

Exchange Rate Volatility and Turkey-US Commodity Trade: An Asymmetry Analysis

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ABSTRACT

In this paper we assess the symmetric and asymmetric effects of lira-dollar volatility on 56 2-digit industries that trade between Turkey and the US. When a linear model was estimated, which assumes the effects to be symmetric, we found short-run effects of volatility on 23 Turkish exporting industries and 31 Turkish importing industries. Short-run effects lasted into the long-run in 6 exporting and 18 importing industries. However, when a nonlinear model was estimated, we found short-run effects in 41 exporting and 42 importing industries which were asymmetric in all industries. Short-run effects translated into asymmetric long-run effects in 45 exporting and 22 importing industries.

JEL Classification: F31

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1. INTRODUCTION

When the international monetary system changed from fixed to relatively flexible exchange rates in 1973, opponents of floating rates argued that such rates introduce uncertainty into international markets and hurt trade flows. Theoreticians then developed models that show exchange rate volatility or uncertainty could promote trade. These studies, such as De Grauwe (1988), Pereg and Steinherr (1989), and Belke and Gros (2001, 2002), showed traders trade more today in order to cover any decline in their future revenue resulting from exchange rate uncertainty. However, risk averse traders will trade less today in order to avoid any price and exchange rate uncertainty. Empirical studies support the fact that exchange rate uncertainty, measured by its volatility, could affect trade flows in either direction. However, what does the literature reveal with regards to the experience of our country of concern, Turkey?³

Turkish-related studies can be divided into three categories. The first group includes studies that have used aggregate trade flows of Turkey with the rest of the world. These studies have either included only Turkey in their paper, or

Turkey with some other countries. Caballero and Corbo (1989) estimated the impact of exchange rate uncertainty on the aggregate export volume of Chile, Colombia, Peru, Philippines, Thailand, and Turkey. In the results for Turkey, they reported significantly negative short-run but not long-run effects. This was the outcome under both estimation techniques: ordinary least squares (OLS) and instrumental variables (IV). When they estimated a static model, however, they found significantly adverse effects of exchange rate volatility on Turkish exports.

That said, these findings are biased since Caballero and Corbo (1989) did not account for either the integrating properties of the variables or cointegration between the variables. To produce meaningful results, Doganlar (2002) used Engle and Granger's (1987) cointegration method to establish cointegration among real exports, relative prices, and exchange rate volatility. Turkey was one of the five countries included in the sample. Because the variables were cointegrated and the volatility measure of the exchange rate carried a negative coefficient, it was interpreted as volatility hurting the real exports of Turkey. However, when Kasman and Kasman (2005) applied Johansen's cointegration method, they found exchange rate volatility to have significantly positive effects on Turkish real exports. Significantly, these positive effects of exchange rate volatility on Turkish real exports were also confirmed by Ozturk and Kalyoncu (2009), who also relied upon Engle and Granger's (1987) method but for an extended period.

Adopting Pesaran *et al*'s (2001) ARDL approach, under which variables can be a combination of $I(0)$ and $I(1)$, yielded the same positive long-run effects for Altintas *et al* (2011). The outcome (a positive and significant effect) did not change when Demirhan and Demirhan (2015) used monthly data, a GARCH-based volatility measure, and Johansen's cointegration method, as opposed to the moving average standard deviation method of previous studies. However, when Asteriou *et al* (2016) used a GARCH-based measure of volatility in conjunction with Pesaran *et al*'s (2001) ARDL approach, they found no significant effects of volatility on Turkish exports and imports. Finally, the positive effect of exchange rate volatility on Turkish exports was recently confirmed by Tatliyer and Yigit (2016), who used monthly data over the period 1990–2015.

Clearly, the above studies suffer from aggregation bias. Turkey's trade flows with different trade partners may respond differently to a measure of volatility that is based on real bilateral exchange rates, rather than the lira's effective exchange rate. To address this issue, studies in the second group use bilateral trade flows of Turkey with major trading partners. Vergil (2002) assessed the impact of real exchange rate volatility on Turkey's exports to the USA, Germany, Italy, and France. Using Johansen's cointegration technique, he found exchange rate volatility to have a significantly negative effect on Turkish exports to all four partners. However, when Demez and Ustaoglu (2012) considered Turkish aggregate exports to five major partners (UK, Russia, Italy, USA, and Germany),

they found no significant effect of exchange rate volatility on Turkish exports. Denaux and Falks (2013) considered total Turkish imports from five major European Union (EU) partners and found that exchange rate volatility had no significant impact on Turkey's imports.

The studies in the second group also suffer from aggregation bias, in that different industries trading between Turkey and a partner may react differently to exchange rate volatility. To reduce the bias, a couple of studies have disaggregated Turkish trade flows by industry and have used firm level data in their research. Solakoglu *et al* (2008) used data from 143 Turkish firms that exported to Germany, USA, UK, Italy, France, Spain, Netherlands, Russia, Israel, and Greece between 2001 and 2003 in a panel model and found no significant effect of exchange rate volatility on exports. Of course, this could be a result of the short frequency of the time-series component of their model. Indeed, when Alper (2017) extended the time-series component of the panel model to include trade data over the period 2002–2013 from 43 Turkish exporting industries to, and 34 importing industries from, 15 European countries, he found evidence of both negative and positive effects of volatility on Turkish trade flows. Clearly, the two studies in this group also suffer from aggregation bias in that they are panel models and whatever may hold true for one industry, may not hold true for another industry.

