How Sensitive are the U.S. Inpayments and Outpayments to Exchange Rate Changes: An Asymmetry Analysis

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ABSTRACT

Previous studies that assessed the impact of exchange rate changes on a country's inpayments and outpayments assumed that such effects are symmetric. The evidence from the literature reveals that import and export prices react to exchange rate changes in an asymmetric manner. This implies that export earnings and payments for imports should also react to exchange rate changes in an asymmetric manner. We demonstrate this by using Shin *et al.*'s (2014) nonlinear ARDL approach and inpayments and outpayments of the U.S. with her 15 trading partners. We find evidence of short-run as well as long-run asymmetric effects in more than half of the models, though the findings are found to be partner specific.

JEL Classification: F31

Key Words: The U.S., Inpayments, Outpayments, Value of the dollar, Asymmetry Analysis

I. INTRODUCTION

Impact of exchange rate changes on trade flows and on the trade balance still remains a matter of concern by policy makers in almost every country. This is currently evidenced by the U.S. President, Donald J. Trump who argues against over-valued dollar again Chinese yuan, claiming that the overvalued dollar is hurting American exporters and helping the Chinese ones. Of course China is not the only major partner. Canada and Mexico are as large partners as China, each with almost 15% of the U.S. trade share. Although share of other partners are not as large as those of the three major ones, they are important and perhaps large enough relative to many other partners in the world and they are also subject to the same question and issue with the U.S., i.e. the role of the exchange rate in the trade between the U.S. and each partner. In order to gain some insight about the real value of the dollar against currency of each partner, we plot them in figure 1.

Figure 1 goes about here

Although the claim of dollar appreciation against the Yuan is borne out by the figure, the dollar has fluctuated against other currencies in most instances. The 15 partners reported in Figure 1 engage in close to 73% of the U.S. trade. [1]

What has been the response of the U.S. exports to and imports from each partner to changes in the real bilateral exchange rate? A common practice to answer this question is to estimate export and import price elasticities where real exports and real imports are related to relative prices in addition to scale variables, the so called Marshall-Lerner condition.[2] However, due to lack of export and import prices at bilateral level, a body of the literature considers the response of nominal exports and nominal imports to changes in the real bilateral exchange rate, a direct approach of assessing the impact of exchange rate changes on inpayments and outpayments of a country. This tradition began by Haynes et al (1986) who considered nominal exports and imports of manufactured goods between the U.S. and

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1 Partners considered in this paper and cited in Figure 1 are Australia (with 0.96% trade share), Belgium (1.43%), Canada (15.35%), Hong Kong (1.17%), China (15.97%), France (2.12%), Germany (4.65%), Italy (1.61%), Japan (5.17%), Korea (3.08%), Mexico (14.18%), Netherlands (1.53%), Singapore (1.25%), Switzerland (1.44%), U.K. (3.05%). Trade shares belong to 2015 and are defined as sum of the U.S. exports to and imports from a partner as a percent of sum of the U.S. exports to and imports from the World.

2 For a review article see Bahmani-Oskooee *et al*. (2013).

Japan and found that they are not too sensitive to the bilateral exchange rate. As they concluded, "Given the dominance of U.S. imports from Japan relative to exports, this finding suggests that even a major depreciation of the dollar relative to the yen will not markedly reduce the present U.S. manufacturing trade deficit with Japan".[3] Similar findings were also reported by Bergstrand (1987) but not by Cushman (1987) when they considered the U.S. nominal trade flows with Japan as well as a few other large partners.

The finding by the above studies are somewhat biased in that they neither considered integrating properties of variables nor cointegration among the variables in their models. Bahmani-Oskooee and Ratha (2008) resolves this issue by employing Pesaran *et al.*'s (2001) ARDL approach where variables could be combination of stationary and first-differenced stationary.[4] Furthermore, they also expand the U.S. partners from 5-7 to 19. They find that dollar depreciation increases the U.S. inpayments from Austria, Denmark, Finland, Germany, Greece, Japan, New Zealand, Sweden, and Switzerland in the long run. However, they find that dollar depreciation lowers the U.S. outpayments only to Denmark, Germany, Greece, Ireland, and Sweden.[5]

A common feature of all of the above mentioned studies is that they have assumed exchange rate changes to have symmetric effects on bilateral inpayments and outpayments. However, Bussiere (2013) has shown that the pass-through effects of exchange rate changes to import and export prices are in an asymmetric manner. Therefore, if import and export prices react to exchange rate changes in an asymmetric manner, so should the import and export values. Therefore, it is our main purpose in this paper to establish whether exchange rate changes have symmetric or asymmetric effects on the U.S. inpayments and outpayments with each of her 15 major trading partners. These partners all together engage in more than 70% of the U.S. trade. Since assessing asymmetric effects requires using nonlinear

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3 See Haynes et al. (1986, p. 931).

4 A stationary variable is usually denoted by I(0). Therefore, an I(1) variable is a variable that achieves stationarity after being differenced once.

5 The same approach has also been followed by Bahmani-Oskooee and Goswami (2004) using data between Japan and her nine major partners and by Bahmani-Oskooee et al. (2005a, 2005b) between U.K. and her partners and between Canada and her partners.

models, we introduce the linear as well as nonlinear models in Section II. Empirical results supporting our main conjecture, i.e., asymmetric effects are reported in Section III. Finally, while Section IV concludes, a data Appendix provides data sources and definition of variables.

II. The Models and the Methods

The inpayments and outpayments schedules or specifications in this paper will be similar to those in the literature (e.g., Bahmani-Oskooee and Ratha 2008) and will take the following forms.

$$LnVX_{j,t} = a + bLnY_{j,t} + cLnREX_{j,t} + \varepsilon_t \qquad (1)$$

$$LnVM_{j,t} = d + eLnY_{US,t} + fLnREX_{j,t} + \mu_t \qquad (2)$$

where $VX_{j,t}$ is the nominal value of U.S. exports to trading partner j which is assumed to depend on partner j's income, Y_j, and the real bilateral exchange rate, REX_j. Since an increase in partner j's income stimulates the U.S. exports to j, we expect an estimate of b to be positive. From the Appendix we gather that the real bilateral exchange rate between the dollar and currency of j is defined in a manner that a decline reflects depreciation of the dollar. Hence, if dollar depreciation is to increase the U.S. exports and eventually export earnings, we expect an estimate of c to be negative. In case partner j's demand for U.S. exports is inelastic, then an estimate of c could also be positive. Similarly, equation (2) outlines the U.S. outpayments schedule to partner j where $VM_{j,t}$ is the dollar value of U.S. imports from partner j and is assumed to depend on the U.S. income, Y_{US}, and again, on the real bilateral exchange rate. Since an increase in U.S. income is expected to boost U.S. imports, an estimate of e is expected to be positive. Assuming U.S. import demand to be elastic, if dollar depreciation is to reduce U.S. imports, an estimate of f is expected to be positive. Clearly, if U.S. import demand with partner j is inelastic, then an estimate of f could be negative.

The next step in our modelling approach is to follow Pesaran et al.'s (2001) ARDL bounds testing approach and re-write (1) and (2) in an error-correction format so that we can also asses the short-run effects of exogenous variables on the dependent variables. The new specifications are outlined by (3) and (4):

$$\Delta LnVX_{j,t} = \alpha + \sum_{i=1}^{n1} \beta_i \Delta LnVX_{j,t-i} + \sum_{i=0}^{n2} \delta_i \Delta LnY_{j,t-i} + \sum_{i=0}^{n3} \phi_i \Delta LnREX_{j,t-i} +$$
$$\gamma_0 LnVX_{t-1} + \gamma_1 LnY_{j,t-1} + \gamma_2 LnREX_{j,t-1} + \xi_t \qquad (3)$$

$$\Delta LnVM_{j,t} = \alpha' + \sum_{i=1}^{n1} \beta_i' \Delta LnVM_{j,t-i} + \sum_{i=0}^{n2} \delta_i' \Delta LnY_{US,t-i} + \sum_{i=0}^{n3} \phi_i' \Delta LnREX_{j,t-i} +$$
$$\gamma_0' LnVM_{t-1} + \gamma_1' LnY_{US,t-1} + \gamma_2' LnREX_{j,t-1} + \xi_t' \qquad (4)$$

In error-correction models (3) and (4) short-run effects are reflected in the estimates of coefficients attached to first-differenced variables and long-run effects are inferred by the estimates of γ_1 *and* γ_2 normalized on γ_0 in (3) and by the estimates of γ_1' *and* γ_2' normalized on γ_0' in (4). However, for the long-run effects to be meaningful, we must establish cointegrtion among the variables in each model by applying the F test for joint significance of lagged level variables. Pesaran et al. (2001) demonstrate that the F test in this context has a nonstandard distribution, hence they tabulate new critical values. Since the critical values account for integrating properties of variables, there is no need for pre unit-root testing and variables could be combination of I(0) and I(1) which are properties of most macro variables.

