (2.12)**	.31 (2.45)**		
ΔLnY_{t-2}		.05 (.45)		.29 (2.45)**		
ΔLnY_{t-3}		.31 (2.64)**				
ΔLnY_{t-4}						
$\Delta LnREX_t$	.24 (3.07)**		-.33 (2.87)**		.11 (4.21)**	
$\Delta LnREX_{t-1}$			.04 (.28)		.08 (3.17)**	
$\Delta LnREX_{t-2}$			-.19 (1.60)			
$\Delta LnREX_{t-3}$			-.23 (1.81)*			
$\Delta LnREX_{t-4}$						
ΔPOS_t		-.07 (.30)		-.17 (90)		0.00 (.07)
ΔPOS_{t-1}		-.60 (2.62)**				
ΔPOS_{t-2}		-.40 (1.85)*				
ΔPOS_{t-3}		-.55 (2.45)**				
ΔPOS_{t-4}						
ΔNEG_t		.48 (5.03)**		-.18 (1.05)		.13 (3.51)**
ΔNEG_{t-1}				.63 (2.74)*		.15 (4.51)**
ΔNEG_{t-2}				.19 (.89)		
ΔNEG_{t-3}						
ΔNEG_{t-4}						
Panel B: Long Run Estimates						
Constant	16.05 (6.46)**	3.04 (10.11)**	4.88 (.28)	2.83 (63.98)**	-.40 (.08)	4.75 (4.16)**
$LnREX_t$	-2.27 (4.13)**		.19 (.05)		1.23 (1.14)	
POS_t		3.38 (4.39)**		.72 (6.11)**		.23 (.42)
NEG_t		-.37 (1.07)		-1.81 (22.8)**		.05 (.10)
Panel C: Diagnostic Statistics						
F	5.15*	4.71	1.34	6.52**	7.46**	5.67*
ECM_{t-1}	-.05 (3.24)*	-.17 (3.91)**	-.02 (1.66)	-.37 (4.53)**	-.03 (3.91)**	-.06 (4.24)**
LM	.94	3.16*	.98	3.73*	.02	.03
RESET	8.32**	9.33**	.76	.37	2.25	3.36*
CUSUM	S	S	S	S	S	S
CUSUMSQ	S	S	S	S	S	S
Wald-L		64.61**		772.05**		.43
Wald-S		9.46**		2.53		6.18**
Adjusted R^2	.35	.55	.67	.77	.50	.54

Notes:

a. Numbers inside 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 sizes (n=35).

c. Number inside the parenthesis next to ECMt-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 Lagrange Multiplier test of residual serial correlation. It is distributed as $\chi2$ 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 $\chi2$ distribution with one degree of freedom.

e. RESET is Ramsey's test for misspecification. It is distributed as $\chi2$ with one degree of freedom.