Now that we have access to enough monthly time series trade data between Turkey and one of its major partners, the US, for as many as 56 2-digit exporting and 62 2-digit importing industries, we are now able to assess the impact of the real lira-dollar rate volatility on each industry's trade flows.⁴ However, unlike all of the studies reviewed above, we take an additional step and separate increased volatility from decreased volatility and engage in asymmetry analysis. Bahmani-Oskooee and Aftab (2017), who first introduced the idea, argued that trade flows could respond to exchange rate volatility in an asymmetric manner as a result of a change in traders' expectations. Furthermore, the approach allows us to identify industries that are hurt by increased or decreased exchange rate volatility and those that benefit from increased or decreased volatility. To that end, we introduce the models and methods in Section 2, followed by our empirical results in Section 3. A summary is then provided in Section 4 which is followed by an Appendix in which we provide definitions of the variables and cite the sources of our data.

2. THE MODELS AND METHODS

It is common practice, in trying to assess the impact of exchange rate volatility on trade flows, to rely upon export and import demand models in which measures of economic activity, the real exchange rate itself as a measure of relative prices, and volatility of the real exchange rate, are identified to be the main determinants of trade flows. As such, we adopt the specification from Bahmani-Oskooee and Aftab (2017) as follows:

$$\text{Ln}X_{i,t}^{TR} = \alpha_0 + \alpha_1 \text{Ln}Y_t^{US} + \alpha_2 \text{Ln}REX_t + \alpha_3 \text{Ln}V_t + \varepsilon_t \quad (1)$$

$$\text{Ln}M_{i,t}^{TR} = \beta_0 + \beta_1 \text{Ln}Y_t^{TR} + \beta_2 \text{Ln}REX_t + \beta_3 \text{Ln}V_t + \mu_t \quad (2)$$

Equation (1) is the US demand for Turkish exports of commodity i (X_i^{TR}) which is assumed to depend on the level of economic activity in the US (Y^{US}), the real lira-dollar rate (REX), and a GARCH-based volatility of the real exchange rate, V . Equation (2) is Turkey's import demand for commodity i from the US (M_i^{TR}), which is assumed to depend on the level of economic activity in Turkey (Y^{TR}), the REX , and V . Since increased economic activity is supposed to stimulate trade, we expect estimates of α_1 and β_1 to be positive. From the Appendix we gather that the real lira-dollar rate (REX) is defined in a manner that an increase reflects lira depreciation. If lira depreciation is to boost Turkish exports of commodity i and reduce Turkish imports of commodity i , we expect an estimate of α_2 to be positive and that of β_2 to be negative. Finally, as argued in the introductory section, since exchange rate volatility could have negative or positive effects on trade flows, estimates of both α_3 and β_3 could be negative or positive.

The coefficient estimates discussed above reflect the long-run effects of exogenous variables in both models. In order also to estimate their short-run effects, we re-write (1) and (2) in an error-correction form as follows:

$$\begin{aligned} \Delta \text{Ln}X_{i,t}^{TR} = & a_1 + \sum_{j=1}^{n1} a_{2j} \Delta \text{Ln}X_{i,t-j}^{TR} + \sum_{j=0}^{n2} a_{3j} \Delta \text{Ln}Y_{t-j}^{US} + \sum_{j=0}^{n3} a_{4j} \Delta \text{Ln}REX_{t-j} + \sum_{j=0}^{n4} a_{5j} \Delta \text{Ln}V_{t-j} \\ & + \theta_0 \text{Ln}X_{i,t-1}^{TR} + \theta_1 \text{Ln}Y_{t-1}^{US} + \theta_2 \text{Ln}REX_{t-1} + \theta_3 \text{Ln}V_{t-1} + \varepsilon_t \end{aligned} \quad (3)$$

$$\begin{aligned} \Delta \text{Ln}M_{i,t}^{TR} = & b_1 + \sum_{j=1}^{n5} b_{2j} \Delta \text{Ln}M_{i,t-j}^{TR} + \sum_{j=0}^{n6} b_{3j} \Delta \text{Ln}Y_{t-j}^{TR} + \sum_{j=0}^{n7} b_{4j} \Delta \text{Ln}REX_{t-j} + \sum_{j=0}^{n8} b_{5j} \Delta \text{Ln}V_{t-j} \\ & + \rho_0 \text{Ln}M_{i,t-1}^{TR} + \rho_1 \text{Ln}Y_{t-1}^{TR} + \rho_2 \text{Ln}REX_{t-1} + \rho_3 \text{Ln}V_{t-1} + \mu_t \end{aligned} \quad (4)$$

The above error-correction models come from Pesaran *et al* (2001) and have advantages over other methods. First, short-run and long-run effects are estimated in one step. In both models, short-run effects are reflected in the estimates of coefficients attached to first-differenced variables. The long-run effects are inferred from the estimates of θ_1 - θ_3 divided by $-\theta_0$ in (3) and estimates of $\rho_1 - \rho_3$ divided by $-\rho_0$ in (4).⁵ However, for the long-run estimates to be meaningful, we must establish cointegration. Pesaran *et al* (2001) recommend two tests, the F-test to establish joint significance of lagged level variables and the t-test to establish significance of θ_0 in (3) and ρ_0 in (4).⁶ They demonstrate that the distributions of both tests are non-standard; hence they tabulate new critical values that account for the degree of integration of the variables. Indeed, under this method variables can be a combination of I(0) and I(1) and this is another advantage of this method, since almost all macro variables are either I(0) or I(1). Therefore, there is no need for pre unit root testing under this

method. Finally, since the short-run dynamic adjustment process is included in estimating long-run effects, any feedback effect among the variables is accounted for (Pesaran *et al* 2001 p 299).

