Thailand-China Commodity Trade and Exchange Rate Uncertainty: Asymmetric Evidence from 45 Industries

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Abstract

Assessing the short-run and long-run effects of exchange rate uncertainty on trade flows since 2017 has taken a new direction by engaging in asymmetry analysis. In this paper we add to the new literature by estimating both a linear and a nonlinear ARDL export and import demand models for each of the 45 industries that trade between Thailand and China. Estimates of the linear models revealed that exchange rate uncertainty has short-run effects on 22 Thai exporting and 32 Thai importing industries. However, the nonlinear model revealed that exchange rate uncertainty has short-run asymmetric effects on the trade flows of almost all industries. Short-run asymmetric effects lasted into long-run asymmetric effects in 50% of the industries.

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I. Introduction

The change in international monetary system in 1973 from fixed to relatively more flexible exchange rates not only introduced uncertainty about future rates but also opened an avenue for research on the effects of exchange rate uncertainty on the trade flows. Theoretically, exchange rate uncertainty could have negative or positive impact on trade flows. Risk averse traders will trade less in order to avoid future uncertain exchange rates and prices. Risk tolerant traders will trade more today in order to hedge against loss of income in the future. Indeed, theoretical developments by De Grauwe (1988) and Peree and Steinherr (1989) and empirical literature reviewed by Bahmani-Oskooee and Hegerty (2007) support both views.

The review article by Bahmani-Oskooee and Hegerty (2007) reveals that researchers have used trade data at three different levels of disaggregation. The first group have looked at the impact of exchange rate uncertainty on the trade flows of one country with the rest of the world. As far as our country of concern, Thailand, is concerned, Caballero and Corbo (1989) formulated an aggregate export demand model in which the real exchange rate, world demand, and a measure of exchange rate uncertainty were identified to be the main determinants of a country's exports. The model is then estimated for six developing countries including Thailand. Their estimates revealed that exchange rate uncertainty has significantly negative impact on Thailand's exports to the world. Arize *et al*. (2000) consider exports of 13 developing countries, including Thailand. Again, their cointegration approach reveals that not only the variables in an export demand model are cointegrated but exchange rate uncertainty has significantly adverse impact on exports of all 13 countries including Thailand. However, exactly opposite results are reported by Poon *et al.* (2005) who found that exchange rate volatility had a significantly positive effect on Thailand's exports which could be due to extended data. Finally, Sauer and Bohara (2001) estimated a panel export demand model by

using time-series data over the period 1973-93 across 91 countries. When all 91 countries were included in the model, they report significantly negative effects of exchange rate uncertainty on aggregate exports. Clearly, their findings could suffer from aggregation bias in that what may be true for all countries together, may not be true for each cross-sectional unit. Indeed, when the data were disaggregated by region and the model was estimated for a panel of 12 Asian countries that included Thailand, exchange rate volatility was found to have no significant impact on exports.

Bahmani-Oskooee and Satawatananon (2012) criticized the above time-series and panel studies and argued that they suffer from aggregation bias. As they pointed out, trade flows between one country and its major partners could react differently to exchange rate uncertainty. To reduce the bias, some studies assess the impact of exchange rate volatility on bilateral trade flows between two countries. Even bilateral trade flows between two countries will suffer from another aggregation bias in that different industries may react differently to a measure of exchange rate uncertainty. To demonstrate their point, Bahmani-Oskooee and Satawatananon (2012) disaggregated the trade flows between Thailand and its major partner, the U.S., by industry and considered the response of trade flows of 118 Thai importing industries from the U.S. and 41 Thailand exporting industries to the U.S. They found that exchange rate uncertainty has short-run effects on the trade flows of most industries. In the long-run, the main determinants of the trade flows were the level of economic activities in both countries.

Due to increased role of China in the global economy, today China happens to be the major trading partner of Thailand. Indeed, Bahmani-Oskooee and Kantipong (2018) have shown that trade share of China with Thailand is almost twice as large of that of the U.S.. Now that China is the major trading partner of Thailand, we wonder if commodity trade flows between Thailand and China respond to a measure of real Baht-Yuan volatility negatively or

positively. As depicted in Figure 1, the real exchange rate between the Thai Baht and Chinese Yuan has been volatile during our study period. Although our goal is to identify industries that respond negatively and those that respond positively, we address another deficiency of the above studies. That is, they have assumed that response of trade flows to a measure of exchange rate uncertainty is symmetric, i.e., if an x% increase in exchange rate volatility hurts exports by y%, an x% decrease in volatility will boost exports by y%. However, Bahmani-Oskooee and Aftab (2017) recently argued that since traders could have different reactions to an increase in volatility as compared to a decrease in volatility, the effects of exchange rate uncertainty on trade flows could be asymmetric.[1]

Therefore, we not only assess the symmetric effects of the real Baht-Yuan volatility on imports and exports of 45 industries that trade between the two countries, but also its asymmetric effects. To that end, in Section II we outline the models and explain the methods. We then present our results in Section III that is followed by a summary in Section IV. Data definition and sources are then provided in an Appendix.

II. The Models and Methods[2]

Almost all models in the literature have identified a scale variable, relative prices, and volatility of the real exchange rate to be the main determinants of a country's trade flows. Indeed, in showing the asymmetric effects of exchange rate volatility on trade flows at commodity level Bahmani-Oskooee and Aftab (2017) modified these models so that they conform to commodity level data. Therefore, we closely follow their specifications and their approaches by adopting the following two specifications first:

1 There is now abundant evidence that domestic prices, import and export prices, and trade flows react asymmetrically to exchange rate changes. If so, we would also expect them to react asymmetrically to a volatility measure of exchange rate. See Delatte and Lopez-Villavicencio (2012), Bussiere (2013), Bahmani-Oskooee and Fariditavana (2016), Nusair (2017), and Arize et al. (2017).

$$LnX_{i,t}^{TH} = \alpha_o + \alpha_1 LnY_t^{CH} + \alpha_2 LnREX_t + \alpha_3 LnV_t + \varepsilon_t \qquad (1)$$

$$LnM_{i,t}^{TH} = \beta_o + \beta_1 LnY_t^{TH} + \beta_2 LnREX_t + \beta_3 LnV_t + \mu_t \qquad (2)$$

Specification (1) is commonly referred to as an export demand model (i.e., China's demand for Thailand's export of commodity i) and specification (2) is known as Thailand's import demand (i.e., Thailand's imports of commodity i from China). In (1) we have assumed that Thailand's export of commodity i, $X_{i,t}^{TH}$, depends on China's income, Y_t^{CH}, the real bilateral Baht-Yuan exchange rate, REX_t, and a volatility measure of the real exchange rate, V_t. Since an increase in Chinese income is expected to boost Thailand's exports, we expect an estimate of α_1 to be positive. Furthermore, as Baht depreciates against Yuan in real term, i.e., as REX_t declines, since we expect Thailand's exports to rise, an estimate of α_2 is expected to be negative. Finally, as mentioned in previous section, since exchange rate volatility could have negative or positive effects on Thailand's exports, an estimate of α_3 could be negative or positive.

As mentioned specification (2) is Thailand's own import demand model where we have assumed Thailand's import of commodity i ($M_{i,t}^{TH}$) depends on Thailand's income (Y_t^{TH}), the real exchange rate, and its volatility. Following the same logic as above, we expect an estimate of β_1 to be positive if income increase in Thailand is to induce more imports.[3] On the other hand, if a depreciation is to reduce imports, an estimate of β_2 is expected to be positive. Finally, just like exports since exchange rate volatility could have negative or positive effects on imports, an estimate of β_3 could be negative or positive.

Estimates of (1) and (2) by any method only yields the long-run effects of exogenous variables on trade flows. In order to also assess the short-run effects of exogenous variables, the common practice is to rewrite the models in an error-correction format as outlined by (3)

2 The models and methods will closely follow Bahmani-Oskooee and Aftab (2017).

and (4) below:

$$\Delta LnX_{i,t}^{TH} = a_1 + \sum_{j=1}^{n1} a_{2j}\Delta LnX_{i,t-j}^{TH} + \sum_{j=0}^{n2} a_{3j}\Delta LnY_{t-j}^{CH} + \sum_{j=0}^{n3} a_{4j}\Delta LnREX_{t-j} + \sum_{j=0}^{n4} a_{5j}\Delta LnV_{t-j}$$

$$+ \theta_1 LnX_{i,t-1}^{TH} + \theta_2 LnY_{t-1}^{CH} + \theta_3 LnREX_{t-1} + \theta_4 LnV_{t-1} + \varepsilon_t \qquad (3)$$

$$\Delta LnM_{i,t}^{TH} = b_1 + \sum_{j=1}^{n5} b_{2j}\Delta LnM_{i,t-j}^{TH} + \sum_{j=0}^{n6} b_{3j}\Delta LnY_{t-j}^{TH} + \sum_{j=0}^{n7} b_{4j}\Delta LnREX_{t-j} + \sum_{j=0}^{n8} b_{5j}\Delta LnV_{t-j}$$

$$+ \rho_1 LnM_{i,t-1}^{TH} + \rho_2 LnY_{t-1}^{TH} + \rho_3 LnREX_{t-1} + \rho_4 LnV_{t-1} + \varepsilon_t \qquad (4)$$

The above error-correction models are due to Pesaran et al. (2001) and have an advantage of estimating short-run and long-run effects of all exogenous variables in one step. Indeed, in both error-correction models short-run effects are reflected in the estimates of coefficients assigned to first-differenced variables and long-run effects by the estimates of θ_2-θ_4 normalized on θ_1 in (3) and $\rho_2 - \rho_4$ normalized on ρ_1 in (4). However, in order for the long-run effects to be meaningful in both models, Pesaran *et al*. (2001) propose applying the F test to establish joint significance of lagged level variables as a sign of cointegration.[4]

Specifications (3) and (4) assumes that the effects of each of the exogenous variables on the dependent variables are symmetric. However, as mentioned in the previous section, our goal is to assess the asymmetric effects of the volatility measure. Following Bahmani-Oskooee and Aftab (2017) we first form *ΔLnV* which includes positive changes and negative changes. We then construct two new time-series variables, one representing only increased volatility as a partial sum of positive changes, denoted by POS and the second one measuring decreased volatility as a partial sum of negative changes denoted by NEG as follows:

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3 Note that income elasticities in both models could be negative if increase in income is due to an increase in import-substitute goods (Bahmani-Oskooee 1986).

4 Note that the F test in this context has new critical values that they tabulate. Since the critical values do account for integrating properties of variables, variables could be combination of I(0) and I(1) and this is another advantage of this approach.

$$POS_t = \sum_{j=1}^{t} \max(\Delta LnV_j, 0), \quad NEG_t = \sum_{j=1}^{t} \min(\Delta LnV_j, 0) \qquad (5)$$

We then shift back to (3) and (4) and replace the volatility variable, LnV_t, with POS_t and NEG_t variables. The outcome is:

$$\begin{aligned}\Delta LnX_{i,t}^{TH} &= c_1 + \sum_{j=1}^{n1} c_{2j} \Delta LnX_{i,t-j}^{TH} + \sum_{j=0}^{n2} c_{3j} \Delta LnY_{t-j}^{CH} + \sum_{j=0}^{n3} c_{4j} \Delta LnREX_{t-j} \\ &+ \sum_{j=0}^{n4} c_{5j} \Delta POS_{t-j} + \sum_{j=0}^{n5} c_{6j} \Delta NEG_{t-j} + \lambda_1 LnX_{i,t-1}^{TH} + \lambda_2 LnY_{t-1}^{CH} \\ &+ \lambda_3 LnREX_{t-1} + \lambda_4 POS_{t-1} + \lambda_5 NEG_{t-1} + \varepsilon_t \qquad (6)\end{aligned}$$

$$\begin{aligned}\Delta LnM_{i,t}^{TH} &= d_1 + \sum_{j=1}^{n6} d_{2j} \Delta LnM_{i,t-j}^{TH} + \sum_{j=0}^{n7} d_{3j} \Delta LnY_{t-j}^{TH} + \sum_{j=0}^{n8} d_{4j} \Delta LnREX_{t-j} \\ &+ \sum_{j=0}^{n9} d_{5j} \Delta POS_{t-j} + \sum_{j=0}^{n10} d_{6j} \Delta NEG_{t-j} + \pi_1 LnM_{i,t-1}^{TH} + \pi_2 LnY_{t-1}^{TH} \\ &+ \pi_3 LnREX_{t-1} + \pi_4 POS_{t-1} + \pi_5 NEG_{t-1} + \varepsilon_t \qquad (7)\end{aligned}$$

Shin *et al*. (2014) who introduced this asymmetry approach first call models like (6) and (7) nonlinear ARDL models since constructing the POS and NEG variables introduce nonlinearity into the model. By contrast, (3) and (4) are called linear ARDL models. Shin *et al*. (2014) show that the linear and nonlinear models could be estimated and tested for cointegration by applying Pesaran *et al*.'s (2001) bounds tests.[5]

Once (6) and (7) are estimated and cointegration is established, short-run asymmetric effects will be established if at a given lag order j, the size of the coefficient estimate attached to ΔPOS_{t-j} and ΔNEG_{t-j} are different. However, e, short-run cumulative or impact asymmetry effects of exchange rate volatility will be established if we can reject the null hypothesis of $\sum \hat{c}_{5j} = \sum \hat{c}_{6j}$ in the nonlinear model (6) and $\sum \hat{d}_{5j} = \sum \hat{d}_{6j}$ in the nonlinear model (7).