Table 10 continued

	Netherlands		New Zealand		Norway	
	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL
Panel A: Short Run Estimates						
ΔLnY_t						
ΔLnY_{t-1}	.27 (1.81)*	.39 (2.81)**			.39 (2.50)**	.38 (2.79)**
ΔLnY_{t-2}					-.09 (.54)	.14 (.93)
ΔLnY_{t-3}					-.28 (1.80)*	-.25 (1.95)*
ΔLnY_{t-4}						
$\Delta LnREX_t$	-.11 (1.25)		.02 (.44)		-.21 (2.66)**	
$\Delta LnREX_{t-1}$			.07 (1.50)			
$\Delta LnREX_{t-2}$			.08 (1.75)*			
$\Delta LnREX_{t-3}$						
$\Delta LnREX_{t-4}$						
ΔPOS_t		-.16 (.84)		.06 (.66)		-.28 (1.99)*
ΔPOS_{t-1}						.01 (.06)
ΔPOS_{t-2}						.39 (2.95)**
ΔPOS_{t-3}						
ΔPOS_{t-4}						
ΔNEG_t		.00 (.00)		.00 (.01)		-.09 (.71)
ΔNEG_{t-1}				.11 (1.51)		.09 (.44)
ΔNEG_{t-2}				.13 (1.81)*		.04 (.19)
ΔNEG_{t-3}						.40 (2.63)**
ΔNEG_{t-4}						
Panel B: Long Run Estimates						
Constant	32.49 (1.48)	3.81 (17.23)**	-23.01 (1.46)	3.80 (18.90)**	37.42 (3.70)**	3.88 (28.95)**
$LnREX_t$	-5.93 (1.26)		5.74 (1.71)*		-7.06 (3.22)**	
POS_t		.54 (.58)		-.24 (.31)		-1.39 (2.08)**
NEG_t		-1.07 (1.40)		-1.10 (1.20)		-3.74 (6.67)**
Panel C: Diagnostic Statistics						
F	1.58	1.99	.69	.77	5.81*	4.20
ECM_{t-1}	-.01 (1.78)	-.13 (2.47)	.01 (1.08)	-.07 (1.44)	-.03 (3.46)**	-.18 (3.68)**
LM	.33	.26	.05	.10	.19	1.35
RESET	.11	.10	.05	.61	.02	.92
CUSUM	S	S	S	S	S	S
CUSUMSQ	S	S	U	U	S	S
Wald-L		38.36**		46.06**		207.60**
Wald-S		.35		.59		.31
Adjusted R^2	.14	.18	.04	.04	.45	.62

Notes:

a. Numbers inside 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 sizes (n=35).

c. Number inside the parenthesis next to ECMt-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 Lagrange Multiplier test of residual serial correlation. It is distributed as $\chi 2$ 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 $\chi 2$ distribution with one degree of freedom.

e. RESET is Ramsey's test for misspecification. It is distributed as $\chi 2$ with one degree of freedom.

Table 10 continued

	Pakistan		Paraguay		Philippines	
	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL
Panel A: Short Run Estimates						
ΔLnY_t						
ΔLnY_{t-1}	.34 (2.00)**	.28 (1.78)*		.26 (1.53)	.58 (3.44)**	.71 (4.18)**
ΔLnY_{t-2}				.31 (1.68)	-.31 (1.80)*	-.22 (1.29)
ΔLnY_{t-3}				.68 (3.50)**		
ΔLnY_{t-4}						
$\Delta LnREX_t$	.04 (.63)		.10 (1.24)		.04 (.56)	
$\Delta LnREX_{t-1}$					.09 (1.58)	
$\Delta LnREX_{t-2}$						
$\Delta LnREX_{t-3}$						
$\Delta LnREX_{t-4}$						
ΔPOS_t		.04 (.28)		.24 (1.49)		.33 (2.04)**
ΔPOS_{t-1}				-.50 (2.92)**		
ΔPOS_{t-2}				-.35 (1.80)*		
ΔPOS_{t-3}				-.35 (2.09)**		
ΔPOS_{t-4}						
ΔNEG_t		.05 (.64)		-.06 (.54)		-.09 (.93)
ΔNEG_{t-1}				.17 (1.62)		
ΔNEG_{t-2}				.26 (2.20)**		
ΔNEG_{t-3}				.24 (2.22)**		
ΔNEG_{t-4}						
Panel B: Long Run Estimates						
Constant	-7.34 (.12)	3.52 (8.74)**	-25.87 (.17)	3.71 (79.26)**	-7.53 (.45)	3.39 (24.55)**
$LnREX_t$	3.90 (.23)		8.14 (.20)		2.14 (.63)	
POS_t		1.96 (3.07)**		.62 (8.42)**		1.63 (2.75)**
NEG_t		-.72 (1.97)*		-.33 (5.47)**		.06 (.14)
Panel C: Diagnostic Statistics						
F	1.36	3.51	.07	6.93**	.92	1.12
ECM_{t-1}	.00 (1.66)	-.11 (3.19)	.00 (.28)	-.72 (4.85)**	.01 (1.37)	-.05 (1.88)
LM	.29	.57	.00	12.64**	.21	.73
RESET	2.48	2.71*	7.28**	1.57	6.08**	9.06**
CUSUM	S	S	S	S	S	S
CUSUMSQ	S	S	S	U	S	S
Wald-L		53.66		523.97**		5.69**
Wald-S		.16		7.64**		3.17*
Adjusted R^2	.22	.35	-.01	.53	.31	.34