Shin *et al* (2014) modify models like those in (3) and (4) so that one can engage in an assessment of asymmetric impacts of any of the variables on the dependent variable. Since our main goal is to investigate asymmetric effects of volatility, we concentrate on that measure and first form ΔLnV , which includes positive values as a sign of increased volatility and negative values as a sign of decreased volatility. Then the concept of partial sum is used to construct two new time-series variables from ΔLnV as follows:

$$POS_t = \sum_{j=1}^t \max(\Delta \text{LnV}_j, 0), \text{ and } NEG_t = \sum_{j=1}^t \min(\Delta \text{LnV}_j, 0) \quad (5)$$

where the POS variable is the partial sum of positive changes and represents only increased volatility; and the NEG variable, which is the partial sum of negative changes, reflects only decreased volatility.⁷ Next, we shift back to error-correction models (3) and (4) and replace the LnV variable with the two partial sum variables to arrive at the following:

$$\begin{aligned} \Delta \text{LnX}_{it}^{TR} = & c_1 + \sum_{j=1}^{n1} c_{2j} \Delta \text{LnX}_{i,t-j}^{TR} + \sum_{j=0}^{n2} c_{3j} \Delta \text{LnY}_{t-j}^{US} + \sum_{j=0}^{n3} c_{4j} \Delta \text{LnREX}_{t-j} + \sum_{j=0}^{n4} c_{5j} \Delta POS_{t-j} \\ & + \sum_{j=0}^{n5} c_{6j} \Delta NEG_{t-j} + \lambda_0 \text{LnX}_{i,t-1}^{TR} + \lambda_1 \text{LnY}_{t-1}^{US} + \lambda_2 \text{LnREX}_{t-1} + \lambda_3 POS_{t-1} \\ & + \lambda_4 NEG_{t-1} + \varepsilon_t \end{aligned} \quad (6)$$

and

$$\begin{aligned} \Delta \text{LnM}_{it}^{TR} = & d_1 + \sum_{j=1}^{n6} d_{2j} \Delta \text{LnM}_{i,t-j}^{TR} + \sum_{j=0}^{n7} d_{3j} \Delta \text{LnY}_{t-j}^{TR} + \sum_{j=0}^{n8} d_{4j} \Delta \text{LnREX}_{t-j} + \sum_{j=0}^{n9} d_{5j} \Delta POS_{t-j} \\ & + \sum_{j=0}^{n10} d_{6j} \Delta NEG_{t-j} + \pi_0 \text{LnM}_{i,t-1}^{TR} + \pi_1 \text{LnY}_{t-1}^{TR} + \pi_2 \text{LnREX}_{t-1} + \pi_3 POS_{t-1} \\ & + \pi_4 NEG_{t-1} + \varepsilon_t \end{aligned} \quad (7)$$

While (3) and (4) are known as linear ARDL models, specifications such as (6) and (7) are known as nonlinear ARDL models, given the nature of constructing the partial sum variables. Shin *et al* (2014) demonstrate that both the linear and nonlinear models are subject to the same tests and diagnostic statistics. They even argue that in applying the F test for cointegration, the two partial sum variables must be treated as one variable, so that the critical values of the F test can stay at a high level when we move from the linear to nonlinear model (Shin *et al* 2014 p 291).

Once we estimate (6) and (7), we can test our asymmetry hypotheses. First, there will be evidence of adjustment asymmetry if $n4 \neq n5$ in (6) and $n9 \neq n10$ in (7); that is, if the partial sum variables accept different lag orders. Second, if at

any given lag order j , the estimate attached to ΔPOS_{t-j} is different than the one attached to ΔNEG_{t-j} , short-run asymmetric effects of volatility will be confirmed. While this hypothesis could be tested by the Wald test, given the volume of the results we shall avoid it and instead test the null hypothesis of $\sum\hat{c}_{5j} = \sum\hat{c}_{6j}$ in (6) and $\sum\hat{d}_{5j} = \sum\hat{d}_{6j}$ in (7). If the Wald test rejects the null, short-run cumulative or impact asymmetry will be confirmed. Finally, we shall use the Wald test also to test the null hypotheses 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). If the null is rejected, the long-run asymmetric impact of volatility on trade flows will be confirmed.⁸

3. RESULTS

In this section we review estimates of two linear and two nonlinear models for each industry in our sample but only present estimates of the nonlinear models. As mentioned, we have a total of 56 Turkish 2-digit industries that export to the US and 62 Turkish 2-digit industries that import from the US. Monthly data over the period January 2003 to October 2018 are used. Since data are monthly, we impose a maximum of 12 lags on each first-differenced variable and use Akaike's Information Criterion (AIC) to select the optimum lag order. Furthermore, since there are different critical values for different estimates and diagnostics, we collect them in the notes to each table and use them to identify significant estimates, as indicated in each table. Additionally, to account for the global financial crisis of 2008, we include a dummy variable in all models.