As mentioned earlier, the main assumption in estimating (3) and (4) is that exchange rate changes have symmetric effects. In order to assess the asymmetric effects of exchange rate changes, Shin *et al.* (2014) modify such models. The modification basically involves separating dollar depreciations from dollar appreciations by using partial sum concept. To this end, we first form *ΔLnREX* series which includes negative changes (dollar depreciations) and positive changes (dollar appreciations). Next, we use the following partial sum concept and generate two new time-series variables of concern by:

$$POS_t = \sum_{j=1}^{t} \Delta LnREX_j^+ = \sum_{j=1}^{t} \max(\Delta LnREX_j, 0),$$

$$NEG_t = \sum_{j=1}^{t} \Delta LnREX_j^- = \sum_{j=1}^{t} \min(\Delta LnREX_j, 0) \quad (5)$$

where POS_t is a new time series variable that represents only dollar appreciation and NEG_t is a new variable that represents only dollar depreciation. Shin *et al.* (2014) then propose replacing *LnREX* variable in both models (3) and (4) by POS_t and NEG_t to arrive at two new models as follows:

$$\Delta LnVX_{j,t} = \alpha + \sum_{i=1}^{n1} \beta_i \Delta LnVX_{j,t-i} + \sum_{i=0}^{n2} \delta_i \Delta LnY_{j,t-i} + \sum_{i=0}^{n3} \phi_i^+ \Delta POS_{j,t-i} + \sum_{i=0}^{n4} \phi_i^- \Delta NEG_{j,t-i}$$

$$+ \gamma_0 LnVX_{t-1} + \gamma_1 LnY_{j,t-1} + \gamma_2^+ POS_{j,t-1} + \gamma_2^- NEG_{j,t-1} + \xi_t \quad (6)$$

and

$$\Delta LnVM_{j,t} = \alpha' + \sum_{i=1}^{n1} \beta_i' \Delta LnVM_{j,t-i} + \sum_{i=0}^{n2} \delta_i' \Delta LnY_{US,t-i} + \sum_{i=0}^{n3} \phi_i'^+ \Delta POS_{j,t-i} + \sum_{i=0}^{n4} \phi_i'^- \Delta NEG_{j,t-i}$$

$$+ \gamma_0' LnVM_{t-1} + \gamma_1' LnY_{US,t-1} + \gamma_2'^+ POS_{j,t-1} + \gamma_2'^- NEG_{j,t-1} + \xi_t' \quad (7)$$

Due to nature of constructing the partial sum variables, Shin *et al.* (2014) label models like (6) and (7) as nonlinear ARDL models whereas original Pesaran *et al.*'s (2001) specifications such as (3) and (4) are labeled as the linear ARDL models. However, Shin et al. (2014) demonstrate that Pesaran *et al.*'s approach of estimating any linear model is equally applicable to nonlinear models.

Once (6) and (7) are estimated, a few hypothesis with regards to asymmetric effects of exchange rate changes on inpaymnets and outpayments could be tested. First, short-run "adjustment asymmetry" will be confirmed if n3 ≠ n4 in both (6) and (7). Second, short-run asymmetric effects will be observed if at each lag $\hat{\phi}_i^+ \neq \hat{\phi}_i^-$ in (6) and $\hat{\phi}_i'^+ \neq \hat{\phi}_i'^-$ in (7). Third, short-run cumulative or impact asymmetry will be established if $\sum \hat{\phi}_i^+ \neq \sum \hat{\phi}_i^-$ in (6) and $\sum \hat{\phi}_i'^+ \neq \sum \hat{\phi}_i'^-$ in (7). Finally, long-run asymmetry will be established if $-\frac{\hat{\gamma}_2^+}{\hat{\gamma}_0} \neq -\frac{\hat{\gamma}_2^-}{\hat{\gamma}_0}$ in (6) and $-\frac{\hat{\gamma}_2'^+}{\hat{\gamma}_0'} \neq -\frac{\hat{\gamma}_2'^-}{\hat{\gamma}_0'}$ in (7). To test all these inequalities, the Wald test will be applied.[6]

III. Empirical Results

In this section we estimate two linear and two nonlinear models outlined by equations (3), (4), (6), and (7). We use quarterly data over the period 1970I-2015IV between the U.S. and each of her 15 trading partners. In estimating each model we impose a maximum of eight lags on each first-differenced variable and use Akaike's Information Criterion (AIC) to select an optimum specification. We then report the estimates in Tables 1 for the U.S. inpayments schedules and Table 2 for its outpayments schedules. Since different critical values are used for different estimates, we collect them in the footnotes to Tables 1 and 2 and use them to identify significance level by * at the 10% level and ** at the 5% level.

Tables 1 and 2 go about here

Let us consider the U.S. inpayments first, reported in Table 1. We review the results for both the linear (L-ARDL) and nonlinear (NL-ARDL) models of the U.S. with the first partner, Australia, and then summarize them for all partners. From the estimates of the linear model we gather that both Australian income and the real bilateral exchange rate have short-run effects on the U.S. inpayments with Australia. They both carry at least one lagged significant coefficient in Panel A. However, only the effects of Australian income lasts into the long run since the normalized long-run income elasticity is significant and positive in Panel B. As Australia grows, U.S. exports more and earns more. The long-run income effect is valid because cointegration is supported by significant F test as well as ECM_{t-1} test reported in Panel C.[7]

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[6] For more on the application of these methods see Delatte and Lopez-Villavicencio (2012), Verheyen (2013), Bahmani-Oskooee and Fariditavana (2015), Bahmani-Oskooee and Saha (2015), Gogas and Pragidis (2015), Durmaz (2015), Baghestani and Kherfi (2015), Pal and Mitra (2016), Al-Shayeb and Hatemi-J.(2016), Lima et al. (2016), Nusair (2017), Aftab et al. (2017), and Gregoriou (2017).

[7] The ECM_{t-1} test is an alternative test under which we use the normalized coefficients estimates and long-run model (1) to generate the error term, denoted by ECM. We then replace the lagged level variables by ECM_{t-1} and estimate the new specification after imposing the same optimum lag numbers from Panel A. A significantly

Several additional diagnostic statistics are also reported in Panel C. The Lagrange-Multiplier statistic is reported to test for autocorrelation. Since it is insignificant, residuals are autocorrelation free. Ramsey's RESET statistic is also reported to judge misspecification. It is also insignificant, ruling out misspecification.[8] To establish stability of all short-run and long-run coefficients estimates, it is a common practice to apply the well-known CUSUM and CUSUMSQ tests to the residuals of the optimum model. Denoting these tests by CS and CS^2 respectively, and stable estimates by "S" and unstable estimates by "NS", we gather that all coefficient estimates are stable. Finally, we report the size of adjusted R^2 to judge the goodness of fit. How do the results change if we shift to the estimate of the U.S.-Australia nonlinear inpayment model?

From the short-run coefficient estimates in Panel A we gather that while appreciation of the dollar has short-run significant effects on the U.S. inpayments, its depreciation does not. This is because ΔPOS carries at least one significant coefficient but ΔNEG does not. This by itself is a sign of short-run asymmetric effects of exchange rate changes. Furthermore, since the two variables take different lags, short-run "adjustment asymmetry" is also supported. However, there seems to be no short-run cumulative or impact asymmetric effects since the Wald test reported as Wald-S in Panel C is insignificant. This test is for establishing whether sum of the coefficients attached to ΔPOS is different than the sum of coefficients attached to ΔNEG. In the long-run, however, the story changes. Dollar appreciation has no significant effects on the U.S. inpayments from Australia but dollar depreciation does.[9] The estimated normalized coefficients are not significantly different from each other since the Wald test reported as Wald-L in Panel C is insignificant. All in all, if we were to rely upon old approach of estimating only the linear model, since the exchange rate did not play any significant role in the long run, we would have stopped the process. However, estimates from the nonlinear model proves us

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negative coefficient estimate attached to ECM_{t-1} will support cointegration. Like the F test, Pesaran et al. (2001, p. 303) tabulate new critical values for the t test to be used in establishing significance of this estimate.

8 In some models we had to include additional lags of the dependent variable in order to reduce the RESET statistic to an insignificant level.

9 As dollar appreciates against Australian dollar in real term, expensive U.S. goods does not hurt the U.S. export earnings due to an inelastic import demand by Australia.

wrong and this must be due to introducing nonlinear adjustment of the exchange rate.

Based on the above detailed review of the U.S.-Australia inpayment model, we now summarize the results from Table 1 for all 15 partners. From the linear models we gather that the real bilateral exchange rate has short-run significant effects in 12models. However, in the nonlinear models, either ΔPOS or ΔNEG carry at least one significant coefficient in 13 models. Since the short-run estimates attached to ΔPOS are different than those attached to ΔNEG variable in most instances, there is evidence of short-run asymmetric effects. However, short-run impact asymmetry is supported only in the models with Belgium, Hong Kong, Italy, Korea, Mexico, Netherlands, and Switzerland. Only in these models the Wald-S statistic is significant. There is also evidence of short-run "adjustment asymmetry" in nine models where ΔPOS takes a different lag order than ΔNEG. As for long-run asymmetric effects, we find meaningful long-run asymmetric effects of exchange rate changes on the U.S. inpayments from Belgium, Japan, Singapore, Switzerland, and the U.S. In these cases, not only there is evidence of asymmetry cointegration either by the F or ECM_{t-1} test, the Wald-L statistic is also significant in these models. All in all, the results from nonlinear models are unique and partner specific and are masked by the linear models. For example, in the linear model with one of the largest partners, Mexico, the exchange rate carries an insignificant long-run coefficient, implying that the real peso-dollar rate has no long-run effects on the U.S. inpayments from Mexico. However, the estimates from nonlinear model reveals that once dollar appreciations are separated from dollar depreciations, both have long-run effects that are in line with our theoretical expectations. As dollar appreciates, it hurts U.S. inpayments and as it depreciates, it boosts the U.S. inpayments from Mexico in an asymmetric manner.[10]

Next we consider the estimates of the U.S. outpayments schedule (both the linear and nonlinear models) with each partner that are reported in Table 2. In the linear models, the bilateral exchange rate has significant short-run effects in eight models. However, the number increases to 10 when we move

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[10] Other statistics from panel C reveal that the residuals are autocorrelation free in most models since the LM statistic is insignificant. The RESET test is also insignificant in most models support lack of misspecification. Furthermore, most estimates are stable.

to nonlinear models. In 10 nonlinear models either ΔPOS or ΔNEG carry at least one significant coefficient. This increased number of cases, again, should be attributed to nonlinear adjustment of the exchange rate in each case. Furthermore, short-run effects are asymmetric since size of the short-run estimates attached to ΔPOS differ from those attached to ΔNEG. There is also evidence of short-run "adjustment asymmetry" in six models since number of lags on ΔPOS differs from number of lags on ΔNEG variable. These six cases are: Australia, Belgium, France, Germany, Korea, and Mexico. Finally, there is evidence of short-run cumulative or impact asymmetry in the U.S. model with Australia, China (Mainland), Italy, Korea, and Switzerland. In the models with these five partners, the Wald-S statistic is significant (Panel C). Do short-run effects translate into the long-run?