Notes:

a. Numbers inside 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 sizes (n=35).
c. Number inside the parenthesis next to ECMt-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 Lagrange Multiplier test of residual serial correlation. It is distributed as χ2 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 χ2 distribution with one degree of freedom.
e. RESET is Ramsey's test for misspecification. It is distributed as χ2 with one degree of freedom.

Table 10 continued

	Portugal		Saudi Arabia		Sierra Leone	
	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL
Panel A: Short Run Estimates						
ΔLnY_t						
ΔLnY_{t-1}						
ΔLnY_{t-2}						
ΔLnY_{t-3}						
ΔLnY_{t-4}						
$\Delta LnREX_t$	.22 (1.07)		-.27 (2.77)**		-.06 (70)	
$\Delta LnREX_{t-1}$						
$\Delta LnREX_{t-2}$						
$\Delta LnREX_{t-3}$						
$\Delta LnREX_{t-4}$						
ΔPOS_t		.53 (1.71)*		-.25 (1.10)		.27 (1.10)
ΔPOS_{t-1}						
ΔPOS_{t-2}						
ΔPOS_{t-3}						
ΔPOS_{t-4}						
ΔNEG_t		-.30 (.66)		-.32 (2.98)**		-.13 (1.27)
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)
$LnREX_t$	.27 (.21)		-47.30 (.11)		.21 (.34)	
POS_t		.14 (.12)		-2.70 (.36)		23.92 (.18)
NEG_t		-.86 (.34)		-4.42 (.72)		5.23 (.18)
Panel C: Diagnostic Statistics						
F	4.03	2.00	15.53**	18.32**	.75	3.87
ECM_{t-1}	-.10 (2.88)	-.13 (2.52)	-.003 (5.66)**	-.04 (7.59)**	.07 (1.24)	-.01 (3.36)*
LM	.13	.01	1.31	.28	1.71	.04
RESET	7.30**	4.47**	.38	.10	1.14	3.97**
CUSUM	S	S	S	S	S	S
CUSUMSQ	U	U	U	U	S	U
Wald-L		.73		4.26**		.01
Wald-S		1.35		.03		.59
Adjusted R^2	.16	.17	.47	.63	-.01	.22

Notes:

a. Numbers inside 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 sizes (n=35).
c. Number inside the parenthesis next to ECMt-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 Lagrange Multiplier test of residual serial correlation. It is distributed as $\chi 2$ 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 $\chi 2$ distribution with one degree of freedom.
e. RESET is Ramsey's test for misspecification. It is distributed as $\chi 2$ with one degree of freedom.

Table 10 continued

	Singapore		South Africa		Spain	
	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)	.32 (2.20)**	.42 (2.71)**	.50 (3.90)**	.39 (3.23)**
ΔLnY_{t-2}	-.35 (3.12)**	-.32 (2.94)**				
ΔLnY_{t-3}		.17 (1.62)				
ΔLnY_{t-4}						
$\Delta LnREX_t$	.37 (5.12)**		-.01 (.23)		-.01 (.12)	
$\Delta LnREX_{t-1}$			.09 (2.26)**			
$\Delta LnREX_{t-2}$						
$\Delta LnREX_{t-3}$						
$\Delta LnREX_{t-4}$						
ΔPOS_t		.41 (2.52)**		.04 (.56)		.02 (.15)
ΔPOS_{t-1}						
ΔPOS_{t-2}						
ΔPOS_{t-3}						
ΔPOS_{t-4}						
ΔNEG_t		.46 (3.77)**		.02 (.32)		.03 (.27)
ΔNEG_{t-1}						.28 (2.34)**
ΔNEG_{t-2}						
ΔNEG_{t-3}						
ΔNEG_{t-4}						
Panel B: Long Run Estimates						
Constant	15.22 (3.22)**	3.41 (1.95)*	11.61 (4.30)**	3.77 (43.55)**	-52.75 (.48)	3.96 (15.79)**
$LnREX_t$	-1.87 (1.79)*		-1.46 (2.81)**		12.18 (.52)	
POS_t		-.12 (.07)		.60 (2.21)**		-.63 (.77)
NEG_t		-1.93 (2.88)**		-.12 (.69)		-2.31 (2.33)**
Panel C: Diagnostic Statistics						
F	11.16**	9.35**	.89	1.05	3.08	6.28**
ECM_{t-1}	-.03 (4.74)**	-.07 (5.46)**	-.03 (1.32)	-.13 (1.82)	.01 (2.51)	-.08 (4.33)**
LM	.24	.18	1.06	.18	.10	.30
RESET	6.67**	3.41*	.05	3.80*	.00	.06
CUSUM	S	S	S	S	S	S
CUSUMSQ	S	S	U	U	S	S
Wald-L		2.24		30.49**		27.92**
Wald-S		.04		.02		.07
Adjusted R^2	.49	.55	.13	.10	.44	.55