5 Note that in applying the F test, Shin et al. (2014, p. 291) argue that the two partial sum variables should be

Finally, the long-run asymmetry effects of exchange rate volatility on trade flows will be established if we reject the null hypothesis of $\hat{\lambda}_4 / -\hat{\lambda}_1 = \hat{\lambda}_5 / -\hat{\lambda}_1$ in (6) and $\hat{\pi}_4 / -\hat{\pi}_1 = \hat{\pi}_5 / -\hat{\pi}_1$ in (7). To test both nulls, the Wald test which has a χ^2 distribution with one degree of freedom will be applied.[6]

III. The Results

In this section we estimate we estimate two linear and two nonlinear ARDL models for each of the 45 tw0-digit industries that trade between Thailand and China. A maximum of eight lags are imposed on each first-differenced variables and Akaike's Information Criterion is used to select an optimum model in each case. Since different estimates are subject to different critical values, we have collected them in the notes to each table and used them to indicate significance of an estimate. If an estimate or a diagnostic statistic is significant at the 10% level, it is identified by * and if that estimate is significant at the 5% level, it is identified by **.

We begin with the estimate of the linear export demand model. To save space, short-run results are not tabulated but we confirm that the volatility measure carried at least one significant lagged coefficient in 22 Thai exporting industries coded 11, 17, 28, 29, 30, 32, 35, 39, 41, 51, 52, 57, 60, 62, 64, 69, 70, 73, 74, 76, 91, and 94. However, short-run effects lasted into long run, only in industries coded 28, 35, 41, 57, 60, 64, 69, and 94, since the normalized long-run coefficient estimates reported in Table 1 are only significant in these eight industries. However, the estimates are meaningful only in five industries 28 (Inorganic chemical), 57 (Carpets and other textile floor coverings), 60 (Knitted fabrics), 64 (Footware), and 69

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treated as a single variable so that the critical values of the F test stay at the same high level for both the linear and nonlinear models.

[6] For some other application of these and other nonlinear models see Wimanda (2014), McFarlane (2014), Gogas and Pragidis (2015), Durmaz (2015), Baghestani and Kherfi (2015), Al-Shayeb and Hatemi-J.(2016), Lima et al. (2016), Aftab et al. (2017), Gregoriou (2017), Olaniyi (2019), and Istiak and Alam (2019).

(ceramic products) since the F test for cointegration is only significant in these five industries (Table 2). For the remaining three industries also tried an alternative test known as the ECM_{t-1} or the t-test.[7] Since we may need this test for some other industries in other models, we carried out this alternative test for all industries. Our effort was futile in that in none of the three industries 28, 35, and 41 this test was significant.

Tables 1 and 2 go about here

We have also reported in Table 2 a few additional diagnostic statistics. The Lagrange Multiplier test is reported as LM to determine if there is evidence of serial correlation in any model. As can be seen, only in four cases it is significant, supporting autocorrelation free residuals in 41 models. Ramsey's rest test is also insignificant in most models, rejecting misspecification. We also applied the CUSUM and CUSUMSQ tests to determine stability of all coefficient estimates. Indeed, almost all estimates were stable.[8] Finally, the size of adjusted R^2 is reported to judge good ness of fit.

Next we report estimates of the linear import demand model in Table 3 and associated diagnostics in Table 4. Once again, short-run estimates not reported revealed that the real baht-yuan volatility had significant short-run effects on the Thai imports from China in 32 industries coded as 11, 12, 15, 16, 17, 19, 20, 23, 28, 29, 30, 32, 34, 35, 39, 48, 50, 52, 57, 58, 60, 64, 69, 70, 71, 72, 73, 74, 76, 82, 87, and 94. However, only in 12 industries short-run effects last into the long run significant and meaningful effects. These 12 industries are coded as 15, 16, 23, 28, 30, 35, 48, 71, 72, 74, 87, and 95. While imports of four industries (i.e., 15,

[7] Under this alternative test we use normalized long-run coefficient estimates from Table 1 and long-run export demand model (1) to generate the error. Labeling the error term as ECM, we then move back to equation (2) and replace the linear combination of lagged level variables by ECM_{t-1} and estimate this new specification after imposing the same optimum lag numbers that were selected by the AIC. A significantly negative estimate attached to ECM_{t-1} supports cointegration. Since the t-test with new critical values is used to assess the significance of estimated coefficient, the test is also known as the t-test. Like the F test, Pesaran et al. (2001, p. 303) tabulate new critical values for this test which account for the degree of integration of the variables in a given model.

[8] To save space, we do not report the results of CUSUM and CUSUMSQ test results but they are available from the authors upon request.

16, 23, and 30) are affected negatively, imports of remaining eight industries (i.e., 28, 35, 48, 71, 72, 74, 87, and 95) are affected positively. From the long-run estimates it is clear that the Thai economic activity is an important long-run determinant of almost every importing industry since it carries a significantly positive normalized coefficient that is meaningful in most industries.[9]

Tables 3 and 4 go about here

How will the outcome change if we consider estimate of the nonlinear model for each industry? We consider the estimate of nonlinear export demand model (6) that are reported in Tables 5-8 first.

Tables 5-8 go about here

From Tables 5 and 6 which report the short-run coefficient estimates attached to increased volatility (ΔPOS) and to decreased volatility (ΔNEG) respectively, we gather that either ΔPOS or ΔNEG carry at least one significant coefficient in a total of 42 industries, supporting short-run effects of volatility on Thai exports to the U.S.[10] The increase in number of industries that are affected by volatility in the short run from 22 linear models to 42 nonlinear models must be attributed to introducing the nonlinear adjustment of the real baht-yuan volatility. Furthermore, at any given lag order, estimate attached to ΔPOS is different than the estimate attached to ΔNEG, supporting short-run asymmetric effects of exchange rate volatility. However, sum of the coefficient estimates attached to ΔPOS is significantly different than the sum attached to ΔNEG in 27 industries since the Wald test reported as Wald-S in Table 8 is significant, rejecting the equality of the two sums and providing support for cumulative or impact short-run asymmetric effects. In which industry short-run asymmetric effects translate into the long-run asymmetric effects?

[9] Other diagnostic statistics are similar to those in Table 2, indicating lack of serial correlation, correctly specified optimum models, stable estimates, and good fits in most models.

[10] In the remaining three industries (i.e., 33, 47, and 50) neither partial sum variables carry a significant

From the long-run coefficient estimates in Table 7 and the results of the F or t-test in Table 8 we gather that only in 19 industries either the POS or the NEG variable carry a significant and meaningful coefficient. These 19 industries are coded as 12, 28, 30, 35, 41, 48, 51, 57, 59, 61, 62, 64, 69, 70, 73, 76, 85, 94, and 95. Again, the increase in number of industries that are affected by volatility in the long run from five in the linear model to 19 in the nonlinear model must be attributed to nonlinear adjustment of the real baht-yuan volatility. Clearly, the findings are industry specific. For example, consider industry 12 (Oil seed). In the linear model in Table 1 the volatility measure carried an insignificant coefficient. If we were to rely upon old literature, we would have concluded that the real baht-yuan volatility has no long-run effects on the export of this industry to the U.S. However, the results from nonlinear model in Table 7 reveal that both the POS and NEG variables carry significantly negative and asymmetrically cointegrated coefficients, implying that increase volatility will hurt oil seed exports and decreased volatility will boost it. Such new discoveries that are masked by the linear export demand model is due to using the nonlinear model which separates increased volatility from declines in volatility. Furthermore, the long-run effects are asymmetric in a total of 22 industries due to the fact that the Wald test reported as Wald-L in Table 8 is significant, rejecting the equality of the normalized estimates attached to the POS and NEG variables.[11] Other diagnostics in Table 8 are similar to those of the linear model and need no repeat here.

Finally we turn to the estimate of nonlinear import demand model (7) for each industry and again, report the results in Tables 9-12. From the short-run coefficient estimates attached to ΔPOS in Table 9 and to ΔNEG in Table 10 we gather that except in industries 15, 26, 33, and 41, either the ΔPOS or the ΔNEG variable carries at least one lagged significant

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coefficient.

[11] Note that in some limited number of cases such as industry 19 in which neither the POS nor the NEG carried a significant coefficient, the Wald test is significant.

coefficient. Thus, it appears that the real baht-yuan volatility has short-run effects in 41 industries. Furthermore, the short-run effects are asymmetric since at any given lag order the estimate attached to the ΔPOS variable is different than the estimate attached to the ΔNEG variable.[12] However, sum of the estimates attached to both variables is significantly different in 23 industries coded 11, 12, 15, 16, 17, 19, 23, 28, 30, 35, 39, 50, 57, 58, 64, 68, 69, 71, 73, 85, 91, 94, and 95. In these industries the Wald test reported as Wald-S in Table 12 is significant, supporting cumulative or impact short-run asymmetric effects. However, short-run effects last into the long run significant and meaningful effects only in 12 industries. In these 12 industries coded as 11, 15, 16, 23, 30, 35, 41, 47, 50, 52, 69, and 71, either the POS variable or the NEG variable carry significant coefficient (Table 11) that is supported by the F or t-test for cointegration (Table 12). Furthermore, the long-run effects of volatility are asymmetric in 12 importing industries coded as 20, 23, 29, 33, 35, 41, 47, 50, 52, 69, 71, and 74. In these Thai importing industries the Wald test reported as Wald-L in Table 12 is significant, rejecting the equality of normalized long-run estimates attached to the POS and NEG variables. Once again, the results are industry specific. For example, in industry coded as 12 (Oil seed), the real baht-yuan volatility had no long-run effects on the imports of this industry in Table 3 (the linear import demand model). However, the nonlinear model reveals that while decreased volatility will boost imports of this industry, increased volatility has no effects (Table 11).[13]

IV. Summary and Conclusion

Since advent of the current float in 1973, impact of exchange rate uncertainty or volatility on trade flows have gained momentum. Both theoretical studies as well as empirical

[12] Again, the increase in number of industries from 32 in the linear import demand model to 41 nonlinear model must be attributed to nonlinear adjustment of the real baht-yuan volatility.

[13] Other diagnostics are similar to those in previous models and need no repeat.

literature supports possibility of negative and positive effects. The review article by Bahmani-Oskooee and Hegerty (2007) reveals that the literature is so large that each country has its own literature. As far as our country of concern, Thailand, is concerned, a few studies have included Thailand in their study and have found mixed results in the Thai trade with the world. To resolve the issue, one study proposed using trade flows between Thailand and its major partner, the U.S. at the commodity level. This study basically showed that the effects of exchange rate volatility on the Thai-U.S. commodity trade are short run and not long run.

Lack of long-run effects of exchange rate uncertainty on the trade flows were recently questioned by Bahmani-Oskooee and Aftab (2017) who argued and demonstrated that it could be due to assuming the movement of exchange rate volatility to be linear or symmetric. Once they introduce nonlinear adjustment of the volatility measure and engage in asymmetry analysis, they provide more evidence of significant link between commodity trade flows between U.S. and Malaysia and exchange rate volatility in an asymmetric manner. Since assessing the asymmetric effects of volatility on trade flows is a new direction, any additional study must be welcomed. To this end, we add to this new literature by considering trade flows of 45 industries that trade between Thailand and her major partner, China. We employ Pesaran et al.'s (2001) linear ARDL approach to assess the symmetric effects of the real baht-yuan volatility on the exports and imports of each industry first. We then use Shin et al. (2014) nonlinear ARDL approach to assess the asymmetric effects.