From Panel B we gather that the short run effects of exchange rate changes translate into the long-run significant and meaningful effects only in one linear model (US-UK) and in nine nonlinear models that belong to Australia, Belgium, China (Hong Kong), China (Mainland), Germany, Italy, Korea, Mexico, and the U.K. In these cases, significant normalized long-run coefficient estimates are supported by either the F or ECM_{t-1} test for cointegration. However, long-run effects are asymmetric only in the cases of China (Hong Kong), China (Mainland), Germany, and Korea, since the Wald-L statistic is significant only in these cases. Again, the results are partner specific. For example, consider the results with Mainland China, one of the three largest partners. If we were to rely upon the linear model, since the real yuan-dollar rate is insignificant in the long run, we would have concluded that the exchange rate has no long-run effects on the U.S. outpayments to China and the process would have stopped here. However, when we introduce nonlinear adjustment of the exchange rate and consider the results from the nonlinear model, both dollar appreciations and dollar depreciations against yuan seem to have significant effects that are supported by asymmetry cointegration. As dollar appreciates, the U.S. outpayments to China increases because of more imports. Similarly, dollar depreciation lowers the U.S. outpayments due to less imports.Thus, pressure on China to float its currency with a hope that yuna will appreciate and dollar will depreciate will be effective in reducing U.S. outpayments to China and increase its inpayments from China. No matter which model we consider, the level of economic activity in the U.S. seems to be a significant long-run player.[11]

IV. Summary and Conclusion

Early studies that tried to assess the impact of exchange rate changes on the trade balance relied upon the Marshall-Lerner condition which requires estimating import and export demand elasticities. In estimating these elasticities, usually a country's volume of exports to and imports from the world are linked to relative prices. Aggregate volume of trade is said to suffer from aggregation bias and it is suggested that the trade flows to be diaggregated by trading partners. However, since import and export prices are not available at bilateral level, export and import values at bilateral level are directly linked to the exchange rate and effects of exchange rate changes on a country's inpayments from and outpayments to a trading partner are assessed.

Recent advances in asymmetry analysis have revealed that import and export prices respond to exchange rate changes in an asymmetric manner. Since these prices are the main determinants of a country's exports and imports values, we would expect that country's inpayments and outpayments to react also in an asymmetric manner to exchange rate changes. We show this for first time in the literature by considering the U.S. inpayments from and her outpayments to each of the 15 trading partners that all together engage in 70% of the U.S. trade. Since investigating asymmetry effects requires using nonlinear models, our new discoveries should be attributed to nonlinear adjustment of the exchange rate.

After estimating the U.S. inpayments and outpayments linear and nonlinear models with Australia, Belgium, Canada, China (Hong Kong), China (Mainland), France, Germany, Italy, Japan, Korea, Mexico, Netherlands, Singapore, Switzerland, and the United Kingdom, we can summarize our findings as follows. First, we find more short-run effects of exchange rate changes in the nonlinear models than the linear models which we attribute it to nonlinear adjustment of the exchange rate. Second, short-run effects are found to be asymmetric in all models. However, short-run cumulative or

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[11] Other diagnostics are similar to those in Table 1.

impact asymmetric effects are evidenced only in seven U.S. inpayments models (Belgium, Hong Kong, Italy, Korea, Mexico, Netherlands and Switzerland) and in five U.S. outpayments models (Australia, China, Italy, Korea, and Switzerland). Third, we found evidence of short-run "adjustment asymmetry" in nine U.S. inpayments schedules and in six U.S. outpayments schedules. Clearly, exports and imports do not adjust to dollar appreciations at the same pace as to dollar depreciations. Finally, we found evidence of significant long-run asymmetric effects in seven U.S. inpayments models and only in four outpayments models.

Clearly, our findings are partner specific. While in some cases dollar depreciation had desired effects, in some cases it did not, mostly due to demand elasticities. For example, in the trade with China (Mainland), the asymmetric effects of exchange rate changes revealed that while dollar depreciation will lower the U.S. inpayments from China, dollar appreciation will have no long-run effects. The decline in the U.S. inpayments from China could be due to an inelastic Chinese import demand for U.S. goods. However, both dollar appreciation and dollar depreciation against yuan was found to have their expected effects on the U.S. outpayments to China. Future research should concentrate on disaggregating U.S. trade flows by commodity in order to identify industries that could benefit from dollar depreciations.

Appendix

Data definition and sources:

Quarterly data over the 1970Q1-2015Q4 period are used to carry out the empirical exercise. The exception is China for which the data were only available during 1993I-2015IV period.

The data come from the following sources:

a. Direction of Trade Statistics of IMF
b. Federal Reserve Bank of St. Louis.

Variables:

VX_i = The U.S. inpayments (value of exports) from trading partner i. Export value data come from source a.

VM_i = The U.S. outpayments (value of imports) to trading partner i. The data comes from source a.

Y = Measure of income in the United States. It is measured by the index of industrial production. This is the only measure of income that is available on quarterly basis for all countries. The data come from source b.

Y_i = Measure of income in trade partner i. It is measured by the index of industrial production. The data come from source b.

REX_i = The real bilateral exchange rate between the U.S. dollar and partner i's currency. It is defined as $REX_i = (P_{US} . NEX_i / P_i)$ where NEX_i is the nominal exchange rate defined as number of i's currency per dollar, P_{US} is the price level in the U.S. measured by CPI, and P_i is the price level in partner i, again measured by CPI. All nominal exchange rates and CPI data come from source b. Thus, a decline in REX reflects a real depreciation of the United States dollar against i's currency. .

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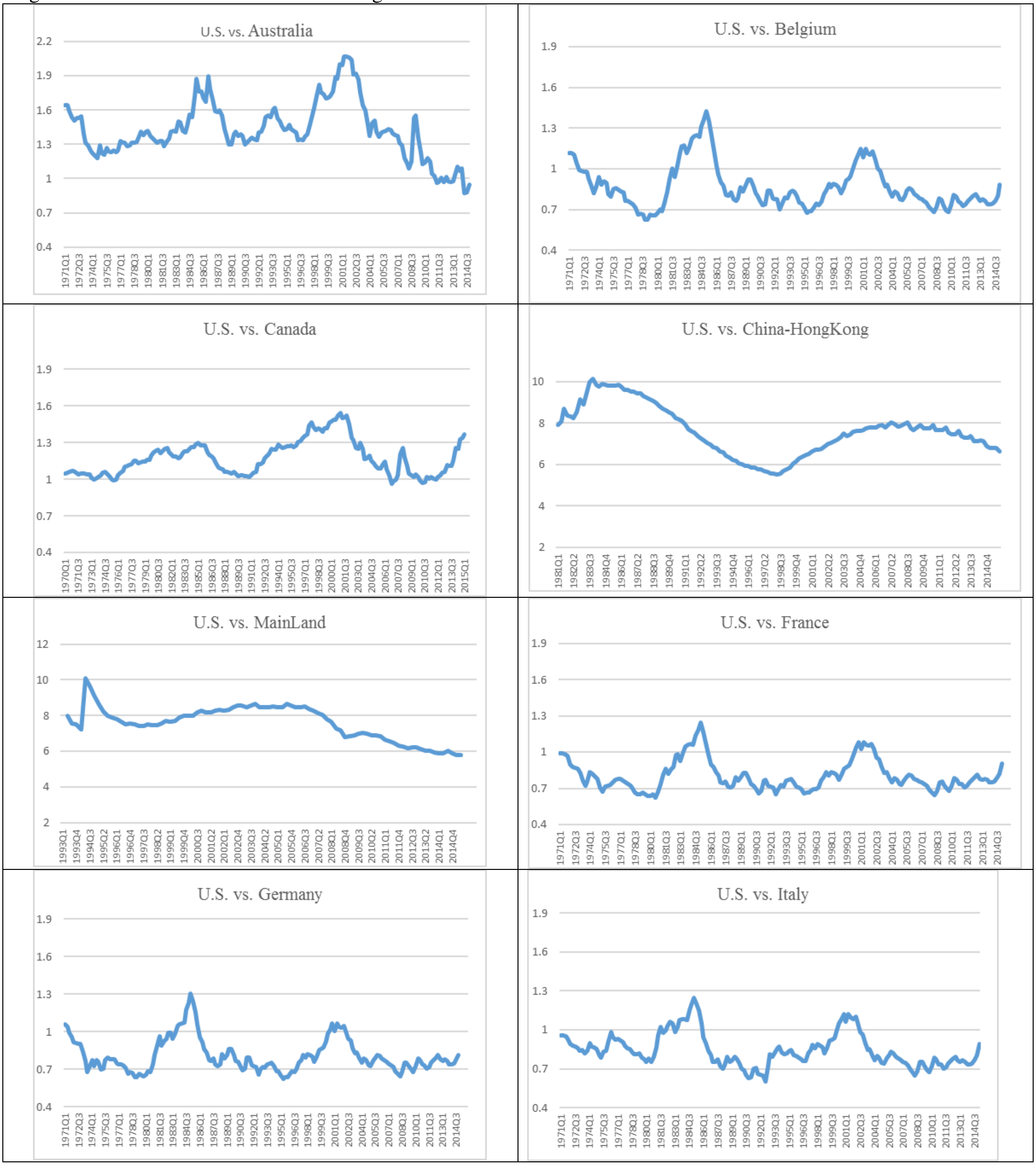
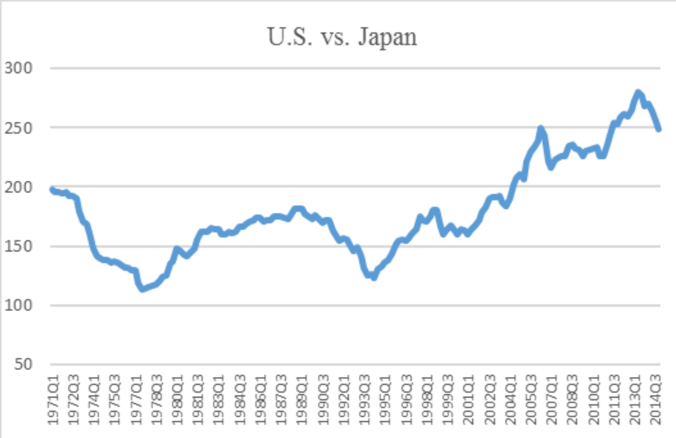
Figure 1: Plot of the Real Bilateral Exchange Rates.