As mentioned, we first review estimates of the Turkish linear export and import demand models, the details of which are available from the authors upon request. The estimates of the export demand models revealed that in 23 industries the volatility measure (ΔLnV) carried at least one significant coefficient, supporting short-run effects of the real lira-dollar volatility. However, short-run effects lasted into the long run in only 15 industries. In these 15 industries the long-run normalised coefficient attached to the LnV variable was significant. However, only in six industries was cointegration supported either by the F or the t-test. These six industries were coded as 18, 29, 58, 61, 69, and 72. While real lira-dollar volatility hurt the exports of industries 29, 58, 69, and 72, it boosted the exports of 18 and 61. One of the two largest industries, 72 (Iron and steel with an 11.01 per cent export share reported in Table 3), was in the first group and seemed to be hurt by the volatility of the lira against the US dollar.⁹

Next, we consider estimates of the Turkish linear import demand models for each industry. The estimates revealed short-run effects of exchange rate volatility in 31 industries. However, short-run effects turned into long-run significant and meaningful effects only in 17 industries.¹⁰ The effects were negative in 13, 17, 21, 54, 55, 58, 59, 91, 94, and 96, and positive in 34, 35, 40, 47, 56, 69, 70, and 88. This time, one of the largest Turkish importing industries, 88 (Aircraft and parts thereof, with a 9.77 per cent import share) was affected positively by exchange rate volatility. Additional diagnostic

statistics supported autocorrelation-free residuals (by the LM test), correctly specified models (by the RESET test), and stable estimates (by the CUSUM and CUSUMSQ tests) in most models. In most models the level of economic activity in Turkey was found to be the main determinant of Turkish imports.¹¹

How do the results change if we consider estimates from the nonlinear models? Following the same order as the linear models, we first consider estimates of the Turkish nonlinear export demand models in Tables 1–4. Given the volume of the results, short-run estimates attached to ΔPOS (increased volatility) are reported in Table 1 and those attached to ΔNEG (decreased volatility) are reported in Table 2. From these two tables we see that either the ΔPOS variable or the ΔNEG variable carry at least one significant coefficient in 41 industries, providing evidence of short-run effects of exchange rate volatility on Turkish exports. This increase in the number of industries from linear to nonlinear models in which changes in exchange rate volatility has short-run effects on Turkish exports must be attributed to the nonlinear adjustment of the volatility measure.

Comparing the estimates at the same lag order and in the same industry, we also realise that in most instances they are different, providing evidence of the short-run asymmetric effects of volatility on exports. However, short-run cumulative or impact asymmetric effects are established in industries coded as 08, 11, 34, 39, 48, 54, 56, 57, 60, 61, 71, 82, and 94. In these industries the Wald test reported as Wald-S in Table 4 (Diagnostics Table) is significant, rejecting the null of equality of the sum of coefficients attached to the ΔPOS and ΔNEG variables.

Do short-run asymmetric effects last into the long run? From the long-run estimates reported in Table 3 we gather that either the *POS* or the *NEG* variable carries a significant coefficient in 13 industries. However, cointegration is supported by either the t-test or the F test (Table 4) only in nine industries, coded 11, 33, 34, 40, 42, 58, 61, 72, and 85. Small as well as large industries such as 72 (Iron and steel with an 11.01 per cent share of exports) are on the list. Increased volatility seems to hurt exports of industries coded as 11, 42, 58, 61, 72, and 85, and boost exports of 33 and 34. However, decreased volatility that introduces stability to the foreign exchange market seems to boost exports of all nine industries, since the *NEG* variable carries a negative coefficient in all nine industries.

The results are industry specific and need to be considered separately. For example, consider industry 40 (Rubber and articles thereof). In the linear model, the measure of exchange rate volatility was insignificant. If we relied only on the results from the linear model, we would have concluded that the real lira-dollar volatility has no long-run effects on the exports of this industry. However, when increased volatility is separated from declines, the nonlinear model reveals that decreased volatility will boost exports of this industry and increased volatility will have no effect, which must be attributed to the nonlinear adjustment of our volatility measure. Although in many industries the estimates

Table 1: Short-run coefficient estimates Attached to ΔPOS (Increased Volatility) in the Turkish Nonlinear Export Models