Our findings could be best summarized by saying that when the linear export and import demand models were estimate for each of the 45 industries we found short-run effects in 22 Thai exporting industries to China and 32 Thai importing industries from China. The short-run effects lasted into long-run significant and meaningful effects in 5 exporting and 12 importing industries. However, estimate of the nonlinear model revealed that the real baht-yuan volatility has short-run asymmetric effects on the exports and imports of almost all

industries, short-run cumulative effects in half of exporting and importing industries, and long-run asymmetric effects on the exports of 22 and imports of 12 industries. More significant outcomes from the nonlinear model was attributed to introducing nonlinear adjustment of exchange rate volatility. Our findings are clearly industry specific and our approach identifies industries that are hurt or helped by increased or decreased volatility.

Appendix

Data Definition and Sources

Quarterly data over the period 2000I-2016IV are used to estimate the models. They come from the following sources:

a. International Financials Statistics by the IMF.
b. Bank of Thailand website (bot.or.th).
c. Thailand Ministry of Commerce website (moc.go.th).

Variables

X_i^{TH} = Thailand's export of industry i to China. Nominal exports value for each industry come from source b. In the absence of industry specific price level, following Bahmani-Oskooee and Aftab (2017), Thailand's aggregate export price index from source a is used to deflate the nominal values to obtain real exports.

M_i^{TH} = Thailand's import of industry i from China. Nominal imports value for each industry come from source b. In the absence of industry specific price level, following Bahmani-Oskooee and Aftab (2017), Thailand's aggregate import price index from source a is used to deflate the nominal values to obtain real exports.

Y_{TH} = Measure of Thailand's income. It is proxied by index of real GDP. The data come from source b.

Y_{CH} = Measure of China's real GDP. The data come from source b.

REX = The real bilateral exchange rate of Thai baht against Chinese yuan. It is defined as $REX = (P_{TH}.NEX/P_{CH})$ where *NEX* is the nominal exchange rate defined as number of yuan per baht. P_{TH} is the price level in Thailand (measured by CPI) and P_{CH} is the price level in China (also measured by CPI). Thus, a decline in *REX* reflects a real depreciation of Thai baht against yuan. All nominal exchange rates come from source e and consumer price indexes come from source b.

V_t = Volatility measure of REX_t as a proxy for exchange rate uncertainty. Following Bahmani-Oskooee and Aftab (2017), it is generated using Generalized Autoregressive Conditional Heteroskedasticity (GARCH 1, 1) method.

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Figure 1: GARCH (1,1) Based Volatility Measure of the Real Baht-Yuan Rate over Our Study Period.

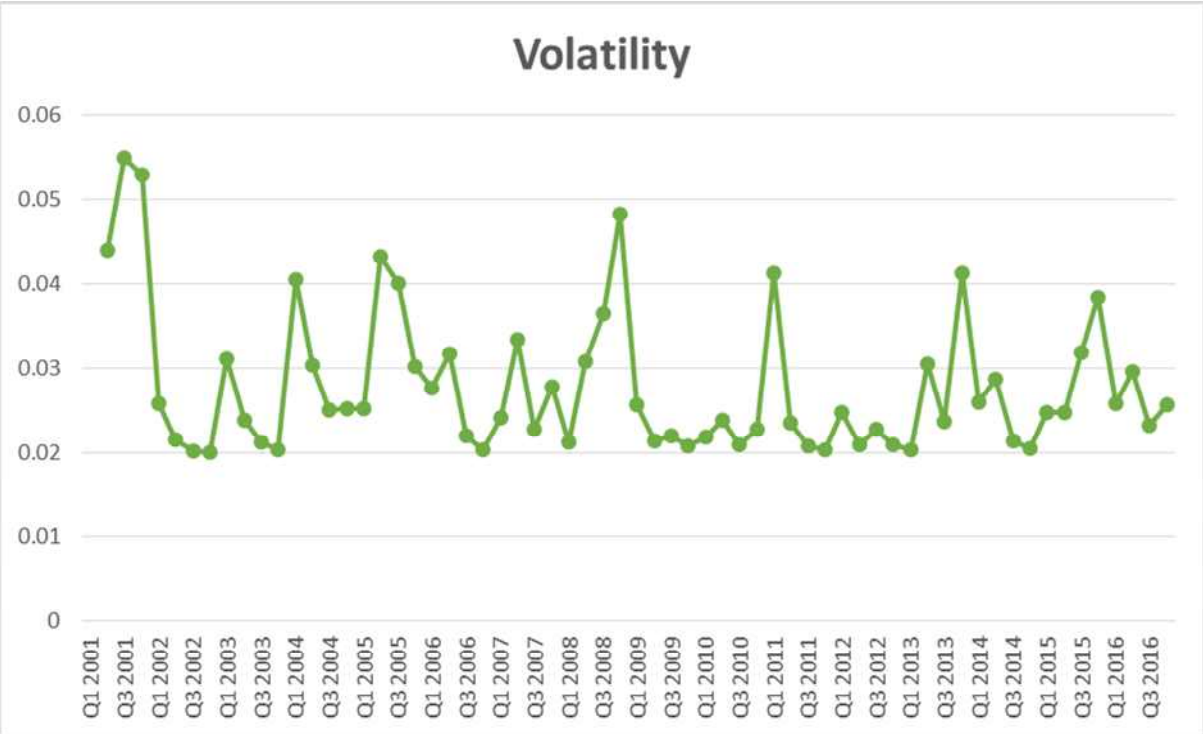

Table 1: Long-Run Coefficient Estimations of the Linear ARDL Export Demand Model				
Industry	Long-run coefficient estimates			
	Constant	LnV_t^{CH}	$LnREX_t$	LnV_t
11- Product of milling industry	-6.992	-3.067	12.35	-9.228
12-Oil seed oleaginous fruit	-3.839	1.000*	12.60*	-0.136
15-Animal or vegetable fats and oils and their cleavage products	18.14	0.168	-13.16	0.065
16-Preparations of meat, of fish or of crustaceans	8.986	2.806**	-5.686	1.570
17-Sugar and confectionery	-36.62	-0.858	47.34*	-7.424
19-Preparations of cereals, flour, starch or milk ; pastrycooks' products	96.32	-2.610	15.96	54.87
20-Preparations of vegetables, fruit, nuts or other parts of plants	-15.22	2.297	8.236	-2.844
23-Risidues and waste from the food industries; prepared animal fodder	-147.2	-1.759	87.51	-7.753
26-Ores, slag and ash	92.10	0.371	-40.03**	1.283
28-Inorganic chemical	0.710	1.417**	2.192*	-2.105**
29-Organic chemicals	12.93	-0.232	-6.523	-6.221
30-Pharmaceutical products	-4.907	0.656*	9.227*	-1.101
32-Tanning or dyeing extracts	24.39	1.096**	-8.054	-1.145
33-Essential oils and resinoids and perfume material	247.7	0.658	-128.50	1.108
34-Soap, organic surface-active agents, washing preparations	21.19	1.718**	-4.031	0.532
35-Albuminoidal substances	-8.099	0.573	8.775*	-2.999*
39-Plastics and articles thereof	-20.24	-1.096	6.931	-10.45
41-Raw hides and skins (other than furskins) and leather	-3.737	0.306	4.295	-4.142**
47-Pulp of wood or of other fibrous cellulosic material	15.15**	0.852**	0.021	-0.225
48-Paper and paperboard	17.24**	-0.115	2.111	0.069
49-Printed books, newspapers, pictures and other products of the printing	17.75	1.327*	-2.951	0.905
50-Silk	28.18**	0.010	-3.029	2.482
51-Wool, fine or coarse animal hair; horsehair yarn and woven fabric	-44.02	-3.611	52.69	4.347
52-Cotton	-41.194	-1.577	10.92	-13.57
57-Carpets and other textile floor coverings	163.4**	0.552	-40.63**	21.74*
58-Special woven fabrics ; tufted textile fabrics	8.365**	1.136**	-3.037	0.388
59-Impregnated, coated, covered or laminated textile fabrics	2.741	0.285	6.087*	-0.093
60-Knitted or crocheted fabrics	0.904	1.117**	1.798	-2.125**
61-Articles of apparel and clothing accessories, knitted or crocheted	17.14	0.256	-4.567	3.534
62-Articles of apparel and clothing accessories not knitted or crocheted	10.72	0.655	-0.512	2.019
64-Footwear	18.72**	1.928**	-10.25**	4.206**
68-Articles of stone, plaster, cement, asbestos, mica or similar materials	-0.499	0.561	6.345	-1.529
69-Ceramic products	-13.71**	1.060**	10.75**	-7.200**
70-Glass and glassware	-19.49	-0.758	25.43	-6.665
71-Natural or cultured pearls, precious or semi-precious stones, precious metals	1.205	2.965**	3.805	1.083
72-Iron and steel	12.70**	-1.546**	0.053	0.647
73-Articles of iron or steel	21.98*	3.539**	-10.89	7.533
74-Copper and articles thereof	10.05	-5.705	-6.532	-9.871
76-Aluminium and articles thereof	7.704**	1.025**	-1.353	0.330
82-Tools, implements, cutlery, spoons and forks, of base metal	3.996*	0.609**	3.894	0.374
85-Electrical machinery and equipment and parts thereof	10.01**	0.954**	-1.843	0.104
87-Vehicles other than railway or tramway rolling-stock, and parts	4.345	1.971**	0.971	-0.009
91-Clocks and watches and parts thereof	-0.136	-1.843	13.38	-0.954
94-Furniture	-16.81**	2.367**	15.93*	-5.207*
95-Toy, games and sports requisites; parts and accessories thereof	-0.679	0.321	9.336*	-0.654

Note: * and ** indicate significance at the 10% and 5% levels respectively. Standard critical values of the t-test are used to identify the significance level.