Notes:

a. Numbers inside 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 sizes (n=35).
c. Number inside the parenthesis next to ECMt-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 Lagrange Multiplier test of residual serial correlation. It is distributed as $\chi 2$ 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 $\chi 2$ distribution with one degree of freedom.
e. RESET is Ramsey's test for misspecification. It is distributed as $\chi 2$ with one degree of freedom.

Table 10 continued

	St. Kitts and Nevis		St. Lucia		St. Vincent and the Grenadines	
	L-ARDL	**NL-ARDL**	**L-ARDL**	**NL-ARDL**	**L-ARDL**	**NL-ARDL**
Panel A: Short Run Estimates						
$\mathbf{\Delta LnY_t}$						
ΔLnY_{t-1}	.45 (2.55)**	.39 (2.18)**			-.26 (1.51)	-.18 (1.13)
ΔLnY_{t-2}	-.43 (2.18)**					.30 (1.90)*
ΔLnY_{t-3}						
ΔLnY_{t-4}						
$\mathbf{\Delta LnREX_t}$	-.39 (2.00)*		-.60 (3.10)**		-.24 (1.23)	
$\Delta LnREX_{t-1}$					-.43 (2.13)**	
$\Delta LnREX_{t-2}$						
$\Delta LnREX_{t-3}$						
$\Delta LnREX_{t-4}$						
$\mathbf{\Delta POS_t}$		-.51 (1.29)		-.44 (1.16)		.28 (.71)
ΔPOS_{t-1}				-.80 (2.11)**		-1.13 (3.14)**
ΔPOS_{t-2}				-.30 (.90)		-.60 (1.41)
ΔPOS_{t-3}						
ΔPOS_{t-4}						
$\mathbf{\Delta NEG_t}$		-.01 (.03)		-.72 (1.98)*		-.68 (1.63)
ΔNEG_{t-1}				.60 (1.62)		
ΔNEG_{t-2}						
ΔNEG_{t-3}						
ΔNEG_{t-4}						
Panel B: Long Run Estimates						
Constant	20.70 (1.54)	4.23 (2.31)**	15.42 (2.60)**	4.21 (6.35)**	-106.28 (.42)	3.57 (6.26)**
$LnREX_t$	-3.40 (1.18)		-2.32 (1.82)*		24.30 (.44)	
POS_t		-.39 (.09)		.74 (.52)		4.16 (2.04)**
NEG_t		-1.51 (.83)		-.15 (.10)		1.00 (.53)
Panel C: Diagnostic Statistics						
F	1.37	.71	3.90	3.46	5.02	4.33
ECM_{t-1}	-.03 (1.69)	-.04 (1.33)	-.05 (2.55)	-.09 (3.13)	-.01 (3.22)*	-.20 (3.75)**
LM	2.58	.81	.03	1.27	.19	.23
RESET	1.32	.67	.02	1.63	1.86	9.15**
CUSUM	S	S	S	S	S	S
CUSUMSQ	S	S	S	S	U	S
Wald-L		10.57**		2.02		58.42**
Wald-S		.26		2.30		.46
Adjusted R^2	.27	.18	.26	.36	.26	.36