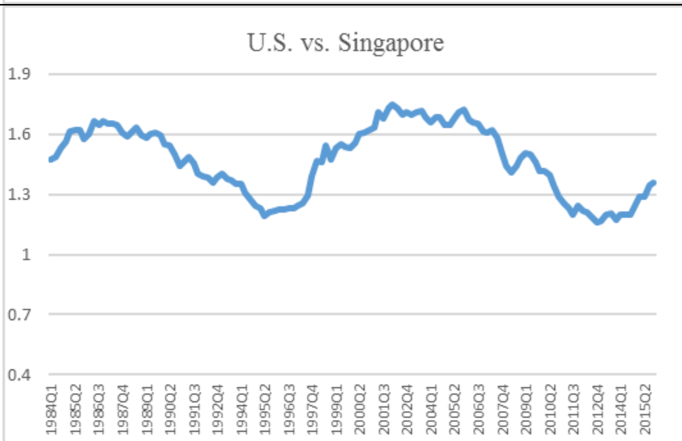


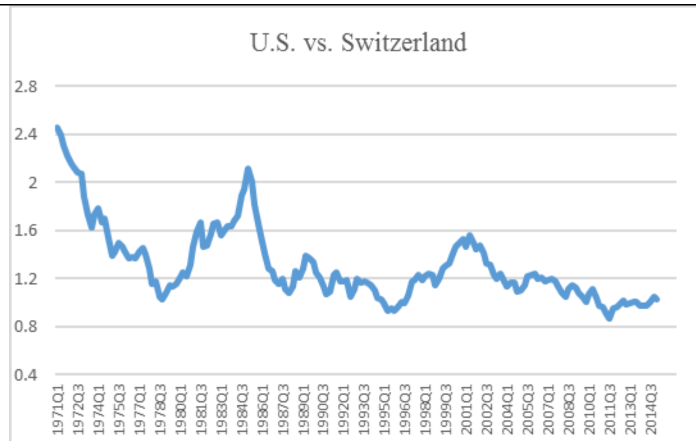

U.S. vs. Japan
300
250
200
150
100
50


U.S. vs. Korea
6000
5000
4000
3000
2000
1000


U.S. vs. Mexico
30
25
20
15
10
5


U.S. vs. Netherlands
1.9
1.6
1.3
1
0.7
0.4


U.S. vs. Singapore
1.9
1.6
1.3
1
0.7
0.4


U.S. vs. Switzerland
2.8
2.4
2
1.6
1.2
0.8
0.4

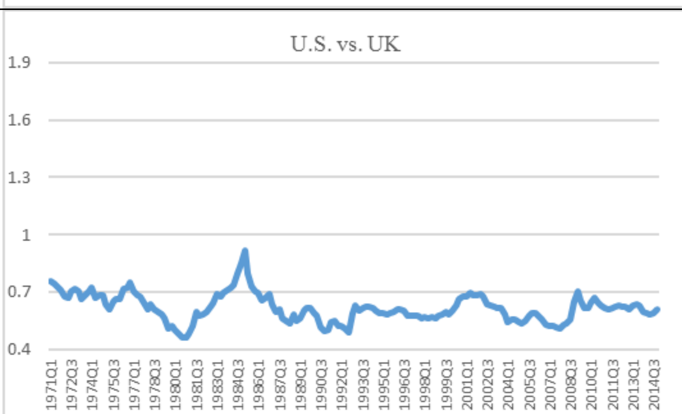

U.S. vs. UK
1.9
1.6
1.3
1
0.7
0.4

Table 1: Full-Information In-Payment Estimates of Both Linear ARDL (L-ARDL) and Nonlinear ARDL (NL-ARDL) Models								
	i = Australia		i = Belgium		i = Canada		i = China, Hong Kong	
	L - ARDL	NL - ARDL	L - ARDL	NL - ARDL	L - ARDL	NL - ARDL	L - ARDL	NL - ARDL
Panel A: Short–Run Estimates								
$\Delta lnY_{i,t}$	1.03 [2.01]**	1.09 [2.11]**	1.41 [4.56]**	1.08 [3.87]**	1.77 [7.87]**	1.75 [8.06]**	0.12 [0.74]	-0.13 [0.16]
$\Delta lnY_{i,t-1}$	1.52 [2.96]**	1.48 [2.86]**					0.56 [0.89]	0.41 [0.87]
$\Delta lnY_{i,t-2}$	0.72 [1.38]						0.74 [1.55]	1.19 [1.98]**
$\Delta lnY_{i,t-3}$							1.41 [2.23]**	1.47 [2.65]**
$\Delta lnY_{i,t-4}$							0.86 [1.21]	1.34 [2.01]**
$\Delta lnY_{i,t-5}$							0.17 [0.67]	0.89 [1.54]
$\Delta lnY_{i,t-6}$								
$\Delta lnY_{i,t-7}$								
$\Delta lnREX_{i,t}$	-0.20 [1.33]		0.10 [0.57]		0.04 [0.42]		-1.80 [2.01]**	
$\Delta lnREX_{i,t-1}$	-0.18 [1.16]		-0.23 [1.15]		0.27 [2.04]**			
$\Delta lnREX_{i,t-2}$	-0.52 [3.08]**		-0.34 [1.72*]		0.26 [1.88]*			
$\Delta lnREX_{i,t-3}$	-0.14 [0.78]							
$\Delta lnREX_{i,t-4}$	-0.04 [0.24]							
$\Delta lnREX_{i,t-5}$	-0.35 [2.04]**							
$\Delta lnREX_{i,t-6}$								
$\Delta lnREX_{i,t-7}$								
ΔPOS_t		-0.51 [1.19]		1.10 [1.57]		0.02 [0.04]		0.56 [0.73]
ΔPOS_{t-1}		0.07 [0.12]		-2.28 [2.79]**		0.94 [2.12]**		
ΔPOS_{t-2}		-1.63 [2.83]**		-1.07 [1.22]		0.75 [1.63]		
ΔPOS_{t-3}				-2.22 [2.38]**		0.20 [0.42]		
ΔPOS_{t-4}				-0.92 [1.03]		-1.44 [3.12]**		
ΔPOS_{t-5}				-1.65 [2.02]**		-0.74 [1.49]		
ΔPOS_{t-6}								
ΔPOS_{t-7}								
ΔNEG_t		-0.92 [1.48]		-0.13 [0.18]		-0.06 [0.18]		-6.43 [2.11]**
ΔNEG_{t-1}				1.47 [1.78]*				-4.81 [2.01]**
ΔNEG_{t-2}				0.37 [0.44]				-5.01 [1.60]
ΔNEG_{t-3}				3.13 [3.75]**				-2.55 [1.28]
ΔNEG_{t-4}				2.72 [2.88]**				
ΔNEG_{t-5}				2.56 [2.69]**				
ΔNEG_{t-6}								
ΔNEG_{t-7}								
Panel B: Long-Run Estimates								
ln Y_i	2.09 [5.61]**	3.05 [2.86]**	2.55 [8.91]**	1.39 [4.23]**	3.32 [5.26]**	5.70 [1.97]**	1.76 [8.14]**	1.33 [2.89]**
ln REX_i	-0.38 [1.51]		0.04 [0.13]		-2.28 [3.85]**		-0.85 [3.35]**	
POS		-1.97 [1.61]		-0.35 [1.13]		-6 .17 [1.19]		-1.28 [1.68]*
NEG		-1.28 [2.35]**		-0.97 [2.54]**		-2.14 [1.32]		-3.05 [2.49]**
Constant	-0.98 [1.14]	-4.81 [1.20]	-2.79 [2.27]**		-3.94 [3.91]**	-6.22 [1.24]	2.38 [3.13]	1.77 [1.18]
Panel C: Diagnostic Statistics								
F	4.76*	3.55	2.52	5.75**	11.62**	4.78**	4.02	3.87