Table 2: Diagnostic Statistics Associated with Table 1 (Linear Export Demand Model)					
Industry	Diagnostics				
	F[a]	ECM^{b}_{t-1}	$Adj.R^2$	LM[c]	RESET[d]
11- Product of milling industry	1.066	-0.086(1.760)	0.310	0.298	0.519
12-Oil seed oleaginous fruit	3.168	0.374(3.180)	0.466	0.778	0.101
15-Animal or vegetable fats and oils and their cleavage products	0.739	-0.024(0.139)	0.394	2.840	1.179
16-Preparations of meat, of fish or of crustaceans	1.395	-0.165(1.800)	0.382	0.416	0.018
17-Sugar and confectionery	1.492	-0.241(1.626)	0.603	6.58**	0.064
19-Preparations of cereals, flour, starch or milk	0.556	-0.040(0.639)	0.003	1.061	0.099
20-Preparations of vegetables, fruit, nuts or other parts of plants	1.718	-0.115(1.567)	0.471	0.911	0.212
23-Risidues and waste from the food industries	0.871	0.140(1.529)	0.369	0.712	0.010
26-Ores, slag and ash	8.78**	-0.199(2.716)	0.462	0.741	0.920
28-Inorganic chemical	7.528**	-0.446(1.249)	0.273	2.000	1.664
29-Organic chemicals	2.015	-0.041(0.738)	0.280	0.519	0.113
30-Pharmaceutical products	2.420	-0.359(3.144)	0.583	0.003	1.885
32-Tanning or dyeing extracts	3.995*	-0.154(2.164)	0.517	0.199	1.410
33-Essential oils and resinoids and perfume material	2.756	-0.053(0.744)	0.417	0.030	0.025
34-Soap, organic surface-active agents, washing preparations,	3.482	-0.188(3.246)	0.430	0.740	2.920*
35-Albuminoidal substances	2.394	0.140(2.105)	0.407	0.084	0.627
39-Plastics and articles thereof	1.098	-0.044(0.913)	0.407	0.139	11.129**
41-Raw hides and skins (other than furskins) and leather	2.092	-0.104(1.058)	0.370	0.050	11.20**
47-Pulp of wood or of other fibrous cellulosic material	4.809**	-0.428(3.132)	0.329	0.979	4.236*
48-Paper and paperboard	3.488	-0.149(2.363)	0.047	0.384	0.305
49-Printed books, newspapers, pictures and other products	1.177	-0.283(1.562)	0.469	0.199	2.089
50-Silk	3.034	-0.275(2.247)	0.422	0.375	1.031
51-Wool, fine or coarse animal hair; horsehair yarn	3.094	-0.281(1.990)	0.535	1.055	0.440
52-Cotton	4.281**	-0.096(1.521)	0.150	2.282	0.463
57-Carpets and other textile floor coverings	5.864**	-0.010(0.577)	0.240	6.063**	0.123
58-Special woven fabrics ; tufted textile fabrics	3.733*	-0.195(2.552)	0.252	1.006	0.213
59-Impregnated, coated, covered or laminated textile fabrics	5.259**	-0.27(3.497)*	0.388	0.812	12.15**
60-Knitted or crocheted fabrics	5.407**	-0.497(2.946)	0.328	0.093	0.417
61-Articles of apparel and clothing accessories, knitted	7.950**	-0.199(3.151)	0.670	0.292	4.699**
62-Articles of apparel and clothing accessories not knitted	0.653	-0.113(1.364)	0.471	0.477	1.037
64-Footwear	6.050**	-0.116(1.022)	0.402	0.075	8.213**
68-Articles of stone, plaster, cement, asbestos,	3.419	-0.258(3.367)	0.580	3.564**	1.389
69-Ceramic products	4.324**	-0.166(1.846)	0.211	0.231	2.150
70-Glass and glassware	2.250*	-0.232(1.606)	0.320	0.238	0.326
71-Natural or cultured pearls, precious or semi-precious stones,	2.465	-0.279(2.402)	0.341	0.002	1.468
72-Iron and steel	6.043**	-0.152(2.215)	0.236	0.013	0.735
73-Articles of iron or steel	5.710**	-0.071(0.604)	0.087	0.039	0.023
74-Copper and articles thereof	1.279	-0.044(0.667)	0.138	0.330	1.057
76-Aluminium and articles thereof	7.110**	-0.183(1.027)	0.377	0.518	0.343
82-Tools, implements, cutlery, spoons and forks, of base metal	7.922**	-0.825(5.03)**	0.446	4.011**	1.480
85-Electrical machinery and equipment and parts thereof	0.935	-0.037(0.891)	0.289	0.017	0.305
87-Vehicles other than railway or tramway rolling-stock	1.565	-0.127(1.982)	0.178	0.062	0.948
91-Clocks and watches and parts thereof	3.224	-0.248(3.331)	0.577	1.554	3.257*
94-Furniture	2.025	-0.061(0.592)	0.349	1.529	0.034
95-Toy, games and sports requisites; parts and accessories	3.892*	-0.231(3.244)	0.518	0.172	2.553

a. The upper bound critical value of the F-test for cointegration when there are three exogenous variables is 3.77 (4.35) at the 10% (5%) level of significance. These come from Pesaran *et al*. (2001, Table CI, Case III, p. 300).

b. The critical value for significance of ECM_{t-1} is -3.46 (-3.78) at the 10% (5%) level when k =3. The comparable figures in the nonlinear model when k = 4 are -3.66 and -3.99 respectively. These come from Pesaran *et al*. (2001, Table CII, Case III, p. 303).

c. LM is the Lagrange Multiplier statistic to test for autocorrelation. It is distributed as χ^2 with one degree of freedom since we are testing for first order autocorrelation. The critical value is 2.70 (3.84) at the 10% (5%) level.

d. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) level.

e. All Wald tests are distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) level.

Table 3: Long-Run Coefficient Estimations of the Linear Import Demand ARDL Model

Industry	Long-run coefficient estimates			
	Constant	LnY_t^{TM}	$LnREX_t$	LnV_t
11- Product of milling industry	13.46**	3.159	-8.799*	2.874*
12-Oil seed oleaginous fruit	3.093	2.138**	-1.268	-1.412
15-Animal or vegetable fats and oils and their cleavage products	-4.260**	2.514**	4.995**	-1.986**
16-Preparations of meat, of fish or of crustaceans	-2.397**	2.492**	5.118**	-1.291**
17-Sugar and confectionery	3.785	4.161**	-5.332	-0.213
19-Preparations of cereals, flour, starch or milk ; pastrycooks' products	51.70	-6.349	-68.45	-15.30
20-Preparations of vegetables, fruit, nuts or other parts of plants	9.571	2.222**	1.049	0.524
23-Risidues and waste from the food industries; prepared animal fodder	10.49**	0.520**	1.866	-0.985**
26-Ores, slag and ash	23.37**	1.647**	-4.712*	1.307**
28-Inorganic chemical	22.88**	1.884**	-2.498**	1.358**
29-Organic chemicals	7.624**	2.503**	0.806	-0.459*
30-Pharmaceutical products	-4.491	2.123**	5.236**	-1.508*
32-Tanning or dyeing extracts	9.521**	2.070**	1.320	0.046
33-Essential oils and resinoids and perfume material	0.670	2.800**	3.741**	0.066
34-Soap, organic surface-active agents, washing preparations, lubricating	-7.412	3.812**	4.516	-0.394
35-Albuminoidal substances	11.41**	3.393**	-1.819	1.194**
39-Plastics and articles thereof	12.55**	2.938**	-0.592	0.580
41-Raw hides and skins (other than furskins) and leather	26.55**	-0.169	-2.154	0.805
47-Pulp of wood or of other fibrous cellulosic material	1.525	2.368**	-1.293	-2.325
48-Paper and paperboard	18.80**	3.743**	-4.180	2.075**
49-Printed books, newspapers, pictures and other products of printing industry	15.85	1.915	-3.169	-0.159
50-Silk	-7.417	-0.517	10.09	-2.252
51-Wool, fine or coarse animal hair; horsehair yarn and woven fabric	16.72**	0.353	2.450	0.850
52-Cotton	25.85**	0.511**	-3.102**	0.444
57-Carpets and other textile floor coverings	-8.305	5.023**	3.164	0.634
58-Special woven fabrics ; tufted textile fabrics	7.263**	1.190**	-0.385	0.426
59-Impregnated, coated, covered or laminated textile fabrics	5.055**	2.514**	-1.311	0.015
60-Knitted or crocheted fabrics	6.308	1.642**	0.298	0.579
61-Articles of apparel and clothing accessories, knitted or crocheted	13.23	2.226	-17.31	-3.45
62-Articles of apparel and clothing accessories not knitted or crocheted	4.040	2.477**	0.076	-0.045
64-Footwear	-103.6	1.980	126.15	-6.813
68-Articles of stone, plaster, cement, asbestos, mica or similar materials	4.163**	2.243**	0.395	0.218
69-Ceramic products	5.545**	2.675**	-1.451	0.338
70-Glass and glassware	9.150**	3.257**	-2.918**	2.714**
71-Natural or cultured pearls, precious or semi-precious stones, precious metals	13.91**	1.876**	-5.995**	2.321**
72-Iron and steel	13.15**	3.182**	-2.721	4.674**
73-Articles of iron or steel	4.83**	3.404**	-0.014	1.039
74-Copper and articles thereof	12.98*	4.055**	-8.870*	3.227**
76-Aluminium and articles thereof	8.749**	2.536**	-2.684	1.359
82-Tools, implements, cutlery, spoons and forks, of base metal	-0.313	1.998**	4.576	-1.230
85-Electrical machinery and equipment and parts thereof	7.372**	2.278**	-0.930	0.239
87-Vehicles other than railway or tramway rolling-stock,	6.030**	4.790**	-4.587**	1.646**
91-Clocks and watches and parts thereof	2.595	1.003**	5.193*	-0.208
94-Furniture	-14.76	2.758*	15.857	-4.119
95-Toy, games and sports requisites; parts and accessories thereof	7.150**	1.380**	0.149	0.556*

Note: * and ** indicate significance at the 10% and 5% levels respectively.

Table 4 Diagnostic Statistics Associated with Table 3 (Linear Import Demand Model)					
Industry	Diagnostic Statistics				
	Fa	ECM^{b}_{t-1}	$Adj.R^2$	LMc	RESETd
11- Product of milling industry	1.903	-0.080(0.721	0.334	0.255	0.256
12-Oil seed oleaginous fruit	2.786	-0.029(0.151)	0.617	0.149	11.00**
15-Animal or vegetable fats and oils and their cleavage products	3.84*	-0.526(1.802)	0.384	0.223	0.115
16-Preparations of meat, of fish or of crustaceans	6.341**	-1.27(4.19)**	0.603	1.067	1.568
17-Sugar and confectionery	3.787*	-0.582(3.67)*	0.524	0.423	1.051
19-Preparations of cereals, flour, starch or milk ; pastrycooks' products	4.371*	-0.030(0.201)	0.265	0.017	0.563
20-Preparations of vegetables, fruit, nuts or other parts of plants	0.619	-0.177(1.141)	0.736	0.033	0.504
23-Risidues and waste from the food industries;	10.11**	-0.51(4.87)**	0.366	4.855**	0.601
26-Ores, slag and ash	2.899	-0.099(0.281)	0.570	0.240	3.324*
28-Inorganic chemical	11.704**	0.020(0.182)	0.163	0.228	0.976
29-Organic chemicals	6.443**	-0.230(1.443)	0.325	3.148*	2.852*
30-Pharmaceutical products	5.223**	-0.326(1.493)	0.524	0.032	0.455
32-Tanning or dyeing extracts	2.508	0.232(1.931)	0.685	0.089	4.460**
33-Essential oils and resinoids and perfume material	5.110**	-0.510(4.23)*	0.436	0.130	1.399
34-Soap, organic surface-active agents, washing preparations,	1.192	-0.511(2.18)*	0.618	2.52	0.194
35-Albuminoidal substances	6.964**	-0.282(1.818)	0.383	0.001	4.611**
39-Plastics and articles thereof	1.551	-0.074(0.611)	0.631	0.004	1.514
41-Raw hides and skins (other than furskins) and leather	2.733	0.435(1.391)	0.302	0.788	0.091
47-Pulp of wood or of other fibrous cellulosic material	2.759	-0.440(3.027)	0.451	3.158*	8.854**
48-Paper and paperboard	5.899**	-0.30(3.655)*	0.689	0.447	0.693
49-Printed books, newspapers, pictures and other products	3.058	-0.181(1.431)	0.304	2.557	3.097*
50-Silk	1.188	-0.268(2.258)	0.561	1.288	0.104
51-Wool, fine or coarse animal hair; horsehair yarn and woven fabric	2.600	-0.331(1.827)	0.847	0.835	0.005
52-Cotton	7.172**	0.002(0.03)	0.135	1.925	3.435*
57-Carpets and other textile floor coverings	2.016	-0.308(0.880)	0.489	4.998**	0.011
58-Special woven fabrics ; tufted textile fabrics	5.362**	-0.026(0.318)	0.618	0.067	2.643
59-Impregnated, coated, covered or laminated textile fabrics	1.619	-0.126(1.785)	0.387	0.436	3.300*
60-Knitted or crocheted fabrics	2.940	-0.209(2.966)	0.755	1.982	0.005
61-Articles of apparel and clothing accessories, knitted or crocheted	1.930	-0.076(0.743)	0.683	0.600	1.811
62-Articles of apparel and clothing accessories not knitted or crocheted	1.765	-0.159(1.510)	0.449	1.159	0.553
64-Footwear	3.647	-0.239(2.975)	0.497	0.975	10.445**
68-Articles of stone, plaster, cement, asbestos, mica or similar materials	7.624**	-0.199(2.135)	0.155	0.529	0.724
69-Ceramic products	10.550**	-0.103(0.608)	0.153	0.201	0.470
70-Glass and glassware	9.173**	0.045(0.473)	0.343	8.020**	0.568
71-Natural or cultured pearls, precious or semi-precious stones,	4.012*	-0.076(0.701)	0.514	2.465	0.654
72-Iron and steel	4.580**	-0.196(1.796)	0.334	1.517	0.0008
73-Articles of iron or steel	3.190	-0.202(1.902)	0.083	0.050	2.813*
74-Copper and articles thereof	5.311**	-0.140(1.735)	0.113	0.524	5.550**
76-Aluminium and articles thereof	5.969**	-0.083(0.836)	0.357	0.859	0.006
82-Tools, implements, cutlery, spoons and forks, of base metal	0.812	-0.101(0.956)	0.642	0.073	0.283
85-Electrical machinery and equipment and parts thereof	3.742*	-0.085(1.169)	0.141	1.649	0.531
87-Vehicles other than railway or tramway rolling-stock,	4.232*	-0.484(2.784)	0.541	1.937	1.033
91-Clocks and watches and parts thereof	2.404	-0.190(2.238)	0.373	1.624	0.815
94-Furniture	1.321	-0.148(1.191)	0.689	1.740	12.73**
95-Toy, games and sports requisites; parts and accessories thereof	4.143*	-0.026(0.352)	0.565	0.260	2.265

a. The upper bound critical value of the F-test for cointegration when there are three exogenous variables is 3.77 (4.35) at the 10% (5%) level of significance. These come from Pesaran *et al*. (2001, Table CI, Case III, p. 300).

b. The critical value for significance of ECM_{t-1} is -3.46 (-3.78) at the 10% (5%) level when k =3. The comparable figures in the nonlinear model when k = 4 are -3.66 and -3.99 respectively. These come from Pesaran *et al*. (2001, Table CII, Case III, p. 303).

c. LM is the Lagrange Multiplier statistic to test for autocorrelation. It is distributed as χ^2 with one degree of freedom since we are testing for first order autocorrelation. The critical value is 2.70 (3.84) at the 10% (5%) level.

d. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) level.

e. All Wald tests are distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) level.