Code	# Lags on ΔPOS												
	0	1	2	3	4	5	6	7	8	9	10	11	
07 Edible vegetables and certain roots and tubers	0.04												
08 Edible fruits and nuts, peel of melons or citrus fruits	0.03	0.08	0	0.10 **	0.02	0.07 *							
09 Coffee, tea, mate and spices	-0.05	-0.25 **											
11 Products of the millings industry, malt and starches,	0	1.20 *	0.89	0.68	1.04 **	0.25	0.52	0.63 *	0.5	0.80 **	0.54 **	0.48 **	
12 Oil seeds and oleaginous fruit, industrial plants,	0.24												
15 Animals and vegetable fats and oils and related products	-0.07	0.14	-0.07	-0.16	-0.1	-0.17	-0.31 **						
17 Sugar and sugar confectionery	-0.28 **	-0.36 **											
18 Cocoa and cocoa preparations	0.04												
19 Preparations of cereals, flour or starch or milk	0.01												
20 Preparations of vegetables, fruits or other parts of plants	-0.03												
21 Miscellaneous edible preparations	-0.09												
22 Beverages, spirits and vinegar	-0.14	0.37 **											
24 Tobacco and materials instead of tobacco	0.34 **	0.31											
25 Salt, sulphur, earths and stones, plastering materials, lime and cement	-0.05	0.23											
28 Inorganic chemicals, organic or inorganic compounds	0.16	-0.12	-0.41 *	-0.44 **	-0.37 **	-0.13	0.02	-0.26 **	-0.21 *	0.12	0.15	-0.18	
29 Organic chemicals	0.17												
33 Essential oils and resinoids, perfumery, cosmetic or toilet prep.	0.04												
34 Soap, organic surface-active agents, washing preparations ext.	-0.03	-0.43 *	-0.57 **										
39 Plastic and articles thereof	-0.03	-0.08	-0.05	-0.06	-0.08 **	-0.06	-0.06 *	-0.06 *	-0.15 **	-0.08 **	-0.05	0.07 **	
40 Rubber and articles thereof	-0.04												
41 Row hides and skins (other than furskins) and sole leather	0.09												
42 Articles of leather, saddlery, harness, travel goods, articles	-0.1												
43 Furskins and artificial fur manufactures thereof	-0.01												
44 Wood and articles of wood, wood charcoal	0.14												
48 Paper and paperboard, articles of paper pulp of paper or of paperboard	0.04												
49 Printed books, newspapers, pictures and other products of print industry	-0.06	0.07	0.49 **	0.15	0.18	-0.03							
51 Wool and other animal hair	0.07												
52 Cotton, cotton yarn and cotton textiles	-0.02	-0.10 **											
54 Man-made filament	-0.03	0.23 **	0.23 **	0.22 **	0.17 **	0.19 **	0.13 **	0.01	0.10 **	0.14 **	0.05 *	0.07 **	
55 Man-made fibres (discontinuous)	0.01	0.06											
56 Wadding and felt, twine, cordage, special fabrics and thereof	0.05												
57 Carpets, mats matting and tapestries	0.01												
58 Special fabrics, lace, wall carpets, embroidery	-0.25 **												
60 Knitted and crocheted goods	0.11	0.63 **	0.43 **	0.29									
61 Knitted and crocheted goods and articles thereof	-0.01	0.06	0.11 **	0.11 **	0.03	-0.03	-0.07 **	0.04 *	0.03				
62 Non knitted and crocheted goods and articles thereof	-0.02												
63 Old clothing and other textile articles, rags	-0.02												
64 Footwear, gaiters and the like, parts of such articles	0.07	-0.02	-0.05	0.34 **									
68 Articles of stone, of plaster, of cement, of asbestos of mica	-0.03	0.01	0.02	0.06	0.01	0	0	0.05	0.02	-0.03	-0.05	0.06 *	
69 Ceramic products	-0.02	0.09 *	-0.02	0.06 *									
70 Glass and glassware	-0.02	-0.06											
71 Precious stones, precious metals, pearls and articles thereof	-0.06 *												
72 Iron and steel	-0.08												
73 Articles of iron and steel	-0.08	0.25 *											
74 Copper and articles thereof	0												
76 Aluminium and articles thereof	0.01												
82 Tools, implements, cutlery, spoons, forks of base metal, parts thereof	-0.12	0.36	0.30 *	0.14	0.34 **								
83 Miscellaneous articles of base metal	0.02												
84 Boilers, machineries and mechanical appliances, parts thereof	0.01	0.09	0.05	0.16 **	0.07	0.05	-0.01	0.09 **					
85 Electrical machinery and equipment, parts thereof	-0.03	0.24 **	0.16 **										
87 Vehicles other than railway or tramway rolling-stock, parts thereof	0.01												
88 Aircraft and parts thereof	-0.16 **	0.1	-0.02	-0.12	-0.07	-0.07	0.25 **						
90 Optical, photographic, cinematographic, measuring checking, precision	0												
93 Arms and ammunition, parts thereof	0.03	0.11	0.05	0.04	0.19	0.04	-0.19 **	0.01	-0.08	-0.07	-0.1 *	0.08	
94 Furniture	0.01	0.07	0.14 **	0.11 **									
96 Miscellaneous manufactured articles (pens and brushes etc)	-0.02	0.19	0.25	0.29	0.26	0.62 **	0.22	-0.33 *	0.28 *				

Notes: * and ** indicate significance at 10% and 5% levels, respectively. The critical values of standard t-distribution, i.e., 1.64 and 1.96 are used to arrive at * and **. The t-ratios themselves are not reported

due to space constraints but they are available from the authors upon request.

Table 2: Short-run coefficient estimates Attached to Δ NEG (Decreased Volatility) in the Turkish Nonlinear Export Models