Notes:

a. Numbers inside 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 sizes (n=35).

c. Number inside the parenthesis next to ECMt-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 Lagrange Multiplier test of residual serial correlation. It is distributed as $\chi 2$ 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 $\chi 2$ distribution with one degree of freedom.

e. RESET is Ramsey's test for misspecification. It is distributed as $\chi 2$ with one degree of freedom.

Table 10 continued

	Sweden		Switzerland		Togo	
	L-ARDL	**NL-ARDL**	**L-ARDL**	**NL-ARDL**	**L-ARDL**	**NL-ARDL**
Panel A: Short Run Estimates						
ΔLnY_t						
ΔLnY_{t-1}	.32 (2.17)**	.31 (2.41)**	.26 (1.73)*	.29 (2.05)**		
ΔLnY_{t-2}	-.22 (1.53)		-.21 (1.45)			
ΔLnY_{t-3}						
ΔLnY_{t-4}						
$\Delta LnREX_t$	.05 (.94)		-.14 (2.28)**		-.13 (1.13)	
$\Delta LnREX_{t-1}$	-.01 (.07)		-.10 (1.53)			
$\Delta LnREX_{t-2}$	.11 (1.51)					
$\Delta LnREX_{t-3}$	.12 (1.84)*					
$\Delta LnREX_{t-4}$						
ΔPOS_t		.05 (.41)		.01 (.07)		.23 (1.23)
ΔPOS_{t-1}						
ΔPOS_{t-2}						
ΔPOS_{t-3}						
ΔPOS_{t-4}						
ΔNEG_t		.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	14.17 (15.3)**	3.86 (218.2)**	-72.35 (.11)	3.93 (56.86)**	10.91 (3.29)**	4.22 (61.63)**
$LnREX_t$	-2.03 (10.9)**		18.69 (.12)		-1.35 (1.92)*	
POS_t		-.01 (.03)		.02 (.10)		.71 (2.36)**
NEG_t		-.86 (7.22)**		-1.12 (3.71)**		-.01 (.04)
Panel C: Diagnostic Statistics						
F	4.09	8.09**	.07	2.88	3.64	3.74
ECM_{t-1}	-.11 (2.90)	-.39 (5.08)**	.00 (.02)	-.18 (2.86)	-.18 (2.71)	-.63 (3.39)*
LM	3.54*	2.41	1.35	1.23	.25	.52
RESET	5.81**	9.91**	.26	.78	.10	.48
CUSUM	S	S	S	U	S	S
CUSUMSQ	U	U	S	U	S	S
Wald-L		87.86**		109.00**		27.76**
Wald-S		5.45**		.01		.34
Adjusted R^2	.39	.56	.25	.38	.14	.29

Notes:

a. Numbers inside 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 sizes (n=35).

c. Number inside the parenthesis next to ECMt-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 Lagrange Multiplier test of residual serial correlation. It is distributed as $\chi 2$ 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 $\chi 2$ distribution with one degree of freedom.

e. RESET is Ramsey's test for misspecification. It is distributed as $\chi 2$ with one degree of freedom.