Table 5: Short-Run Coefficient Estimates Attached to ΔPOS in the Nonlinear ARDL Export Demand Model

Industry	Short-Run Coefficient Estimates							
	ΔPOS_t	ΔPOS_{t-1}	ΔPOS_{t-2}	ΔPOS_{t-3}	ΔPOS_{t-4}	ΔPOS_{t-5}	ΔPOS_{t-6}	ΔPOS_{t-7}
11- Product of milling industry	0.143	0.306*	0.050	0.420*	0.379**	0.505**		
12-Oil seed oleaginous fruit	-2.052**	-0.248	-3.823**	-4.774**	-4.116**	-2.66**	0.406	1.405**
15-Animal or vegetable fats and oils and their products	0.60.**	1.209**	1.886**	0.552	-0.474	-0.438	-0.461	0.234
16-Preparations of meat, of fish or of crustaceans	0.194	-0.510*	-0.861**	0.035	0.039	-0.399*	-0.211	-0.352**
17-Sugar and confectionery	-0.007	-3.320**	0.279	0.825	-0.261	-1.12**	-2.75**	-1.096**
19-Preparations of cereals, flour, starch or milk	0.287**	-0.136	-0.207	0.197				
20-Preparations of vegetables, fruit, and nuts	-1.328**	0.613	-0.521	0.583	0.476	-0.461	0.399	1.571**
23-Risidues and waste from the food industries	0.516	-8.591**	-14.04**	14.27**	-12.38**	-6.68**	-0.088	1.313**
26-Ores, slag and ash	3.333**	2.389**	-2.933**	-1.926*	-1.476	-1.093	1.870**	
28-Inorganic chemical	-0.084	3.444**	3.364**	4.326**	2.985**	1.240	2.627**	1.456
29-Organic chemicals	-0.513**	-0.109	-0.248	-1.300**	-2.246**	-2.64**	-1.71**	-0.810**
30-Pharmaceutical products	-1.200**	0.396	-0.227	-1.351**	-2.265**	-2.00**	-0.923*	0.584*
32-Tanning or dyeing extracts	-0.036	0.450**						
33-Essential oils and resinoids and perfume material	0.303							
34-Soap, organic surface-active agents, washing preparations,	0.536**	0.600**	0.713**	0.596*	-0.692**	-0.66**		
35-Albuminoidal substances	-0.440**	1.284**	-0.591**	-1.860**	-1.999**	0.151	0.960**	0.532**
39-Plastics and articles thereof	-0.099							
41-Raw hides and skins (other than furskins) and leather	0.363*	1.762**	2.502**	2.179**	2.188**	1.518**	0.964**	0.940**
47-Pulp of wood or of other fibrous cellulosic material	-0.576							
48-Paper and paperboard	1.518**	-1.992**	-0.795*					
49-Printed books, newspapers, pictures and other products	0.950	0.004	-1.008	-1.618	-3.869**	-2.79**	1.049	3.333**
50-Silk	1.292							
51-Wool, fine or coarse animal hair; horsehair yarn	2.266*	-6.332**						
52-Cotton	-0.145	-0.557*	-0.323	0.168	0.610	0.653*	0.407	
57-Carpets and other textile floor coverings	1.153**	-4.507**	-5.678**	-4.159**	-3.373**	3.604**	-.584**	-1.782**
58-Special woven fabrics ; tufted textile fabrics	-0.082	0.309**	-0.107	-0.136				
59-Impregnated, coated, covered or laminated textile fabrics	0.581**	-0.669**	-1.518**	-1.667**	-1.084**	-0.146	0.164	
60-Knitted or crocheted fabrics	0.261**	0.152	-0.184	-0.461**	-0.203*	0.187	0.420	0.233
61-Articles of apparel and clothing accessories, knitted	0.014	-0.354**	-0.124	0.359**	0.513**	0.146		
62-Articles of apparel and clothing accessories not knitted	-0.539**	0.153	-1.162**	-0.884**	-1.178**	-1.29**	-0.83**	
64-Footwear	-0.302**	-0.863**	-0.666**	-0.977**	-0.969**	-1.15**	-0.85**	
68-Articles of stone, plaster, cement, asbestos,	0.396**	-1.471**	-1.427**	-1.126**	-0.516*	0.433*	0.534*	-0.166
69-Ceramic products	-0.182	2.122**	20.19**	1.373**	1.005**	0.811**		
70-Glass and glassware	-0.239	4.626**	3.432**	2.738**	1.850**	0.444**	-0.195	
71-Natural or cultured pearls, precious or semi-precious stones, precious metals	-0.822**	-1.255**	-0.552	0.073	0.676	1.303**	0.963**	
72-Iron and steel	0.397	0.215	-0.449	-0.459				
73-Articles of iron or steel	0.810**	-0.801	-0.811	-0.084	0.319*	0.768**	0.657**	0.460**
74-Copper and articles thereof	0.339**	0.058	-0.445*	-0.548**	-0.162	-0.51**	-0.53**	
76-Aluminium and articles thereof	0.105	-0.923**	-1.175**	-1.179**	-1.136**	-0.591**	-0.353**	-0.209*
82-Tools, implements, cutlery, spoons and forks, of base metal	-0.293	0.845**	-0.311	-1.028**	0.642	0.451	-0.51**	
85-Electrical machinery and equipment and parts thereof	0.375**	-1.221**	-0.973**	-0.831**	-0.404**	0.035	-0.130	-0.436**
87-Vehicles other than railway or tramway rolling-stock, and parts and accessories thereof	-0.248	0.161	0.188	-0.203	-0.384	0.565**	0.324**	
91-Clocks and watches and parts thereof	-0.641**	1.012**	2.213**	0.955**	0.844**	1.450**	0.883**	
94-Furniture	0.017	1.193**	0.039	-0.419**	-0.545**	0.334**	0.433**	0.922**
95-Toy, games and sports requisites; parts and accessories thereof	-0.569**	1.263**	1.545**	1.857**	2.346**	2.132**	0.498**	

Note: * and ** indicate significance at the 10% and 5% levels respectively.

Table 6 Short-run Coefficient Estimates Attached tp ΔNEG Variable in the Nonlinear ARDL Export Demand Model								
Industry	Short-Run coefficient estimates							
	ΔNEG_t	ΔNEG_{t-1}	ΔNEG_{t-2}	ΔNEG_{t-3}	ΔNEG_{t-4}	ΔNEG_{t-5}	ΔNEG_{t-6}	ΔNEG_{t-7}
11- Product of milling industry	-0.133	0.252	0.648**	0.395**	0.541**	-0.076	0.197*	-0.203**
12-Oil seed oleaginous fruit	-2.34**	-0.082	0.712**	1.078**	3.091**	4.154**	3.900**	2.090**
15-Animal or vegetable fats and oils and their cleavage products	0.79**	-0.654*	-2.099**	-2.508**	-1.761**	-1.551**	-1.256**	-1.325**
16-Preparations of meat, of fish or of crustaceans	-0.72**	0.057	0.559**					
17-Sugar and confectionery	2.17**	1.087*	0.029	-1.824**	-2.114**	-2.284**	-0.497	-1.173**
19-Preparations of cereals, flour, starch or milk ;	-0.238*	-0.031	0.152	-0.220**	-0.151*	-0.212**	0.070	-0.194**
20-Preparations of vegetables, fruit, nuts or other parts of plants	-0.665	1.999**	3.583**	1.973**	2.140**	2.580**	2.474**	
23-Risidues and waste from the food industries;	-7.28**	-11.32**	-10.18**	-6.839**	-2.035			
26-Ores, slag and ash	-2.91**	-6.152**	-3.126**	-1.952*	-1.148*	0.647	-1.203**	0.822
28-Inorganic chemical	-1.038	6.219**	4.881**	3.041**	2.098**	3.751**	2.274**	-0.641
29-Organic chemicals	0.489	0.055	-1.174**	-1.585**	-1.419**	-0.789**	-0.396*	
30-Pharmaceutical products	-0.316	0.962*	0.396	-0.659	0.602	1.048**	1.515**	0.678**
32-Tanning or dyeing extracts	-0.320	0.007	0.462**	0.791**	0.645**	0.359**	0.463**	
33-Essential oils and resinoids and perfume material	-0.668							
34-Soap, organic surface-active agents, washing preparations, lubricating preparations, artificial waxes	-0.240	-0.030	-0.145	-0.810**	-0.740**	-0.397**	0.278*	0.593**
35-Albuminoidal substances	-0.64**	2.181**	1.657**	2.421**	2.679**	2.179**	1.352**	0.462**
39-Plastics and articles thereof	-0.094	0.181	0.546**	0.573**	0.283*	0.129	0.288*	0.349**
41-Raw hides and skins (other than furskins) and leather	-0.030	1.499**	0.733*	1.133**	0.034	-0.453**	-0.449**	-0.595**
47-Pulp of wood or of other fibrous cellulosic material	0.036							
48-Paper and paperboard	-0.353	-2.708**	-2.772**	-1.829**	-2.784**	-2.081**	-1.226**	-0.890**
49-Printed books, newspapers, pictures and other products of the printing industry	4.17**	-4.066**	-3.904**	-6.391**	-3.113**	-0.222	-0.784	-2.544**
50-Silk	0.919							
51-Wool, fine or coarse animal hair; horsehair yarn	4.80**	-7.768**	-10.78**	-5.810**	-8.790**	-1.567	-2.597*	-3.460**
52-Cotton	-0.128	1.081**	0.896**	0.905**	0.618*			
57-Carpets and other textile floor coverings	-2.18**	-5.300**	-5.377**	-4.104**	-4.004**	-3.083**	-0.964**	-1.364**
58-Special woven fabrics ; tufted textile fabrics	-0.082							
59-Impregnated, coated, covered or laminated textile fabrics	-0.72**	-1.623**	-1.514**	-0.615**	-0.322*	-0.438**	-0.394**	-0.201**
60-Knitted or crocheted fabrics	-0.47**	-0.346**	-0.451**					
61-Articles of apparel and clothing accessories, knitted	0.289	0.324**	0.678**	0.466**	0.324**	0.125	0.226**	
62-Articles of apparel and clothing accessories not knitted	-0.062	-0.117	1.336**	0.229	1.008**	0.510**	0.687**	0.652**
64-Footwear	0.151	-0.938**	-0.875**	-1.069**	-0.949**	-0.355*	-0.085	-0.222**
68-Articles of stone, plaster, cement, asbestos, mica	-0.213	-0.529	-1.021*	-0.228	-0.247	-0.349	-0.552**	-0.416**
69-Ceramic products	0.341	1.590**	1.412**	0.810**	0.988**	0.323**	0.318**	
70-Glass and glassware	-0.53**	2.882**	2.542**	1.570**	1.138**	0.682**	0.869**	0.529**
71-Natural or cultured pearls, precious or semi-precious stones,	-0.351	1.189*	0.855	1.077**	1.286**	0.263	1.003**	0.546*
72-Iron and steel	0.291	-0.363	-0.229	0.239	-0.459**	0.229	0.387	0.288
73-Articles of iron or steel	-0.028	-1.336**	-0.740**	-0.409*	0.014	-0.455**	-0.152	-0.469**
74-Copper and articles thereof	0.41**	-0.974**	-0.671**	-0.511**	-0.972**	-0.141	-0.420**	
76-Aluminium and articles the reof	0.44**	-0.951**	-0.951**	-0.581**	-0.254**	-0.529**	-0.050	0.372**
82-Tools, implements, cutlery, spoons and forks, of base metal	1.15**	-0.737*	-0.314	1.013**				
85-Electrical machinery and equipment and parts thereof	-0.402*	-0.993**	-1.196**	-0.499**	-0.668**	-0.721**	-0.562**	-0.099
87-Vehicles other than railway or tramway rolling-stock, and parts	0.109	0.277	-0.020	0.108	0.600**			
91-Clocks and watches and parts thereof	1.99**	2.416**	2.262**	2.569**	1.668**	1.377**	0.641**	0.440
94-Furniture	-1.05**	0.388**	0.297	0.403**	0.834**	0.766**	1.354**	0.303**
95-Toy, games and sports requisites; parts and accessories	-0.37**	2.746**	3.034**	2.756**	0.945**	0.896**	0.359**	1.080**