ECM_{t-1}	-0.17 [3.80]*	-0.17 [3.75]*	-0.29 [2.80]	-0.60 [4.92]**	-0.08 [5.89]**	-0.03 [4.40]**	-0.24 [3.49]*	-0.41 [3.60]*
LM	1.67	5.75	3.81	11.61	6.83	9.20*	3.67	5.33
RESET	2.65	2.69	2.63	2.66	2.36	2.50	2.71	2.44
AdjustedR^2	0.39	0.35	0.46	0.64	0.79	0.80	0.39	0.42
CS (CS^2)	S(NS)	S(NS)	S(S)	S(S)	S(S)	S(NS)	S(S)	S(S)
WALD – S		0.92		8.91**		0.09		7.21**
WALD – L		0.74		4.94**		0.71		1.34

Notes: See end of the table.

	i = China, Mainland		i = France		i = Germany		i = Italy	
	L - ARDL	NL - ARDL	L - ARDL	NL - ARDL	L - ARDL	NL - ARDL	L - ARDL	NL - ARDL
Panel A: Short–Run Estimates								
$\Delta \ln Y_{i,t}$	1.10 [4.87]**	0.91 [4.21]**	1.22 [0.93]	1.47 [1.14]	0.92 [3.30]**	0.78 [2.91]**	0.12 [3.52]**	1.14 [3.69]**
$\Delta \ln Y_{i,t-1}$	-1.09 [2.01]**	-1.26 [3.12]**	2.56 [1.83]*	1.92 [1.41]	0.79 [2.59]**	0.86 [2.93]**	1.15 [3.51]**	1.12 [3.51]**
$\Delta \ln Y_{i,t-2}$	-0.63 [1.98]**	-0.91 [3.01]**	3.54 [2.63]**	3.52 [2.66]**	0.77 [2.57]**	0.78 [2.73]**	0.91 [2.65]**	0.82 [2.46]**
$\Delta \ln Y_{i,t-3}$							-0.04 [0.12]	-0.06 [0.19]
$\Delta \ln Y_{i,t-4}$							-0.60 [1.71]*	-0.59 [1.71]*
$\Delta \ln Y_{i,t-5}$							-0.34 [1.02]	-0.52 [1.52]
$\Delta \ln Y_{i,t-6}$							0.97 [2.91]**	0.87 [2.67]**
$\Delta \ln Y_{i,t-7}$								
$\Delta \ln REX_{i,t}$	0.42 [0.46]		-0.21 [1.48]		-0.13 [1.13]		-0.65 [4.19]**	
$\Delta \ln REX_{i,t-1}$	-2.20 [1.97]**		0.09 [0.62]		0.01 [0.09]			
$\Delta \ln REX_{i,t-2}$	-3.13 [2.74]**		0.11 [0.72]		-0.08 [1.09]			
$\Delta \ln REX_{i,t-3}$	-2.22 [1.78]*		-0.02 [0.13]					
$\Delta \ln REX_{i,t-4}$	-2.58 [2.08]**		-0.23 [2.61]**					
$\Delta \ln REX_{i,t-5}$	-0.23 [0.21]		0.17 [1.91]*					
$\Delta \ln REX_{i,t-6}$	0.31 [0.29]		0.10 [1.13]					
$\Delta \ln REX_{i,t-7}$	2.37 [2.24]**		-0.21 [2.30]**					
ΔPOS_t		-3.41 [1.44]		-0.29 [0.52]		0.16 [0.33]		-1.21 [1.91]*
ΔPOS_{t-1}		1.78 [0.43]						-1.51 [2.25]**
ΔPOS_{t-2}		-3.95 [1.11]						
ΔPOS_{t-3}		-5.16 [1.65]*						
ΔPOS_{t-4}		1.33 [0.51]						
ΔPOS_{t-5}		4.71 [1.66]*						
ΔPOS_{t-6}		5.41 [1.80]*						
ΔPOS_{t-7}		4.56 [1.76]*						
ΔNEG_t		3.44 [1.81]*		-0.62 [0.91]		-0.75 [1.49]		-1.42 [1.76]*
ΔNEG_{t-1}		-4.51 [2.12]**		-0.20 [0.03]		0.05 [0.11]		1.89 [2.36]**
ΔNEG_{t-2}		-3.78 [1.99]**		0.52 [0.85]		-1.16 [2.52]**		
ΔNEG_{t-3}		-1.94 [0.62]		-0.35 [0.59]		-0.41 [0.88]		
ΔNEG_{t-4}		-3.46 [1.34]		-0.53 [2.26]**		0.10 [0.56]		
ΔNEG_{t-5}		-4.52 [1.48]		0.52 [2.61]**		0.45 [2.36]**		
ΔNEG_{t-6}		-3.09 [0.97]		0.30 [1.25]		0.52 [2.72]**		
ΔNEG_{t-7}		4.67 [2.24]**		-0.76 [3.16]**		-0.38 [1.95]*		
Panel B: Long-Run Estimates								
$\ln Y_i$	2.04 [2.39]**	2.58 [2.21]**	2.82 [2.45]**	4.32 [2.54]**	3.00 [5.02]**	1.96 [1.36]	0.34 [0.09]	0.62 [0.86]
$\ln REX_i$	2.62 [7.49]**		-1.41 [2.40]**		-1.78 [1.97]**		-6.16 [0.92]	
POS		2.82 [0.70]		-3.15 [2.06]**		-2.79 [1.69]*		-2.45 [1.42]
NEG		8.39 [3.02]**		-2.25 [1.99]**		-3.39 [2.46]**		-3.51 [2.11]**
Constant	-4.52 [4.17]**	-0.99 [0.45]	-4.56 [3.46]**	-11.01[1.72]*	-4.90 [1.92]*	-2.07 [0.35]	5.82 [0.32]	4.12 [1.30]

Panel C: Diagnostic Statistics								
F	7.31**	10.14**	3.64	3.60	5.45**	4.39*	4.29	3.95
ECM_{t-1}	-1.01 [3.75]*	-0.99 [5.01]**	-0.12 [3.23]	-0.13 [3.83]**	-0.07 [4.01]**	-0.09 [4.22]**	-0.02 [2.63]	-0.11 [3.15]
LM	6.32	7.04	10.27**	12.03 **	6.09	7.20	15.62**	12.99**
RESET	2.68	2.46	0.03	0.34	0.76	0.09	0.13	0.02
AdjustedR^2	0.74	0.79	0.58	0.59	.50	0.56	0.65	0.67
CS (CS^2)	S(S)	S(S)	S(S)	S(S)	S(S)	S(NS)	S(S)	S(NS)
WALD – S		0.69		0.23		2.14		3.81*
WALD – L		1.86		0.77		0.85		11.86**