Code	# Lags on Δ NEG											
	0	1	2	3	4	5	6	7	8	9	10	11
07 Edible vegetables and certain roots and tubers	-0.05											
08 Edible fruits and nuts, peel of melons or citrus fruits	-0.02											
09 Coffee, tea, mate and spices	0.09	0.09	-0.1	-0.12	-0.1	0.01	-0.04	-0.12	0.17 *	-0.11	0.28 **	
11 Products of the millings industry, malt and starches, gluten, inulin	-0.41	0.8	1.02 **	0.53	0.02	0.4	0.27	0.60 **				
12 Oil seeds and oleaginous fruit, industrial plants, straw and fodder	-0.29											
15 Animals and vegetable fats and oils and their cleavage products	-0.1											
17 Sugar and sugar confectionery	-0.14	0.05	-0.12	-0.27 **	-0.07	-0.32 **						
18 Cocoa and cocoa preparations	0.24											
19 Preparations of cereals, flour or starch or milk	-0.03	0	0.02	-0.02	-0.06 *	0.10 **						
20 Preparations of vegetables, fruits or other parts of plants	-0.02											
21 Miscellaneous edible preparations	-0.1	-0.23 *										
22 Beverages, spirits and vinegar	0.15											
24 Tobacco and materials instead of tobacco	0.01											
25 Salt, sulphur, earths and stones, plastering materials,	-0.31											
28 Inorganic chemicals, organic or inorganic compounds	-0.06	-0.51 **										
29 Organic chemicals	-0.28 *	0.30 **										
33 Essential oils and resinoids, perfumery, cosmetic or toilet prep.	0.21											
34 Soap, organic surface-active agents, washing preparations ext.	-0.06											
39 Plastic and articles thereof	-0.04	-0.06										
40 Rubber and articles thereof	-0.04											
41 Row hides and skins (other than furskins) and sole leather	0.1	-0.29 **	-0.11									
42 Articles of leather, saddlery, harness, travel goods, articles	-0.17	0.17	0.19 *									
43 Furskins and artificial fur manufactures thereof	-0.15	-0.04	0.11	-0.07	-0.14	-0.43 **						
44 Wood and articles of wood, wood charcoal	-0.14											
48 Paper and paperboard, articles of paper pulp	-0.17	0.01	0.19	0.27 **	0.40 **	0.35 **	0.1	0.02	0.18	0.29 **	0.16	-0.06
49 Printed books, newspapers, pictures and other paper products	0.12											
51 Wool and other animal hair	-0.06											
52 Cotton, cotton yarn and cotton textiles	-0.04											
54 Man-made filament	0.01	0.17 **	0.15 **	0.12 **	0.15 **	0.12 **	0.11 **	0.15 **				
55 Man-made fibers (discontinuous)	-0.06	-0.03	-0.01	-0.02	0.04	0.04	0.12 **	-0.03	-0.07 **	-0.05	0.11 **	0.13 **
56 Wadding and felt, twine, cordage, special fabrics and thereof	-0.05	-0.02	-0.06	-0.03	-0.05	0	0	-0.02	-0.08 **	-0.07 **	-0.06 *	-0.04
57 Carpets, mats matting and tapestries	0	0.04	0.08 **	0.06 **	0.01	0.03	0.06 **	0.05 **				
58 Special fabrics, lace, wall carpets, embroidery	-0.01											
60 Knitted and crocheted goods	-0.02	0.04	0.08	-0.22	0.24 *	0.09	-0.12	-0.13	-0.13	-0.2	0.13	-0.13
61 Knitted and crocheted goods and articles thereof	0											
62 Non knitted and crocheted goods and articles thereof	-0.05											
63 Old clothing and other textile articles, rags	-0.05											
64 Footwear, gaiters and the like, parts of such articles	-0.17											
68 Articles of stone, of plaster, of cement, of asbestos of mica	0	0.04	0.08	0.04	0.02	0.03	0.07	0.06	-0.02	0	0.05 *	0.03
69 Ceramic products	-0.04	0.08 *	0.09 **									
70 Glass and glassware	-0.09 **	-0.07 **										
71 Precious stones, precious metals, pearls and articles thereof	0.12 **											
72 Iron and steel	-0.23											
73 Articles of iron and steel	0.03	0.02	0.08	0.16	-0.05	0.1	-0.17 *	0	-0.18 *	-0.33 **	-0.08	-0.27 **
74 Copper and articles thereof	0											
76 Aluminium and articles thereof	0.06	-0.02	0.11 **									
82 Tools, implements, cutlery, spoons, forks of base metal,	0											
83 Miscellaneous articles of base metal	0.06											
84 Boilers, machineries and mechanical appliances, parts thereof	0.02	0.08	0.13 **	0.02	0.07 *	0.07 **	0.08 **					
85 Electrical machinery and equipment, parts thereof	-0.08	0.17 **	0.11 *									
87 Vehicles other than railway or tramway rolling-stock, parts thereof	0	0.14 **	-0.13 **	-0.02	-0.09	0.14 **						
88 Aircraft and parts thereof	-0.12	-0.2	-0.11	0.13	0.07	0.23 **	0.12 *					
90 Optical, photographic, cinematographic, measuring checking,	-0.23											
93 Arms and ammunition, parts thereof	0.11	0.02	0.06	0.30 **								
94 Furniture	-0.07	0.03	0.04	0.03	-0.02	0.04	0	0.03	-0.08 **	-0.09 **		
96 Miscellaneous manufactured articles (pens and brushes etc)	-0.2	0.53 *	0.36									

Notes: * and ** indicate significance at 10% and 5% levels, respectively. The critical values of standard t-distribution, i.e., 1.64 and 1.96 are used to arrive at * and **. The t-ratios themselves are not reported

due to space constraints but they are available upon request.

Table 3: Long-Run Coefficient Estimates of Turkish Nonlinear Export Demand Models