Note: * and ** indicate significance at the 10% and 5% levels respectively

Table 7: Long-Run Coefficient Estimates of the Nonlinear ARDL Export Demand Model					
Industry	Long-run coefficient estimates				
	Constant	LnY_t^{CH}	$LnREX_t$	POS_t	NEG_t
11- Product of milling industry	12.83**	1.069	-9.469	-0.706	-0.886
12-Oil seed oleaginous fruit	-0.577	-0.319	11.945**	-0.990**	-1.060**
15-Animal or vegetable fats and oils and their cleavage products	-90.775	23.757	103.145	-14.486	-11.918
16-Preparations of meat, of fish or of crustaceans	8.183	-3.060	5.751	-1.739	-2.179
17-Sugar and confectionery	44.150	-7.320	-28.964	6.616	5.498
19-Preparations of cereals, flour, starch or milk ; pastrycooks' products	9.514**	-0.102	-3.438	0.532	0.244
20-Preparations of vegetables, fruit, nuts or other parts of plants	11.330	-0.220	3.980	-2.944*	-3.338**
23-Risidues and waste from the food industries; prepared animal fodder	41.48	-15.02	24.10	11.78	7.922
26-Ores, slag and ash	-101.5	6.566	54.42	-5.404	-2.343
28-Inorganic chemical	11.4**	1.223**	0.277	-1.777**	-1.841**
29-Organic chemicals	38.87**	-2.108	-4.987	-0.072	-0.869
30-Pharmaceutical products	12.04**	-1.021*	5.420**	-1.346	-1.679**
32-Tanning or dyeing extracts	16.43	0.849	-0.480	-2.462	-2.426
33-Essential oils and resinoids and perfume material	33.55**	-0.149	-9.689**	0.201	-0.469
34-Soap, organic surface-active agents, washing preparations, lubricating preparations, artificial waxes	-1.560	3.570	3.112	-0.509	-0.044
35-Albuminoidal substances	7.368*	-1.075**	9.587**	-3.787**	-4.137**
39-Plastics and articles thereof	10.28	-0.124	8.202	-7.717	-7.650
41-Raw hides and skins (other than furskins) and leather	11.71**	0.084	3.194	-1.471	-1.621**
47-Pulp of wood or of other fibrous cellulosic material	16.05**	0.813	-0.003	-0.216	-0.225
48-Paper and paperboard	18.23**	0.377	0.342	2.547**	2.596**
49-Printed books, newspapers, pictures and other products of the printing industry	37.89**	-2.355	-8.689	4.692*	3.676*
50-Silk	25.68	-0.832	-0.426	2.689*	2.493*
51-Wool, fine or coarse animal hair; horsehair yarn and woven fabric	-34.64**	5.238**	20.316**	7.148**	8.679**
52-Cotton	30.60**	-3.532**	1.160	-0.914	-1.755
57-Carpets and other textile floor coverings	9.679	9.897**	-14.40*	9.177*	11.33**
58-Special woven fabrics ; tufted textile fabrics	6.754*	1.315	-1.930	0.170	0.188
59-Impregnated, coated, covered or laminated textile fabrics	9.079**	*1.682**	2.233	1.141**	0.906*
60-Knitted or crocheted fabrics	6.861**	-0.372*	1.195	-0.0177	-0.186
61-Articles of apparel and clothing accessories, knitted or crocheted	25.50**	-0.074	-22.23**	1.486*	1.259**
62-Articles of apparel and clothing accessories not knitted or crocheted	9.852**	-0.952**	-1.980*	-0.538**	-0.871**
64-Footwear	10.34**	2.792**	-8.446*	1.292**	1.403**
68-Articles of stone, plaster, cement, asbestos, mica or similar materials	49.05	-10.56	-29.84	7.257	5.861
69-Ceramic products	-6.896	4.213	6.677	-4.378*	-4.075*
70-Glass and glassware	42.16**	-5.578**	-29.61**	6.480**	5.725**
71-Natural or cultured pearls, precious or semi-precious stones, precious metals	12.62	0.870	-11.93	1.818	1.701
72-Iron and steel	10.36	-0.132	-0.803	0.422	0.548
73-Articles of iron or steel	7.540**	0.381	-0.893	-1.638**	-1.755**
74-Copper and articles thereof	6.747	0.158	2.309	1.179	1.084
76-Aluminium and articles thereof	10.68**	-0.136	-3.053**	0.575**	0.455**
82-Tools, implements, cutlery, spoons and forks, of base metal	5.728**	0.064	2.178	0.246	0.185
85-Electrical machinery and equipment and parts thereof	13.30**	0.323	-4.770	1.702**	1.571**
87-Vehicles other than railway or tramway rolling-stock, and parts and accessories thereof	-104.41	-253.85	142.77	-175.50	-172.31
91-Clocks and watches and parts thereof	25.62	-9.396	-1.237	-1.571	-2.309
94-Furniture	-27.96	2.330	39.84**	-5.540**	-5.428**
95-Toy, games and sports requisites; parts and accessories thereof	14.56**	-0.751*	-7.193**	2.632**	2.353**

Note: * and ** indicate significance at the 10% and 5% levels respectively

Table 8 Diagnostics Associated with Estimates of the Nonlinear Export Demand Modes in Table 7

Industry	F[a]	ECM_{t-1}[b]	$Adj.R^2$	LM[c]	RESET[d]	Wald-S	Wald-L
11- Product of milling industry	3.99**	-0.10(0.8)	0.174	2.926*	0.435	0.050	2.708
12-Oil seed oleaginous fruit	5.54**	-0.30(0.8)	0.273	0.242	1.623	27.33**	5.993**
15-Animal or vegetable fats and oils and their cleavage products	1.165	-0.08(0.5)	0.753	0.001	0.348	44.10**	0.043
16-Preparations of meat, of fish or of crustaceans	0.738	-0.10(0.5)	0.565	0.830	0.166	2.751*	1.148
17-Sugar and confectionery	3.681*	-1.87(2.5)	0.744	0.388	0.327	0.575	0.890
19-Preparations of cereals, flour, starch or milk ;	3.87**	-0.09(0.9)	0.165	1.153	2.826*	1.922	45.01**
20-Preparations of vegetables, fruit, nuts or other parts of plants	2.424	-0.38(1.7)	0.324	0.990	0.297	7.412**	4.984**
23-Risidues and waste from the food industries;	4.49**	-0.30(1.1)	0.154	0.025	0.355	5.963**	5.386**
26-Ores, slag and ash	3.118*	-0.14(1.2)	0.443	0.636	5.110**	7.491**	0.592
28-Inorganic chemical	2.864*	-0.15(0.3)	0.251	1.525	4.404**	0.029	0.489
29-Organic chemicals	4.32**	-0.07(0.6)	0.008	0.018	2.712*	7.001**	12.98**
30-Pharmaceutical products	3.98**	-0.22(1.2)	0.301	3.329*	3.615*	17.04**	6.960**
32-Tanning or dyeing extracts	6.07**	-0.01(0.1)	0.417	1.474	0.136	3.059*	0.005
33-Essential oils and resinoids and perfume material	3.270*	-0.16(1.1)	0.408	0.001	0.001	1.752	81.69**
34-Soap, organic surface-active agents, washing preparations,	2.965*	0.033(0.3)	0.306	10.3**	1.36	1.724	0.366
35-Albuminoidal substances	13.0**	-0.16(1.3)	0.520	0.124	0.001	55.73**	19.25**
39-Plastics and articles thereof	2.486	0.01(0.07)	0.331	1.328	6.022**	6.147**	0.004
41-Raw hides and skins (other than furskins) and leather	5.40**	-0.32(3.2)	0.588	0.288	5.761**	14.88**	1.859
47-Pulp of wood or of other fibrous cellulosic material	3.93**	-0.33(2.5)	0.296	1.125	5.623**	1.988	0.073
48-Paper and paperboard	3.124*	-0.24(1.8)	0.012	0.001	0.681	9.718**	0.303
49-Printed books, newspapers, pictures and other products	1.749	-0.35(0.9)	0.353	0.033	1.172	0.352	2.940*
50-Silk	2.099	-0.40(2.8)	0.475	0.907	1.543	0.056	0.092
51-Wool, fine or coarse animal hair; horsehair yarn and woven fabric	4.98**	-0.30(1.3)	0.466	0.952	0.0002	5.330**	27.28**
52-Cotton	5.93**	-0.19(1.8)	0.048	0.102	14.48**	3.309*	25.84**
57-Carpets and other textile floor coverings	6.68**	-0.09(1.1)	0.282	1.394	0.388	0.274	12.308**
58-Special woven fabrics ; tufted textile fabrics	2.412	-0.12(1.8)	0.249	1.130	0.080	0.490	0.004
59-Impregnated, coated, covered or laminated textile fabrics	7.50**	-0.29(2.8)	0.467	1.478	1.233	3.796**	25.659**
60-Knitted or crocheted fabrics	8.79**	-0.40(2.4)	0.418	0.091	0.014	6.702**	72.07**
61-Articles of apparel and clothing accessories, knitted or crocheted	5.16**	0.07(0.64)	0.529	1.684	0.202	4.845*	2.883*
62-Articles of apparel and clothing accessories not knitted	12.9**	-0.25(1.2)	0.601	5.32**	0.126	39.40**	145.62**
64-Footwear	7.25**	-0.09(0.7)	0.358	5.74**	8.078**	2.137	1.071
68-Articles of stone, plaster, cement, asbestos,	0.874	-0.07(0.5)	0.558	0.578	0.866	0.032	0.099
69-Ceramic products	6.00**	-0.16(0.7)	0.262	0.364	0.011	1.314	1.106
70-Glass and glassware	5.48**	-0.27(1.7)	0.180	0.062	3.112*	7.771**	20.42**
71-Natural or cultured pearls, precious or semi-precious stones,	0.650	-0.03(0.1)	0.526	2.352	0.543	3.863**	0.047
72-Iron and steel	2.103	-0.12(0.5)	0.316	0.077	0.623	0.127	2.186
73-Articles of iron or steel	4.44**	-0.06(0.5)	0.101	1.274	1.528	9.609**	8.812**
74-Copper and articles thereof	2.618	-0.26(2.7)	0.380	0.003	6.792**	1.160	0.146
76-Aluminium and articles thereof	9.58**	0.09(0.76)	0.419	0.315	0.148	11.17**	25.20**
82-Tools, implements, cutlery, spoons and forks, of base metal	7.51**	-0.61(2.0)	0.538	1.710	0.005	0.836	9.470**
85-Electrical machinery and equipment and parts thereof	5.67**	-0.15(1.3)	0.020	0.233	1.704	4.026**	4.516**
87-Vehicles other than railway or tramway rolling-stock,	0.780	-0.16(1.5)	0.451	0.0007	0.012	0.472	0.0001
91-Clocks and watches and parts thereof	5.16**	-0.36(2.9)	0.642	0.910	7.832**	3.852**	1.690
94-Furniture	7.37**	-0.29(1.5)	0.555	3.060*	1.236	3.629**	0.192
95-Toy, games and sports requisites; parts and accessories thereof	3.384*	-0.05(0.5)	0.878	0.023	1.364	8.633**	59.79**

a. The upper bound critical value of the F-test for cointegration when there are three exogenous variables is 3.77 (4.35) at the 10% (5%) level of significance. These come from Pesaran *et al*. (2001, Table CI, Case III, p. 300).

b. The critical value for significance of ECM_{t-1} is -3.46 (-3.78) at the 10% (5%) level when k =3. The comparable figures in the nonlinear model when k = 4 are -3.66 and -3.99 respectively. These come from Pesaran *et al*. (2001, Table CII, Case III, p. 303).

c. LM is the Lagrange Multiplier statistic to test for autocorrelation. It is distributed as χ^2 with one degree of freedom since we are testing for first order autocorrelation. The critical value is 2.70 (3.84) at the 10% (5%) level.

d. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) level.

e. All Wald tests are distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) level.