	i = Japan		i = Korea		i = Mexico		i = Netherlands	
	L - ARDL	NL - ARDL	L - ARDL	NL - ARDL	L - ARDL	NL - ARDL	L - ARDL	NL - ARDL
Panel A: Short–Run Estimates								
$\Delta lnY_{i,t}$	0.67 [3.73]**	0.68 [3.79]**	1.02 [3.38]**	1.07 [3.70]**	1.82 [5.29]**	1.79 [7.14]**	0.53 [1.47]	0.33 [0.92]
$\Delta lnY_{i,t-1}$	0.08 [2.62]**	0.48 [2.41]**	1.13 [3.63]**	1.60 [5.09]**	0.58 [1.61]	1.06 [3.09]**		
$\Delta lnY_{i,t-2}$			0.79 [2.57]**	1.29 [4.10]**	0.47 [1.32]	0.28 [0.79]		
$\Delta lnY_{i,t-3}$			0.51 [1.73]*	0.67 [2.20]**	0.37 [1.03]	0.61 [2.21]**		
$\Delta lnY_{i,t-4}$			0.74 [2.55]**	1.12 [4.19]**	-0.88 [2.42]**			
$\Delta lnY_{i,t-5}$			-0.45 [1.90]*	-0.27 [0.99]				
$\Delta lnY_{i,t-6}$				0.47 [1.78]*				
$\Delta lnY_{i,t-7}$				0.27 [1.11]	-0.09 [1.14]			
$\Delta lnREX_{i,t}$	0.08 [0.48]		-0.61 [4.10]**		-0.30 [3.17]**		-0.41 [2.49]**	
$\Delta lnREX_{i,t-1}$			-0.07 [0.39]		-0.25 [2.71]**		0.33 [1.89]**	
$\Delta lnREX_{i,t-2}$			0.01 [0.09]		-0.19 [2.04]**		0.25 [1.42]	
$\Delta lnREX_{i,t-3}$			0.58 [3.59]**					
$\Delta lnREX_{i,t-4}$			0.36 [2.04]**					
$\Delta lnREX_{i,t-5}$								
$\Delta lnREX_{i,t-6}$								
$\Delta lnREX_{i,t-7}$								
ΔPOS_t		0.70 [1.02]		-1.43 [3.49]**		-0.17 [0.74]		0.73 [1.06]
ΔPOS_{t-1}				-0.53 [1.19]		0.61 [2.26]**		0.25 [0.33]
ΔPOS_{t-2}				0.75 [1.58]		0.13 [0.50]		0.65 [0.98]
ΔPOS_{t-3}				1.85 [3.67]**		-0.64 [2.43]**		1.47 [2.26]**
ΔPOS_{t-4}						0.32 [1.23]		
ΔPOS_{t-5}						0.32 [1.24]		
ΔPOS_{t-6}								
ΔPOS_{t-7}								
ΔNEG_t		-0.39 [0.64]		-0.90 [1.34]		-0.55 [1.23]		-2.72 [3.73]**
ΔNEG_{t-1}				1.84 [2.72]**		-1.63 [3.71]**		1.59 [2.11]**
ΔNEG_{t-2}				-0.41 [0.66]		-1.02 [2.04]**		
ΔNEG_{t-3}				0.76 [1.26]		0.73 [1.45]		
ΔNEG_{t-4}				1.76 [2.89]**		0.08 [0.19]		
ΔNEG_{t-5}				0.61 [1.01]		-0.52 [1.50]		
ΔNEG_{t-6}				1.34 [2.18]**		-0.32 [1.01]		
ΔNEG_{t-7}				1.26 [2.06]**				
Panel B: Long-Run Estimates								
$\ln Y_i$	2.47 [8.01]**	2.16 [8.31]**	0.55 [5.36]**	0.46 [0.57]	0.32 [0.04]	0.29 [1.05]	4.30 [4.89]**	2.98 [2.63]**
$\ln REX_i$	0.12 [0.46]		-1.38 [2.74]**		-4.06 [0.51]		-1.25 [3.61]**	
POS		-0.46 [0.93]		-1.54 [1.94]*		-1.52 [4.89]**		-3.03 [3.40]**
NEG		-1.34 [1.82]*		-3.77 [2.29]**		-3.95 [3.82]**		-3.25 [4.42]**
Constant	-2.46 [2.01]**	-0.88 [0.93]	6.69 [4.27]	9.13 [3.72]**	3.11 [0.41]	6.29 [6.12]**	-6.71 [6.80]**	-5.59 [1.23]
Panel C: Diagnostic Statistics								
F	5.25**	5.10	6.41**	5.77**	3.75	2.97	10.91**	8.34**

ECM_{t-1}	-0.09 [3.94]**	-0.13 [4.52]**	-0.16 [4.43]**	-0.22 [4.90]**	-0.01 [3.38]**	-0.22 [3.24]	-0.19 [6.11]**	-0.22 [6.67]**
LM	8.10*	7.12	4.61	1.65	1.20	2.34	3.73	6.17
RESET	2.41	2.47	2.08	0.01	1.03	0.54	0.75	0.11
AdjustedR^2	0.26	0.28	0.61	0.68	0.36	0.56	0.47	0.50
CS (CS^2)	S(S)	S(S)	S(S)	S(S)	S(NS)	S(S)	S(S)	S(S)
WALD – S		0.18		5.21**		6.37**		4.48**
WALD – L		6.86**		2.24		3.55*		0.08

	i = Singapore		i =Switzerland		i = United Kingdom	
	L - ARDL	**NL - ARDL**	**L - ARDL**	**NL - ARDL**	**L - ARDL**	**NL - ARDL**
Panel A: Short–Run Estimates						
$\Delta lnY_{i,t}$	-0.46 [1.47]	-0.48 [1.81]*	1.83 [3.21]**	1.73 [3.03]**	0.80 [1.05]	0.74 [1.01]
$\Delta lnY_{i,t-1}$	-0.37 [1.17]	-0.92 [3.23]**				
$\Delta lnY_{i,t-2}$	-0.12 [-0.39]	-0.60 [2.14]**				
$\Delta lnY_{i,t-3}$	0.72 [2.59]**					
$\Delta lnY_{i,t-4}$	1.05 [3.52]**					
$\Delta lnY_{i,t-5}$	0.98 [3.09]**					
$\Delta lnY_{i,t-6}$	0.69 [2.16]**					
$\Delta lnY_{i,t-7}$						
$\Delta lnREX_{i,t}$	-0.01 [0.25]		-0.01 [0.05]		-0.12 [0.45]	
$\Delta lnREX_{i,t-1}$	-0.88 [2.53]**		0.16 [0.52]			
$\Delta lnREX_{i,t-2}$	-0.51 [1.41]		0.81 [2.55]**			
$\Delta lnREX_{i,t-3}$						
$\Delta lnREX_{i,t-4}$						
$\Delta lnREX_{i,t-5}$						
$\Delta lnREX_{i,t-6}$						
$\Delta lnREX_{i,t-7}$						
ΔPOS_t		-4.29 [2.93]**		0.93 [0.65]		-0.81 [0.80]
ΔPOS_{t-1}		-2.01 [0.87]		0.71 [0.53]		
ΔPOS_{t-2}				3.09 [2.32]**		
ΔPOS_{t-3}						
ΔPOS_{t-4}						
ΔNEG_t						
ΔNEG_{t-1}						
ΔNEG_{t-2}						
ΔNEG_{t-3}		2.84 [1.85]*		-0.71 [0.57]		0.70 [0.61]
ΔNEG_{t-4}		-3.66 [2.79]**				
Panel B: Long-Run Estimates						
$\ln Y_i$	0.81 [5.10]**	2.26 [5.04]**	2.53 [5.85]**	1.76 [3.40]**	3.80 [3.93]**	1.16 [2.22]**
$\ln REX_i$	-0.21 [0.41]		-1.55 [4.46]**		-2.35 [2.15]**	
POS		-3.52 [6.12]**		-2.48 [3.08]**		-1.96 [2.24]**
NEG		1.76 [2.68]**		-3.11 [4.51]**		-3.46 [4.22]**
Constant	4.79 [6.67]**	-0.08 [0.10]	-2.92 [2.78]**	-1.60 [0.82]	-9.48 [2.23]**	2.01 [0.90]
Panel C: Diagnostic Statistics						
F	3.67	7.12**	10.84**	8.01**	6.63**	7.68**
ECM_{t-1}	-0.12 [3.35]	-0.34 [5.98]**	-0.32 [5.74]**	-0.38 [5.78]**	-0.12 [4.48]**	-0.34 [5.59]**
LM	5.17	5.39	4.04	0.57	0.78	9.98**
RESET	0.54	0.32	5.29**	3.16*	8.85**	6.91**
AdjustedR^2	0.27	0.33	0.35	0.34	0.37	0.41
CS (CS^2)	S(S)	S(NS)	S(S)	S(NS)	S(NS)	S(S)
WALD – S		0.67		2.75*		0.95
WALD – L		3.94**		3.86**		5.05**

Note:

1.-- Numbers inside the brackets are the absolute values of t-statistics.

2.-- *, ** indicate significance at the 10% and 5% level respectively.

3.-- The critical value of the F test at the 10% (5%) significant level when there are two exogenous variables (k=2) and 50 observations is 4.31 (5.03) respectively. These come from Narayan (2005, p. 1988).

4.-- The number inside the bracket for the ECM_{t-1} statistic is absolute value of the t-ratio. Critical values for this tests are -3.47 (-3.82) at the 10% (5%) level. Since Pesaran et al.'s (2001, p. 303) critical values are for large samples, we use those from Banerjee et al. (1998, Table 1, p. 276).

5.-- LM is Lagrange Multiplier test of residuals serial correlation. Since data are quarterly, we test for 4^{th} order serial correlation. It is distributed as χ^2 with four degrees of freedom. The critical value at 10% (5%) level is 7.77 (9.48)

6.-- RESET is Ramsey's test for misspecification. This is also distributed as χ^2 with one degree of freedom. Its critical value at 10% and 5% level are 2.71 and 3.84 respectively.

7.-- Both Wald statistics are distributed as χ^2 with one degree of freedom and the 10% and 5% critical values are 2.71 and 3.84 respectively.