Table 10 continued

	Trinidad and Tobago		Tunisia		Turkey	
	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)				
ΔLnY_{t-2}						
ΔLnY_{t-3}						
ΔLnY_{t-4}						
$\Delta LnREX_t$	-.19 (2.08)**		.10 (1.36)		.18 (3.21)**	
$\Delta LnREX_{t-1}$						
$\Delta LnREX_{t-2}$						
$\Delta LnREX_{t-3}$						
$\Delta LnREX_{t-4}$						
ΔPOS_t		-.64 (3.11)**		.05 (.08)		.08 (.55)
ΔPOS_{t-1}						
ΔPOS_{t-2}						
ΔPOS_{t-3}						
ΔPOS_{t-4}						
ΔNEG_t		-.03 (.20)		.05 (.70)		.15 (1.84)*
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)**
$LnREX_t$	3.70 (2.01)**		-1.00 (1.85)*		-1.37 (.44)	
POS_t		1.80 (2.05)**		7.96 (2.31)**		.37 (2.53)**
NEG_t		1.17 (1.24)		-.41 (.98)		-.60 (4.40)**
Panel C: Diagnostic Statistics						
F	1.91	1.05	1.97	2.20	.74	2.80
ECM_{t-1}	.03 (1.98)	.08 (1.83)	-.03 (1.93)	-.07 (2.50)	-.01 (1.21)	-.21 (2.97)
LM	.05	.46	.14	.28	.88	.77
RESET	.02	.00	.91	2.07	1.51	3.25*
CUSUM	S	S	S	S	S	S
CUSUMSQ	U	U	S	S	S	S
Wald-L		5.03**		6.15**		339.38**
Wald-S		3.16*		.14		.10
Adjusted R^2	.39	.44	.08	.11	.19	.29

Notes:

a. Numbers inside 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 sizes (n=35).

c. Number inside the parenthesis next to ECMt-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 Lagrange Multiplier test of residual serial correlation. It is distributed as $\chi 2$ 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 $\chi 2$ distribution with one degree of freedom.

e. RESET is Ramsey's test for misspecification. It is distributed as $\chi 2$ with one degree of freedom.

Table 10 continued

	Uganda		United Kingdom		United States	
	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL
Panel A: Short Run Estimates						
ΔLnY_t						
ΔLnY_{t-1}	.04 (.23)	.05 (.35)	.45 (2.97)**	.45 (3.11)**	.22 (1.46)	.33 (2.21)**
ΔLnY_{t-2}	-.42 (2.69)**	-.46 (2.97)**	-.32 (2.00)**	-.18 (1.18)		
ΔLnY_{t-3}						
ΔLnY_{t-4}						
$\Delta LnREX_t$	-.27 (3.02)**		.00 (.04)		.01 (.15)	
$\Delta LnREX_{t-1}$						
$\Delta LnREX_{t-2}$						
$\Delta LnREX_{t-3}$						
$\Delta LnREX_{t-4}$						
ΔPOS_t		-.05 (.21)		.01 (.10)		-.01 (.13)
ΔPOS_{t-1}				-.18 (1.91)*		-.18 (1.78)*
ΔPOS_{t-2}						.16 (1.55)
ΔPOS_{t-3}						
ΔPOS_{t-4}						
ΔNEG_t		-.33 (2.71)**		.01 (.12)		.08 (.84)
ΔNEG_{t-1}				.14 (2.11)**		
ΔNEG_{t-2}						
ΔNEG_{t-3}						
ΔNEG_{t-4}						
Panel B: Long Run Estimates						
Constant	15.44 (5.52)**	-.87 (.95)	89.23 (.02)	3.86 (44.09)**	-15.10 (.29)	4.07 (6.05)**
$LnREX_t$	-2.09 (4.47)**		-33.51 (.02)		4.93 (.40)	
POS_t		-.16 (.08)		.49 (1.69)*		1.45 (1.13)
NEG_t		-1.58 (2.23)**		-.27 (1.08)		.28 (.24)
Panel C: Diagnostic Statistics						
F	4.53	4.45	.16	2.19	1.50	1.10
ECM_{t-1}	-.09 (3.05)*	-.12 (3.67)**	.00 (.45)	-.15 (2.54)	-.01 (1.75)	-.07 (1.86)
LM	.02	.17	.83	.66	1.39	.49
RESET	.94	1.16	1.74	5.10**	.00	1.83
CUSUM	S	S	S	S	S	S
CUSUMSQ	U	U	S	U	S	S
Wald-L		5.65**		82.13**		41.84**
Wald-S		.83		3.45*		.19
Adjusted R^2	.38	.44	.13	.26	.09	.17

Notes:

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

g. 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 sizes (n=35).

h. Number inside the parenthesis next to ECMt-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)

i. LM is Lagrange Multiplier test of residual serial correlation. It is distributed as $\chi 2$ 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 $\chi 2$ distribution with one degree of freedom.

j. RESET is Ramsey's test for misspecification. It is distributed as $\chi 2$ with one degree of freedom.