Table 9 Short-run Coefficient Estimates Attached to ΔPOS Variable in the Nonlinear ARDL Import Demand Model								
Industry	Short-Run coefficient estimates							
	ΔPOS_t	ΔPOS_{t-1}	ΔPOS_{t-2}	ΔPOS_{t-3}	ΔPOS_{t-4}	ΔPOS_{t-5}	ΔPOS_{t-6}	ΔPOS_{t-7}
11- Product of milling industry	-1.250**	-0.440**	0.558**	1.020**	1.052**	1.113**	0.531**	0.403**
12-Oil seed oleaginous fruit	-0.595**	0.193	0.429	1.148	0.877	0.235	0.160	0.299
15-Animal or vegetable fats and oils	-0.217							
16-Preparations of meat, of fish or of crustaceans	-0.682**	0.811**	0.989**	0.755**	0.284*			
17-Sugar and confectionery	0.147	0.750**	0.435*	-0.75**	-0.84**	0.064	0.237*	
19-Preparations of cereals, flour, starch or milk ;	-0.022	0.690**	0.615**	0.520**	0.187*			
20-Preparations of vegetables, fruit, nuts	-0.311	-1.38**	0.183	-0.588	-1.61**	-2.11**	-2.187	-1.091
23-Risidues and waste from the food industries;	-0.390	3.860**	3.471**	-0.205	-2.37**	-2.49**	-0.714	-0.848
26-Ores, slag and ash	0.314							
28-Inorganic chemical	-0.680**	-2.30**	-1.36**	-0.63**	-0.033	-0.142	-0.76**	-0.691**
29-Organic chemicals	-0.051	1.847**	0.907**	0.433*	-0.240	-0.62**	-0.63**	-0.185
30-Pharmaceutical products	-0.273*	0.901**	0.296	0.658**	0.550**	0.270	-0.52**	
32-Tanning or dyeing extracts	-0.081							
33-Essential oils and resinoids and perfume material	0.191							
34-Soap, organic surface-active agents, washing preparations, lubricating preparations, artificial waxes	-0.224	1.108**	0.977	-0.359	-0.573	0.297	-0.464	
35-Albuminoidal substances	-0.060	-1.33**	-1.73**	1.122**	-0.68**	-0.197	0.017	0.211**
39-Plastics and articles thereof	-0.373**	-0.59**	-0.184	0.045	-0.137	-0.39**	0.445**	-0.108
41-Raw hides and skins (other than furskins) and leather	0.178							
47-Pulp of wood or of other fibrous cellulosic material	0.972	3.397**	0.987	0.805	-2.007*	1.708		
48-Paper and paperboard	-0.403**	-0.56**	-0.291	-0.034	-0.41**	0.056	-0.222	0.271
49-Printed books, newspapers, pictures and other products	0.157	0.479	0.252	-0.184	-0.97**	0.648	1.429**	2.028**
50-Silk	-1.126**	-2.76**	-1.56**	-0.276	-0.252	-1.74**	1.459**	
51-Wool, fine or coarse animal hair; horsehair yarn	-0.140	0.037	0.060	-1.79**	-0.170	0.628		
52-Cotton	0.253	-0.354	-1.26**	-0.008	0.315	-0.033	-0.042	0.259
57-Carpets and other textile floor coverings	-0.326	-1.39**	-1.48**	-1.54**	-2.11**	-1.89**	-1.31**	0.491
58-Special woven fabrics ; tufted textile fabrics	-0.147*	-0.48**	-0.54**	-0.27**	-0.165	0.092	0.396**	0.378**
59-Impregnated, coated, covered or laminated textile fabrics	-0.115	-0.34**	0.001	0.047	0.216**	0.278**	0.062	0.159**
60-Knitted or crocheted fabrics	-0.036	-0.30*	-0.163*	-0.34**	-0.20**	-0.18**		
61-Articles of apparel and clothing accessories, knitted	0.027	0.128	0.073	-0.37**	-0.37**	0.217**	0.260**	
62-Articles of apparel and clothing accessories not knitted	0.093	0.267	-0.27**	-0.003	0.171	0.278**	0.412**	0.242**
64-Footwear	0.002	-0.16**	0.144	0.280**	0.168**	-0.079	-0.071	
68-Articles of stone, plaster, cement, asbestos,	-0.330**	0.125	-0.105	0.093	0.382**	0.342**		
69-Ceramic products	-0.282**	-1.07**	-0.65**	0.006	0.229**	0.157**		
70-Glass and glassware	-0.092	-0.81**	-0.49**	-0.229	-0.023	-0.34**	-0.55**	-0.304**
71-Natural or cultured pearls, precious or semi-precious stones, precious metals	0.011	-1.06**	-1.20**	-1.37**	-1.16**	-0.69**	-0.34**	
72-Iron and steel	-0.258	-1.62**	-0.639	-0.181	0.587**	-0.58**	-1.02**	-0.297
73-Articles of iron or steel	0.133	-0.81**	-0.66**	-0.54**	-0.384	-0.95**	-0.75**	-0.527**
74-Copper and articles thereof	-0.078	-0.073	-0.259	-0.38**				
76-Aluminium and articles thereof	0.050	-0.20**	-0.135	-0.010	0.010	-0.28**	-0.28**	
82-Tools, implements, cutlery, spoons and forks	-0.088	-0.10**	-0.14**	0.024	-0.033	-0.16**	0.068	0.068
85-Electrical machinery and equipment and parts thereof	-0.018	-0.13**	-0.09**	-0.12**				
87-Vehicles other than railway or tramway rolling-stock,	0.341**	0.493**	-0.29**	-0.45**	-0.193	0.198	0.318*	-0.166
91-Clocks and watches and parts thereof	-0.206**	0.183	0.422**	0.155	0.020	0.382**	0.360**	-0.243
94-Furniture	-0.193**	0.0345	0.057	0.195	0.278**	-0.18**	-0.35**	
95-Toy, games and sports requisites; parts and accessories	-0.099	-0.106	-0.013	0.297**	0.307**	-0.011	-0.152	-0.070

Note: Numbers inside the parentheses next to coefficient estimates are absolute values of t-ratios. * and ** indicate significance at the 10% and 5% levels respectively

Table 10: Short-run coefficient estimates attached to ΔNEG variable in the nonlinear ARDL import demand model								
Industry	Short-Run coefficient estimates							
	ΔNEG_t	ΔNEG_{t-1}	ΔNEG_{t-2}	ΔNEG_{t-3}	ΔNEG_{t-4}	ΔNEG_{t-5}	ΔNEG_{t-6}	ΔNEG_{t-7}
11- Product of milling industry	0.60**	0.938**	1.570**	1.539**	1.321**	0.668**	0.508**	0.329**
12-Oil seed oleaginous fruit	0.60**	1.465**	1.813**	1.129**	0.899**	0.852**	0.570**	0.543
15-Animal or vegetable fats and oils and their cleavage products	-0.041	0.373	0.300	0.266	0.444	0.469		
16-Preparations of meat, of fish or of crustaceans	0.303	1.181**	1.115**	0.751**	0.619**	0.638**	0.268**	0.304**
17-Sugar and confectionery	-0.88**	-0.638**	-1.034**	-0.526**	-0.171	-0.145	-0.287**	-0.267**
19-Preparations of cereals, flour, starch or milk ;	0.186	0.891**	0.895**	0.613**	0.432**	0.316**	0.132	0.254**
20-Preparations of vegetables, fruit, nuts or other parts of plants	0.360	-0.736	-2.615**	-2.444**	-2.471**	-1.808**	-1.069**	-0.609**
23-Risidues and waste from the food industries;	-0.918	2.124	-1.366	-1.955	-1.355	-0.713	-1.697**	-0.432
26-Ores, slag and ash	0.803							
28-Inorganic chemical	0.96**	0.138	0.607**	1.105**	0.715**	0.576**	0.222	
29-Organic chemicals	-0.186	0.833**	0.748**	0.234	-0.263*	0.181	-0.224*	0.231**
30-Pharmaceutical products	-0.096	1.274**	1.801**	1.222**	0.845**	0.275	0.453**	0.320**
32-Tanning or dyeing extracts	0.28**	-0.128	-0.118	0.080	-0.193**	-0.073	-0.322**	
33-Essential oils and resinoids and perfume material	0.065							
34-Soap, organic surface-active agents, washing preparations,	0.805	0.172	-1.753**	-1.354**	-0.592	-0.828**	0.026	-0.607**
35-Albuminoidal substances	0.34**	-1.439**	-0.419**	-0.103	0.011	0.171	0.070	0.260**
39-Plastics and articles thereof	0.68**	0.096	0.241**	0.086	-0.312**	0.079		
41-Raw hides and skins (other than furskins) and leather	-0.184							
47-Pulp of wood or of other fibrous cellulosic material	-2.82**	2.213	4.005**	1.363	5.110**	0.343	1.860**	
48-Paper and paperboard	0.76**	-0.294	-0.297	-0.310*	0.148	-0.380**	0.268**	-0.320**
49-Printed books, newspapers, pictures and other products of the printing industry	-0.295	-0.548	-0.201	-0.455	1.068**	0.662*	0.510	-0.577**
50-Silk	1.21**	-0.244	0.262	-0.471	-1.108**	0.144	0.864**	0.663**
51-Wool, fine or coarse animal hair; horsehair yarn	-1.286	0.745	0.119	1.451**	1.542**	0.201	1.031**	
52-Cotton	0.085	-1.173**	0.410	0.401	0.210	0.232		
57-Carpets and other textile floor coverings	0.413	-0.715**	-1.267**	-1.293**	-0.575**	0.120	0.412**	0.229
58-Special woven fabrics ; tufted textile fabrics	0.034	-0.285**	0.231**	0.247**	0.442**	0.615**	0.337**	0.211**
59-Impregnated, coated, covered or laminated textile fabrics	0.51**	-0.174	-0.228**	-0.024	-0.060	0.177**	-0.159**	-0.312**
60-Knitted or crocheted fabrics	0.032	-0.329**	-0.343**	-0.205**	-0.241**	0.106**	-0.068	-0.120**
61-Articles of apparel and clothing accessories, knitted	-0.39**	-0.049	-0.291**	0.122**	0.213**	0.066	-0.067	
62-Articles of apparel and clothing accessories not knitted	-0.33**	0.042	0.251**	0.318**	0.296**	0.302**	0.115	0.083
64-Footwear	-0.106	0.058	-0.205**	-0.265**	-0.396**	-0.120**	0.089**	-0.139**
68-Articles of stone, plaster, cement, asbestos,	0.22**	0.177*	0.700**	0.579**	0.372**	0.109	0.007	0.144**
69-Ceramic products	0.67**	-0.413**	0.156	0.159				
70-Glass and glassware	0.20**	-0.258	-0.285	-0.158	-0.435**	-0.348**	-0.086	-0.110**
71-Natural or cultured pearls, precious or semi-precious stones,	0.104	-0.924**	-1.022**	-0.460**				
72-Iron and steel	0.75**	-0.639	-0.773	-0.310	-1.137**	-0.984**	-1.053**	-0.983
73-Articles of iron or steel	0.069	-0.200	-0.438**	-0.366*	-0.645**	-0.383**	-0.239	
74-Copper and articles thereof	0.274*	-0.268	-0.112	0.253**	-0.105			
76-Aluminium and articles thereof	0.160	-0.098	-0.142	-0.221	-0.320**	-0.213**	-0.223**	-0.244**
82-Tools, implements, cutlery, spoons and forks, of base metal	0.164							
85-Electrical machinery and equipment and parts thereof	0.041							
87-Vehicles other than railway or tramway rolling-stock,	-0.061	-0.194	0.031	0.443**	0.415**	0.253	-0.119	0.170**
91-Clocks and watches and parts thereof	-0.32**	0.741**	0.512**	0.534**	0.671**	0.382**	-0.003	0.272**
94-Furniture	0.20**	0.483**	0.457**	0.321**	0.021	0.087	0.254**	0.061
95-Toy, games and sports requisites; parts	0.35**	0.310**	0.353**	0.22**	-0.024	0.064	0.159**	0.076