Industries	Trade Shares	Constant	$\ln Y_t^{US}$	$\ln REX_t$	POS_t	NEG_t
07 Edible vegetables and certain roots and tubers	0.34	3.34 (1.46)	0.24 (0.21)	0.61 (1.53)	-0.07 (-0.96)	-0.08 (-0.97)
08 Edible fruits and nuts, peel of melons or citrus fruits	1.40	3.01 (1.06)	1.30 (1.55)	0.40 (1.47)	-0.11 (-1.38)	-0.12 (-1.50)
09 Coffee, tea, mate and spices	0.28	7.63 (1.30)	0.16 (0.12)	0.05 (0.10)	0.02 (0.21)	0.00 (0.01)
11 Products of the millings industry, malt and starches ,gluten, inulin	0.11	-1.97 (-0.15)	1.14 (0.21)	1.57 (0.86)	-2.75 (-2.22) **	-2.79 (-2.25) **
12 Oil seeds and oleaginous fruit, industrial plants, straw and fodder	0.52	3.86 (0.31)	-1.13 (-0.18)	3.28 (1.54)	-0.34 (-0.73)	-0.38 (-0.82)
15 Animals and vegetable fats and oils and their cleavage products	0.77	8.43 (1.26)	-6.65 (-1.01)	7.95 (3.38) **	-0.96 (-1.39)	-0.94 (-1.37)
17 Sugar and sugar confectionery	0.90	12.12 (1.49)	-2.98 (-1.00)	-0.59 (-0.59)	0.03 (0.10)	-0.05 (-0.18)
18 Cocoa and cocoa preparations	0.14	-12.01 (-1.05)	2.91 (1.51)	2.84 (4.18) **	-0.08 (-0.58)	-0.13 (-0.89)
19 Preparations of cereals, flour or starch or milk	0.28	14.82 (3.30) **	-2.13 (-2.69) **	0.51 (2.35) **	-0.01 (-0.35)	-0.04 (-0.87)
20 Preparations of vegetables, fruits or other parts of plants	1.58	2.85 (1.48)	0.93 (0.97)	0.37 (1.23)	-0.07 (-1.06)	-0.09 (-1.30)
21 Miscellaneous edible preparations	0.70	35.78 (3.69) **	-9.78 (-3.34) **	-2.53 (-2.70) **	0.04 (0.24)	-0.07 (-0.39)
22 Beverages ,spirits and vinegar	0.05	6.52 (0.81)	0.23 (0.16)	-0.30 (-0.62)	-0.10 (-0.70)	-0.13 (-0.95)
24 Tobacco and materials instead of tobacco #	1.81	10.98 (1.03)	0.55 (0.35)	1.20 (2.00) **	-0.04 (-0.26)	-0.05 (-0.31)
25 Salt, sulphur, earths and stones, plastering materials, lime and cement	1.64	-5.90 (-0.61)	4.11 (0.78)	5.21 (1.80) *	-1.18 (-3.28) **	-1.18 (-3.31) **
28 Inorganic chemicals, organic or inorganic compounds #	0.92	-15.83 (-2.08) **	5.90 (3.15) **	-1.13 (-1.69) *	0.34 (1.44)	0.31 (1.33)
29 Organic chemicals	0.60	2.86 (0.43)	1.51 (0.95)	-0.28 (-0.57)	-0.16 (-1.36)	-0.18 (-1.51)
33 Essential oils and resinoids, perfumery, cosmetic or toilet prep.	0.15	-2.82 (-0.28)	2.17 (1.18)	0.64 (1.13)	0.29 (2.05) **	0.27 (1.94) *
34 Soap, organic surface-active agents, washing preparations ext.	0.09	21.94 (2.25) **	-4.43 (-1.56)	-0.14 (-0.15)	0.58 (1.95) *	0.58 (1.95) *
39 Plastic and articles thereof	1.36	-1.01 (-0.50)	2.52 (2.16) **	1.27 (2.87) **	0.12 (1.05)	0.10 (0.86)
40 Rubber and articles thereof	1.54	6.53 (3.17) **	-0.82 (-0.84)	0.05 (0.16)	-0.10 (-1.39)	-0.13 (-1.80) *
41 Row hides and skins (other than furskins) and sole leather	0.04	-7.49 (-0.94)	3.37 (1.77) *	-1.95 (-2.96) **	0.14 (0.96)	0.11 (0.75)
42 Articles of leather, saddlery, harness, travel goods, articles	0.18	-21.81 (-2.39) **	8.59 (2.65) **	3.41 (3.90) **	-0.51 (-3.20) **	-0.47 (-3.00) **
43 Furskins and artificial fur manufactures thereof	0.14	-37.93 (-4.24) **	8.02 (5.14) **	1.79 (3.07) **	-0.03 (-0.24)	0.01 (0.06)
44 Wood and articles of wood, wood charcoal	0.07	-0.80 (-0.10)	0.97 (0.24)	5.24 (2.56) **	0.21 (0.57)	0.19 (0.52)
48 Paper and paperboard, articles of paper pulp of paper or of paperboard	0.28	10.59 (1.55)	-2.55 (-0.97)	3.09 (2.68) **	-0.29 (-1.36)	-0.32 (-1.46)
49 Printed books, newspapers, pictures and other products of print industry##	0.03	3.72 (0.47)	0.27 (0.14)	3.10 (4.42) **	-0.32 (-1.51)	-0.31 (-1.46)
51 Wool and other animal hair	0.03	-10.06 (-1.31)	4.06 (1.90) *	2.56 (3.52) **	-0.13 (-0.77)	-0.10 (-0.59)
52 Cotton, cotton yarn and cotton textiles	0.41	5.16 (2.22) **	0.25 (0.27)	1.05 (3.43) **	-0.10 (-1.21)	-0.09 (-1.06)