Table 2: Full-Information Out-Payment Estimates of Both Linear ARDL (L-ARDL) and Nonlinear ARDL (NL-ARDL) Models								
	i = Australia		i = Belgium		i = Canada		i = China, Hong Kong	
	L - ARDL	NL - ARDL	L - ARDL	NL - ARDL	L - ARDL	NL - ARDL	L - ARDL	NL - ARDL
Panel A: Short–Run Estimates								
$\Delta lnY_{US,t}$	0.89 [1.33]	1.29 [1.98]**	2.96 [4.10]**	1.34 [1.45]	2.24 [6.79]**	1.96 [5.91]**	0.49 [0.35]	0.71 [0.84]
$\Delta lnY_{US,t-1}$					-0.84 [1.90]*	-0.67 [1.56]	1.01 [0.42]	0.60 [0.36]
$\Delta lnY_{US,t-2}$					0.82 [2.14]	0.78 [2.08]**	3.12 [1.35]	3.31 [1.60]
$\Delta lnY_{US,t-3}$							-1.01 [0.98]	-1.42 [0.83]
$\Delta lnY_{US,t-4}$							5.01 [2.36]**	4.87 [2.22]**
$\Delta lnY_{US,t-5}$								
$\Delta lnY_{US,t-6}$								
$\Delta lnY_{US,t-7}$								
$\Delta lnREX_{i,t}$	-0.16 [0.97]		-0.18 [0.78]		0.04 [0.36]		-0.59 [0.83]	
$\Delta lnREX_{i,t-1}$	0.004 [0.02]				0.27 [1.83]*			
$\Delta lnREX_{i,t-2}$	-0.42 [2.31]**				0.22 [1.46]			
$\Delta lnREX_{i,t-3}$	-0.33 [1.84]*				0.09 [0.61]			
$\Delta lnREX_{i,t-4}$					-0.07 [1.11]			
$\Delta lnREX_{i,t-5}$					-0.02 [0.39]			
$\Delta lnREX_{i,t-6}$					0.14 [2.27]**			
$\Delta lnREX_{i,t-7}$					-0.15 [2.20]**			
ΔPOS_t		0.07 [0.12]		-1.23 [0.99]		-0.34 [0.68]		-5.03 [1.25]
ΔPOS_{t-1}						0.37 [0.73]		
ΔPOS_{t-2}						0.71 [1.38]		
ΔPOS_{t-3}						0.84 [1.51]		
ΔPOS_{t-4}						-1.19 [2.22]**		
ΔPOS_{t-5}						-1.29 [2.26]**		
ΔPOS_{t-6}						-0.94 [1.60]		
ΔPOS_{t-7}						-0.94 [1.57]		
ΔNEG_t		-0.94 [1.40]		1.40 [0.94]		0.23 [0.56]		0.86 [0.67]
ΔNEG_{t-1}		0.05 [0.08]		-0.62 [0.52]		1.35 [2.06]**		
ΔNEG_{t-2}		-2.11 [2.81]**		0.74 [0.64]		0.27 [0.38]		
ΔNEG_{t-3}						0.03 [0.04]		
ΔNEG_{t-4}						-0.04 [0.29]		
ΔNEG_{t-5}						0.08 [0.58]		
ΔNEG_{t-6}						0.47 [3.19]**		
ΔNEG_{t-7}						-0.21 [1.38]		
Panel B: Long-Run Estimates								
$ln Y_{US}$	1.87 [2.49]**	3.43 [2.58]**	3.15 [2.57]**	1.51 [5.24]**	2.49 [6.79]**	3.26 [3.61]**	-1.19 [2.24]**	0.95 [1.10]
$ln REX_i$	-0.32 [1.39]		-1.18 [3.06]**		-0.47 [0.65]		-0.53 [0.80]	
POS		-3.25 [1.56]		-0.46 [1.34]		-2.23 [0.78]		-3.42 [3.16]**
NEG		-1.76 [1.78]*		-1.55 [6.17]**		-1.39 [0.82]		0.86 [0.72]
Constant	-0.82 [1.24]	-6.92 [1.38]	-6.43 [1.15]	0.89 [0.68]	-0.05 [0.03]	-3.07 [0.85]	3.69 [4.61]**	4.22 [1.25]
Panel C: Diagnostic Statistics								
F	4.06	5.26**	2.78	6.33**	3.32	2.64	3.29	3.28
ECM_{t-1}	-0.17 [3.46]	-0.15 [4.61]**	-0.19 [2.90]	-0.66 [3.29]	-0.05 [3.17]	-0.06 [3.28]	-0.17 [3.12]	-0.39 [3.53]*
LM	4.01	5.28	3.49	1.94	12.91**	13.25**	4.26	1.42
RESET	0.03	0.63	0.08	1.45	5.63**	9.67**	2.66	2.02

AdjustedR^2	0.35	0.38	0.42	0.43	0.68	0.71	0.50	0.51
CS (CS^2)	S(NS)	S(NS)	S(NS)	S(S)	S(S)	S(NS)	S(S)	S(S)
WALD – S		5.05**		0.50		5.90		0.85
WALD – L		1.95		0.48		0.34		9.56**

Note: See end of the table.

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	i = China, Mainland		i = France		i = Germany		i = Italy	
	L - ARDL	NL - ARDL	L - ARDL	NL - ARDL	L - ARDL	NL - ARDL	L - ARDL	NL - ARDL
Panel A: Short–Run Estimates								
$\Delta lnY_{US,t}$	0.33 [0.88]	-1.17 [1.51]	0.34 [0.67]	0.48 [0.93]	0.42 [1.12]	0.66 [1.67]*	1.79 [4.36]**	1.73 [4.26]**
$\Delta lnY_{US,t-1}$	0.98 [1.80]*	-0.39 [0.48]	0.96 [1.60]	0.99 [1.62]	1.88 [3.67]**	1.59 [3.34]**	0.64 [1.29]	0.65 [1.34]
$\Delta lnY_{US,t-2}$	1.31 [2.05]**	0.70 [0.88]	1.39 [2.38]**	1.58 [2.57]**	1.46 [3.01]**	1.29 [2.85]**	0.70 [1.38]	0.80 [1.62]
$\Delta lnY_{US,t-3}$		1.59 [2.01]**	-0.30 [0.04]	-0.08 [0.13]			-1.05 [2.07]**	-1.02 [2.02]**
$\Delta lnY_{US,t-4}$		0.86 [0.91]	1.75 [3.41]**	1.32 [2.79]**			1.52 [3.04]**	1.68 [3.42]**
$\Delta lnY_{US,t-5}$		1.27 [1.38]					-0.89 [1.81]*	-0.92 [1.88]*
$\Delta lnY_{US,t-6}$		1.82 [1.88]**					0.79 [1.80]*	0.99 [2.28]**
$\Delta lnY_{US,t-7}$		-0.89 [1.25]						
$\Delta lnREX_{i,t}$	0.43 [0.61]		-0.22 [1.72]*		-0.47 [4.20]**		-0.15 [1.42]	
$\Delta lnREX_{i,t-1}$					-0.07 [0.58]			
$\Delta lnREX_{i,t-2}$					-0.16 [1.33]			
$\Delta lnREX_{i,t-3}$					0.23 [3.39]**			
$\Delta lnREX_{i,t-4}$					0.02 [0.33]			
$\Delta lnREX_{i,t-5}$					0.05 [0.81]			
$\Delta lnREX_{i,t-6}$					0.20 [2.97]**			
$\Delta lnREX_{i,t-7}$								
ΔPOS_t		1.42 [0.53]		-0.13 [0.23]		-0.58 [1.28]		0.53 [1.26]
ΔPOS_{t-1}		-7.26 [4.71]**						
ΔPOS_{t-2}		-2.72 [4.71]**						
ΔPOS_{t-3}		-5.61 [5.13]**						
ΔPOS_{t-4}		-7.92 [4.10]**						
ΔPOS_{t-5}		-4.88 [2.33]**						
ΔPOS_{t-6}		-4.37 [2.59]**						
ΔPOS_{t-7}		-2.26 [1.30]						
ΔNEG_t		1.49 [1.23]		0.89 [1.37]		-1.28 [2.69]**		-1.58 [2.92]**
ΔNEG_{t-1}		-0.05 [0.02]		-0.24 [1.03]		-0.43 [0.97]		
ΔNEG_{t-2}		2.26 [1.30]				-0.21 [0.48]		
ΔNEG_{t-3}		1.74 [1.13]				-0.81 [1.81]**		
ΔNEG_{t-4}		-0.04 [0.03]				0.12 [0.65]		
ΔNEG_{t-5}		2.09 [1.45]				0.19 [1.08]		
ΔNEG_{t-6}		-0.36 [0.24]				0.61 [3.41]**		
ΔNEG_{t-7}		-2.37 [1.56]						
Panel B: Long-Run Estimates								
$\ln Y_{US}$	0.13 [0.51]	0.24 [1.36]	2.19 [5.13]**	2.86 [1.85]*	2.10 [8.69]**	1.26 [1.76]*	2.25 [4.01]**	0.75 [0.53]
$\ln REX_i$	2.84 [1.27]		0.50 [0.89]		0.88 [1.31]		1.52 [1.23]	
POS		4.23 [5.36]**		0.32 [0.20]		2.08 [2.52]**		3.56 [1.81]*
NEG		1.71 [6.23]**		0.82 [0.53]		0.81 [0.96]		2.25 [1.33]
Constant	6.11 [0.53]	9.01 [2.23]**	-0.67 [0.34]	-2.99 [0.56]	-2.52 [1.71]*	3.06 [1.18]	-0.86 [0.32]	4.19 [0.80]
Panel C: Diagnostic Statistics								
F	9.65**	7.78**	5.93**	3.27	1.72	3.39	4.28	3.96
ECM_{t-1}	-0.16 [4.22]**	-1.22 [6.02]**	-0.06 [4.22]**	-0.05 [3.61]*	-0.04 [2.23]	-0.11 [3.72]*	-0.04 [3.61]*	-0.06 [4.01]*
LM	7.13	13.59**	11.28**	6.94	3.44	1.55	12.39**	12.91**
RESET	2.59	1.33	0.86	1.38	1.04	1.06	1.17	0.25
AdjustedR^2	0.93	0.96	0.46	0.45	0.52	0.55	0.52	0.54