Table 10 continued

	Uruguay		Venezuela	
	L-ARDL	NL-ARDL	L-ARDL	NL-ARDL
ΔLnY_t				
ΔLnY_{t-1}	.38 (2.01)**	.46 (3.03)**	.16 (.93)	.23 (1.50)
ΔLnY_{t-2}			-.33 (1.90)*	
ΔLnY_{t-3}				
ΔLnY_{t-4}				
$\Delta LnREX_t$	-.03 (.32)		-.01 (.18)	
$\Delta LnREX_{t-1}$			-.10 (1.99)*	
$\Delta LnREX_{t-2}$				
$\Delta LnREX_{t-3}$				
$\Delta LnREX_{t-4}$				
ΔPOS_t		.13 (1.03)		-.01 (.25)
ΔPOS_{t-1}				-.23 (2.38)**
ΔPOS_{t-2}				
ΔPOS_{t-3}				
ΔPOS_{t-4}				
ΔNEG_t		-.11 (1.37)		.07 (.86)
ΔNEG_{t-1}				
ΔNEG_{t-2}				
ΔNEG_{t-3}				
ΔNEG_{t-4}				
Constant	-6.01 (.36)	3.47 (10.82)**	-1.43 (.23)	3.95 (16.66)**
$LnREX_t$	2.18 (.66)		1.27 (.91)	
POS_t		.34 (1.12)		.06 (.28)
NEG_t		-.78 (1.11)		-.35 (1.18)
F	5.01	8.15**	1.79	1.62
ECM_{t-1}	.06 (2.60)	-.20 (5.04)**	.05 (1.92)	-.20 (2.29)
LM	.15	.26	.03	.27
RESET	4.09**	3.20*	.08	2.08
CUSUM	S	S	S	S
CUSUMSQ	S	S	S	S
Wald-L		6.34**		14.64**
Wald-S		1.93		4.25**
Adjusted R^2	.34	.56	.27	.35

Notes:

a. Numbers inside 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 sizes (n=35).
c. Number inside the parenthesis next to ECMt-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 Lagrange Multiplier test of residual serial correlation. It is distributed as $\chi 2$ 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 $\chi 2$ distribution with one degree of freedom.
e. RESET is Ramsey's test for misspecification. It is distributed as $\chi 2$ with one degree of freedom.

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Appendix A:

Variable Definition

Multivariate Model:

Y: Index of real GDP for Australia and Japan; real GDP in national currency for Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, and Russia.

M: Real money supply defined as real M2 (M3 for Australia).

G: Real government spending.

REX: Real effective exchange rate. A decline reflects a real depreciation of domestic currency.

OP: Real world crude oil (Petroleum) price index.

W: Real wage rate index.

Bivariate Model:

Y: Index of real GDP.

REX: Real effective exchange rate. A decline reflects a real depreciation of domestic currency.

Appendix B:

Data Sources

a) International Financial Statistics of the IMF (IFS)

b) The Bank for International Settlements (BIS)

c) Federal Reserve Bank of St. Louis

Appendix C:

Data period

Multivariate Model:

Country	Period
Australia	1973Q1 – 2013Q4
Japan	1973Q1 – 2015Q4
Czech Republic	1994Q1 – 2013Q4
Estonia	1994Q1 – 2010Q4
Hungary	1995Q1 – 2015Q1
Latvia	2003Q2 – 2013Q4
Lithuania	1996Q4 – 2014Q4
Poland	1996Q4 – 2015Q1
Russia	1995Q2 – 2014Q4

Bivariate model:

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

Curriculum Vitae

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Areas of Interest

Teaching	Macroeconomics, International Economics, Money and Banking, Econometrics, Statistics, Microeconomics
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Publications

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