Note: * and ** indicate significance at the 10% and 5% levels respectively

Table 11: Long-Run Coefficient Estimations of the Nonlinear ARDL Import Demand Model					
Industry	Long-run coefficient estimates				
	Constant	LnY^{CH}	$LnREX$	POS_t	NEG_t
11- Product of milling industry	279.7	-110.96	-129.08	5.874*	-3.124
12-Oil seed oleaginous fruit	-0.069	4.029	2.092	-0.692	-0.527*
15-Animal or vegetable fats and oils and their cleavage products	0.996	3.390	0.712	-0.582**	-0.490
16-Preparations of meat, of fish or of crustaceans	-0.173	2.359	5.036**	-0.617**	-0.619**
17-Sugar and confectionery	19.27	-6.433	-4.674	-1.031	
19-Preparations of cereals, flour, starch or milk ;	221.9	-80.61	-105.4	-14.88	-19.89
20-Preparations of vegetables, fruit, nuts or other parts of plants	51.42**	-4.343	-9.860**	2.365**	1.158
23-Risidues and waste from the food industries;	70.28**	-12.41**	-4.284	-1.380**	-3.698**
26-Ores, slag and ash	52.90	-4.213	-11.25	1.882	0.895
28-Inorganic chemical	-6.635	-4.480	17.46.	-5.928	-7.509
29-Organic chemicals	25.09**	-0.816	-1.424	-0.657**	1.221**
30-Pharmaceutical products	14.51	0.371	1.295	-1.475**	-1.731**
32-Tanning or dyeing extracts	11.32**	1.938**	0.337	0.202	0.146
33-Essential oils and resinoids and perfume material	14.57**	0.151	1.408	0.255	-0.172
34-Soap, organic surface-active agents, washing preparations, lubricating preparations, artificial waxes	-43.55	2.057	25.12	-2.340	-2.805
35-Albuminoidal substances	-16.18	10.01**	-0.788	1.904**	3.151**
39-Plastics and articles thereof	11.36	2.078	11.06	-2.279	-2.469
41-Raw hides and skins (other than furskins) and leather	4.905	3.167	1.333	0.117	0.665*
47-Pulp of wood or of other fibrous cellulosic material	88.22**	-16.04**	-8.354	-7.718**	-10.68**
48-Paper and paperboard	-31.14	12.19	3.123	1.877	3.363*
49-Printed books, newspapers, pictures and other	-66.56	15.78	12.78	-2.129	0.119
50-Silk	-2.784	7.254**	-1.880	1.743**	3.083**
51-Wool, fine or coarse animal hair; horsehair yarn	-849.82	119.52	227.09	18.94	37.71
52-Cotton	11.55**	2.897**	-0.624	0.118	0.563**
57-Carpets and other textile floor coverings	-14.48	6.774**	2.561	0.443	0.810
58-Special woven fabrics ; tufted textile fabrics	-156.4	100.31	22.84	1.990	9.870
59-Impregnated, coated, covered or laminated textile fabrics	0.715	5.555**	-2.417	0.974**	1.113**
60-Knitted or crocheted fabrics	1.264	4.297	0.942	0.479	0.705
61-Articles of apparel and clothing accessories, knitted	47.11	-17.86	-13.72	-1.609	-3.031
62-Articles of apparel and clothing accessories not knitted	13.27	4.830	-16.166	3.526	3.515
64-Footwear	176.8	-37.78	-134.3	2.299	-0.567
68-Articles of stone, plaster, cement, asbestos,	-0.018	4.903**	0.695	-0.172	0.082
69-Ceramic products	-5.409**	8.178**	0.935	0.494**	0.870**
70-Glass and glassware	8.747	1.591	-3.287	1.327**	1.207**
71-Natural or cultured pearls, precious or semi-precious stones,	18.53**	-1.628	-7.773**	1.115**	0.896**
72-Iron and steel	6.479	9.112	-15.01	3.570**	3.888**
73-Articles of iron or steel	51.18	-14.78	-22.84	2.020	0.640
74-Copper and articles thereof	-5.993	12.915**	-6.944	1.231**	1.958**
76-Aluminium and articles thereof	15.16	-1.532	-5.557	0.880*	0.532
82-Tools, implements, cutlery, spoons and forks, of base metal	-3.229	5.296**	4.029	0.197	0.411
85-Electrical machinery and equipment and parts thereof	11.93	-0.256	-2.001	0.372	0.158
87-Vehicles other than railway or tramway rolling-stock,	35.07	-9.169	-15.611	-0.286	-1.232
91-Clocks and watches and parts thereof	-20.66	17.36	0.782	3.615	4.643
94-Furniture	22.24	-4.803	-3.885	-1.866	-2.195
95-Toy, games and sports requisites; parts	46.43	-19.51	-12.30	-0.243	-1.940

Note: * and ** indicate significance at the 10% and 5% levels respectively

Table 12: Diagnostics Associated with Estimates of Nonlinear Import Models in Table 11

Industry	F[a]	ECM^{b}_{t-1}	$Adj.R^2$	LM[c]	RESET[d]	Wald -S	Wald- L
11- Product of milling industry	17.8**	-0.21(1.13)	0.342	0.734	1.611	18.04**	2.573
12-Oil seed oleaginous fruit	2.132	-0.43(1.39)	0.552	0.004	9.594**	5.285**	0.484
15-Animal or vegetable fats and oils and their cleavage products	5.85**	-0.62(2.87)	0.347	2.282	0.291	6.267**	0.455
16-Preparations of meat, of fish or of crustaceans	6.46**	-1.75(3.58)	0.518	6.11**	1.090	6.374**	0.0006
17-Sugar and confectionery	0.728	-0.15(0.91)	0.609	1.062	0.976	8.438**	2.018
19-Preparations of cereals, flour, starch or milk ;	7.59**	-0.33(2.33)	0.095	0.957	0.847	4.974**	0.078
20-Preparations of vegetables, fruit, nuts or other parts of plants	1.94	-0.21(0.68)	0.613	2.760*	0.947	0.479	3.630**
23-Risidues and waste from the food industries; prepared animal fodder	3.56**	-0.24(0.71)	0.508	2.088	0.170	3.261**	16.64**
26-Ores, slag and ash	3.171	-0.97(2.30)	0.616	0.124	4.417**	0.208	1.321
28-Inorganic chemical	4.45**	0.01(0.016)	0.036	8.50**	2.649	5.325**	1.383
29-Organic chemicals	3.131	-0.14(0.61)	0.637	1.764	2.425	1.847	9.552**
30-Pharmaceutical products	6.38**	-0.16(0.55)	0.396	0.549	0.928	8.547**	1.031
32-Tanning or dyeing extracts	1.922	-0.39(2.47)	0.748	0.275	3.304**	0.262	0.136
33-Essential oils and resinoids and perfume material	5.28**	-0.5(4.2)**	0.431	0.092	1.809	0.091	11.69**
34-Soap, organic surface-active agents, washing preparations,	1.605	-0.40(1.22)	0.729	0.190	4.722**	0.792	0.051
35-Albuminoidal substances	7.11**	-0.15(0.61)	0.218	1.022	1.940	5.008**	5.455**
39-Plastics and articles thereof	2.477	0.13(0.80)	0.767	0.307	0.902	18.80**	0.101
41-Raw hides and skins (other than furskins) and leather	5.39**	-0.5(5.1)**	0.340	0.806	0.066	1.295	4.527**
47-Pulp of wood or of other fibrous cellulosic material	5.57**	-0.40(2.87)	0.392	0.050	4.875**	0.946	7.728**
48-Paper and paperboard	3.307	-0.21(2.04)	0.740	0.136	2.414	0.171	1.191
49-Printed books, newspapers, pictures and other products of the printing	4.84**	-0.37(2.29)	0.442	1.475	0.108	1.336	1.363
50-Silk	7.71**	-0.5(4.1)**	0.588	0.521	0.133	12.43**	6.052**
51-Wool, fine or coarse animal hair; horsehair yarn and woven fabric	0.903	-0.02(0.08)	0.872	1.348	2.892	1.724	0.010
52-Cotton	6.93**	-0.58(1.16)	0.173	0.515	3.408**	0.702	6.965**
57-Carpets and other textile floor coverings	6.10**	-0.91(3.00)	0.667	0.025	2.408	9.414**	0.821
58-Special woven fabrics ; tufted textile fabrics	2.097	-0.27(1.26)	0.786	6.66**	0.204	4.345**	0.022
59-Impregnated, coated, covered or laminated textile fabrics	2.507	-0.15(0.88)	0.430	0.153	3.841	0.819	0.607
60-Knitted or crocheted fabrics	2.609	-0.38(1.94)	0.703	3.28**	0.005	0.019	0.659
61-Articles of apparel and clothing accessories, knitted or crocheted	1.191	0.015(0.17)	0.864	2.526	1.600	0.574	1.330
62-Articles of apparel and clothing accessories not knitted or crocheted	1.313	-0.25(1.84)	0.564	2.963*	0.255	0.086	0.0001
64-Footwear	13.4**	-0.20(1.55)	0.369	2.981*	11.53**	8.331**	0.674
68-Articles of stone, plaster, cement, asbestos, mica or similar materials	4.110*	-0.39(1.13)	0.351	0.786	4.305**	4.561**	1.908
69-Ceramic products	7.88**	-0.35(1.63)	0.238	0.012	7.137**	12.05**	28.09**
70-Glass and glassware	1.954	0.07(0.450)	0.466	0.0001	0.333	1.403	0.074
71-Natural or cultured pearls, precious or semi-precious stones,	11.9**	-0.15(0.70)	0.404	4.19**	0.050	31.52**	4.803**
72-Iron and steel	2.271	-0.17(1.24)	0.421	1.161	0.318	0.106	0.100
73-Articles of iron or steel	2.596	-0.01(0.03)	0.512	0.147	0.090	3.408**	2.247
74-Copper and articles thereof	2.951	-0.20(1.86)	0.294	0.0003	0.668	2.130	5.034**
76-Aluminium and articles thereof	2.016	-0.18(1.63)	0.591	12.4**	0.274	0.212	0.621
82-Tools, implements, cutlery, spoons and forks, of base metal	1.639	-0.29(1.48)	0.641	0.285	0.212	2.563	1.293
85-Electrical machinery and equipment and parts thereof	1.450	-0.04(0.37)	0.378	2.483	2.237	3.068**	0.560
87-Vehicles other than railway or tramway rolling-stock, and parts	2.167	-0.45(2.63)	0.722	2.704*	3.778	0.300	0.386
91-Clocks and watches and parts thereof	2.707	-0.15(0.96)	0.412	0.966	0.077	4.444**	0.633
94-Furniture	1.008	-0.06(0.53)	0.818	0.567	2.469	7.535**	0.090
95-Toy, games and sports requisites; parts and accessories thereof	1.601	-0.03(0.21)	0.499	0.010	0.002	4.108**	0.168

a. The upper bound critical value of the F-test for cointegration when there are three exogenous variables is 3.77 (4.35) at the 10% (5%) level of significance. These come from Pesaran *et al*. (2001, Table CI, Case III, p. 300).

b. The critical value for significance of ECM_{t-1} is -3.46 (-3.78) at the 10% (5%) level when k =3. The comparable figures in the nonlinear model when k = 4 are -3.66 and -3.99 respectively. These come from Pesaran *et al*. (2001, Table CII, Case III, p. 303).

c. LM is the Lagrange Multiplier statistic to test for autocorrelation. It is distributed as χ^2 with one degree of freedom since we are testing for first order autocorrelation. The critical value is 2.70 (3.84) at the 10% (5%) level.

d. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) level.

e. All Wald tests are distributed as χ^2 with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) level.