CS (CS^2)	S(S)	S(S)	S(S)	S(NS)	S(NS)	S(S)	S(S)	S(NS)
WALD – S		7.38**		0.75		1.45		6.07**
WALD – L		8.07**		0.34		6.01**		1.72

	i = Japan		i = Korea		i = Mexico		i = Netherlands	
	L - ARDL	NL - ARDL	L - ARDL	NL - ARDL	L - ARDL	NL - ARDL	L - ARDL	NL - ARDL
Panel A: Short–Run Estimates								
$\Delta lnY_{US,t}$	0.74 [1.84]*	0.65 [1.56]	1.87 [3.61]**	1.15 [2.21]**	-0.04 [0.08]	-0.11 [0.19]	1.53 [2.30]**	1.52 [2.24]**
$\Delta lnY_{US,t-1}$	1.60 [3.17]**	1.64 [3.22]**			-0.50 [0.72]	-0.50 [0.71]	1.42 [2.10]**	1.36 [2.05]**
$\Delta lnY_{US,t-2}$	0.79 [1.74]*	0.83 [1.77]*			0.45 [0.65]	0.39 [0.55]		
$\Delta lnY_{US,t-3}$					-0.91 [1.32]	-0.88 [1.27]		
$\Delta lnY_{US,t-4}$					3.08 [5.66]**	3.02 [5.59]**		
$\Delta lnY_{US,t-5}$								
$\Delta lnY_{US,t-6}$								
$\Delta lnY_{US,t-7}$								
$\Delta lnREX_{i,t}$	-0.05 [0.28]		0.14 [1.24]		-0.07 [1.13]		0.001 [0.01]	
$\Delta lnREX_{i,t-1}$					0.14 [2.38]**			
$\Delta lnREX_{i,t-2}$								
$\Delta lnREX_{i,t-3}$								
$\Delta lnREX_{i,t-4}$								
$\Delta lnREX_{i,t-5}$								
$\Delta lnREX_{i,t-6}$								
$\Delta lnREX_{i,t-7}$								
ΔPOS_t		0.52 [0.71]		-0.31 [0.92]		-0.11 [0.67]		0.41 [0.63]
ΔPOS_{t-1}				-0.29 [0.79]		0.46 [2.49]**		
ΔPOS_{t-2}				-0.74 [1.72]*				
ΔPOS_{t-3}				-0.47 [1.27]				
ΔPOS_{t-4}				-0.31 [0.83]				
ΔPOS_{t-5}				-0.57 [1.65]*				
ΔPOS_{t-6}								
ΔPOS_{t-7}								
ΔNEG_t		-0.86 [1.18]		-0.12 [0.19]		-0.04 [0.09]		-0.53 [0.48]
ΔNEG_{t-1}								
ΔNEG_{t-2}								
ΔNEG_{t-3}								
ΔNEG_{t-4}								
ΔNEG_{t-5}								
ΔNEG_{t-6}								
ΔNEG_{t-7}								
Panel B: Long-Run Estimates								
$\ln Y_{US}$	-1.22 [0.52]	-5.50 [0.93]	2.99 [5.30]**	1.11 [7.83]**	2.51 [1.90]*	1.55 [1.07]	2.79 [7.44]**	2.56 [1.09]
$\ln REX_i$	0.31 [0.22]		-0.49 [1.41]		-2.85 [1.41]		0.16 [0.24]	
POS		0.33 [0.09]		0.42 [2.01]**		-4.33 [1.53]		0.48 [0.26]
NEG		-6.01 [0.86]		-0.68 [4.02]**		-5.46 [2.02]**		0.31 [0.17]
Constant	13.91 [1.57]	15.02 [1.36]	-0.59 [0.14]	3.64 [5.98]**	6.98 [0.62]	2.69 [0.46]	-4.48 [2.75]**	-3.59 [0.42]
Panel C: Diagnostic Statistics								
F	8.33**	6.61**	2.26	9.34**	4.08	3.04	2.98	2.04
ECM_{t-1}	-0.03 [4.40]**	-0.02 [4.64]**	-0.11 [2.63]	-0.50 [6.13]**	-0.04 [3.52]**	-0.06 [3.51]**	-0.07 [2.63]	-0.09 [2.87]
LM	7.50	8.16*	8.79*	13.28**	10.43**	9.90**	3.65	5.13
RESET	2.10	2.26	0.06	5.11**	0.33	0.03	2.70	2.16
AdjustedR^2	0.27	0.28	0.44	0.53	0.32	0.31	0.31	0.30
CS (CS^2)	S(S)	S(S)	S(S)	S(S)	S(S)	S(S)	S(S)	S(NS)
WALD – S		1.70		10.51**		0.52		0.41
WALD – L		0.09		5.15**		1.69		0.09

	i = Singapore		i = Switzerland		i = United Kingdom	
	L - ARDL	**NL - ARDL**	**L - ARDL**	**NL - ARDL**	**L - ARDL**	**NL - ARDL**
Panel A: Short–Run Estimates						
$\Delta \ln Y_{US,t}$	-0.69 [0.54]	-0.37 [0.29]	0.61 [0.40]	0.12 [0.07]	0.44 [0.49]	0.49 [0.55]
$\Delta \ln Y_{US,t-1}$			4.68 [2.59]**	5.69 [3.23]**	0.80 [0.75]	1.06 [0.98]
$\Delta \ln Y_{US,t-2}$			-1.09 [0.64]	-0.94 [0.56]	1.08 [1.01]	0.78 [0.73]
$\Delta \ln Y_{US,t-3}$			0.73 [0.40]	0.58 [0.32]	0.72 [0.78]	0.71 [0.68]
$\Delta \ln Y_{US,t-4}$			-3.65 [2.35]**	-3.26[2.13]**	1.40 [1.54]	1.49 [1.66]*
$\Delta \ln Y_{US,t-5}$						
$\Delta \ln Y_{US,t-6}$						
$\Delta \ln Y_{US,t-7}$						
$\Delta \ln REX_{i,t}$	-0.93 [2.70]**		-0.47 [3.07]**		-0.43 [1.91]*	
$\Delta \ln REX_{i,t-1}$			-0.24 [1.51]			
$\Delta \ln REX_{i,t-2}$						
$\Delta \ln REX_{i,t-3}$						
$\Delta \ln REX_{i,t-4}$						
$\Delta \ln REX_{i,t-5}$						
$\Delta \ln REX_{i,t-6}$						
$\Delta \ln REX_{i,t-7}$						
ΔPOS_t		-3.82 [2.68]**		0.04 [0.05]		-0.36 [0.42]
ΔPOS_{t-1}						
ΔPOS_{t-2}						
ΔPOS_{t-3}						
ΔPOS_{t-4}						
ΔNEG_t						
ΔNEG_{t-1}						
ΔNEG_{t-2}						
ΔNEG_{t-3}		-0.41 [0.29]		-2.55 [3.18]**		-1.89 [1.86]*
ΔNEG_{t-4}						
Panel B: Long-Run Estimates						
$\ln Y_{US}$	-1.65 [0.79]	1.09 [0.23]	1.94 [5.79]**	0.95 [1.79]*	1.86 [4.04]**	2.39 [1.50]
$\ln REX_i$	-1.01 [0.78]		0.61 [1.02]		-2.35 [2.10]**	
POS		-5.83 [1.01]		1.51 [1.89]*		-6.58 [1.39]
NEG		-2.01 [0.72]		0.21 [0.22]		-6.01 [1.67]*
Constant	6.11 [1.72]*	4.87 [0.25]	-1.29 [0.58]	1.12 [0.52]	-0.06 [0.04]	-1.27 [0.28]
Panel C: Diagnostic Statistics						
F	5.41**	3.90**	1.07	1.52	6.71**	4.74*
ECM_{t-1}	-0.06 [4.05]**	-0.06 [4.01]**	-0.09 [1.69]	-0.12 [1.92]	-0.12 [4.51]**	-0.10 [4.36]**
LM	8.67*	6.43	1.51	5.12	2.03	3.52
RESET	2.63	1.56	10.67**	2.31	7.45**	6.46**
AdjustedR^2	0.5	0.27	0.34	0.38	0.45	0.44
CS (CS^2)	S(S)	S(NS)	S(NS)	S(NS)	S(NS)	S(S)
WALD – S		1.84		5.19**		0.95
WALD – L		0.27		2.36		0.22

Note:

1.-- Numbers inside the brackets are the absolute values of t-statistics.

2.-- *, ** indicate significance at the 10% and 5% level respectively.

3.-- The critical value of the F test at the 10% (5%) significant level when there are two exogenous variables (k=2) and 50 observations is 4.31 (5.03) respectively. These come from Narayan (2005, p. 1988).

4.-- The number inside the bracket for the ECM_{t-1} statistic is absolute value of the t-ratio. Critical values for this tests are -3.47 (-3.82) at the 10% (5%) level. Since Pesaran et al.'s (2001, p. 303) critical values are for large samples, we use those from Banerjee et al. (1998, Table 1, p. 276).

5.-- LM is Lagrange Multiplier test of residuals serial correlation. Since data are quarterly, we test for 4th order serial correlation. It is distributed as χ^2 with four degrees of freedom. The critical value at 10% (5%) level is 7.77 (9.48)

6.-- RESET is Ramsey's test for misspecification. This is also distributed as χ^2 with one degree of freedom. Its critical value at 10% and 5% level are 2.71 and 3.84 respectively.

7.-- Both Wald statistics are distributed as χ^2 with one degree of freedom and the 10% and 5% critical values are 2.71 and 3.84 respectively.