54 Man-made filament	0.86	2.65 (1.47)	-0.94 (-0.43)	0.85 (1.08)	-0.95 (-2.04) **	-0.96 (-2.07) **
55 Man-made fibres (discontinuous) #	1.42	1.96 (1.00)	1.57 (1.44)	-0.13 (-0.48)	-0.06 (-0.72)	-0.07 (-0.87)
56 Wadding and felt, twine, cordage, special fabrics and thereof	0.70	1.22 (0.53)	0.72 (0.31)	-0.90 (-1.14)	0.27 (1.73) *	0.23 (1.51)
57 Carpets, mats matting and tapestries #	5.37	4.05 (2.51) **	1.15 (1.49)	0.87 (4.75) **	-0.01 (-0.37)	-0.05 (-1.52)
58 Special fabrics, lace, wall carpets, embroidery ##	0.21	-6.72 (-1.02)	3.26 (1.90) *	3.61 (5.00) **	-0.25 (-2.15) **	-0.24 (-2.02) **
60 Knitted and crocheted goods	0.11	4.69 (0.53)	-0.70 (-0.16)	-2.68 (-1.76) *	-0.72 (-1.53)	-0.77 (-1.64)
61 Knitted and crocheted goods and articles thereof	1.75	0.65 (0.40)	2.08 (2.59) **	3.24 (6.15) **	-0.17 (-2.36) **	-0.13 (-1.87) *
62 Non knitted and crocheted goods and articles thereof	1.85	2.62 (1.48)	-2.17 (-0.61)	3.79 (1.61)	-0.16 (-0.70)	-0.14 (-0.68)
63 Old clothing and other textile articles, rags	2.87	2.02 (1.23)	0.65 (0.35)	1.87 (1.74) *	-0.24 (-2.13) **	-0.23 (-2.12) **
64 Footwear, gaiters and the like, parts of such articles	0.14	-2.56 (-0.30)	1.71 (0.82)	2.65 (3.16) **	-0.09 (-0.36)	-0.11 (-0.46)
68 Articles of stone, of plaster, of cement, of asbestos of mica	3.77	-2.87 (-1.75) *	4.38 (3.11) **	1.24 (3.19) **	-0.14 (-0.61)	-0.13 (-0.54)
69 Ceramic products	0.98	1.19 (0.55)	0.76 (0.32)	3.49 (3.39) **	-0.59 (-2.72) **	-0.59 (-2.71) **
70 Glass and glassware	0.51	-0.80 (-0.43)	2.43 (2.41) **	0.51 (1.74) *	-0.02 (-0.21)	-0.02 (-0.23)
71 Precious stones, precious metals, pearls and articles thereof	3.08	0.81 (0.42)	1.73 (1.18)	3.82 (4.01) **	0.13 (1.14)	0.15 (1.30)
72 Iron and steel	11.01	-0.34 (-0.04)	2.52 (0.59)	2.62 (2.04) **	-0.62 (-2.31) **	-0.62 (-2.30) **
73 Articles of iron and steel	2.69	10.49 (1.74) *	-5.03 (-1.18)	0.77 (0.55)	-0.65 (-1.53)	-0.66 (-1.55)
74 Copper and articles thereof	0.31	-0.17 (-0.06)	2.82 (0.64)	-1.10 (-0.72)	-0.24 (-1.01)	-0.22 (-0.92)
76 Aluminium and articles thereof	0.91	1.13 (0.40)	0.75 (0.30)	4.25 (4.42) **	0.18 (0.81)	0.17 (0.78)
82 Tools, implements, cutlery, spoons, forks of base metal, parts thereof	0.10	3.37 (0.42)	0.42 (0.21)	0.62 (0.92)	-0.28 (-1.24)	-0.32 (-1.40)
83 Miscellaneous articles of base metal	0.42	-2.73 (-0.42)	2.26 (1.06)	3.57 (3.80) **	0.08 (0.42)	0.06 (0.33)
84 Boilers, machineries and mechanical appliances, parts thereof	8.71	0.98 (0.54)	2.39 (2.38) **	-0.16 (-0.98)	-0.06 (-0.89)	-0.08 (-1.28)
85 Electrical machinery and equipment, parts thereof	1.37	9.67 (2.44) **	-0.90 (-0.76)	2.81 (4.87) **	-0.47 (-4.34) **	-0.49 (-4.44) **
87 Vehicles other than railway or tramway rolling-stock, parts thereof	16.05	17.51 (4.14) **	-5.49 (-3.24) **	0.11 (0.21)	0.13 (0.93)	0.07 (0.52)
88 Aircraft and parts thereof	8.37	11.05 (2.53) **	-0.62 (-0.53)	1.22 (2.72) **	-0.18 (-0.91)	-0.19 (-0.98)
90 Optical, photographic, cinematographic, measuring checking, precision ##	0.43	26.96 (3.32) **	-3.30 (-2.23) **	1.00 (2.20) **	-0.17 (-1.69) *	-0.20 (-2.01) **
93 Arms and ammunition, parts thereof #	1.24	-2.25 (-0.39)	3.84 (0.81)	-0.18 (-0.17)	-0.07 (-0.14)	-0.09 (-0.19)
94 Furniture #	1.06	-1.70 (-0.75)	3.08 (1.58)	1.81 (2.18) **	-0.28 (-1.40)	-0.30 (-1.49)
96 Miscellaneous manufactured articles (pens and brushes etc)	0.06	0.19 (0.02)	0.74 (0.13)	0.83 (0.34)	-0.70 (-0.88)	-0.76 (-0.94)

Notes: a. Number inside parentheses are t-ratios. b. * and ** indicate significance at 10% levels and 5% level respectively. c. # (##) indicates that the Global Financial Crisis Dummy was negative (positive) and significant.

Table 4: Diagnostic Statistics Associated with Turkish Nonlinear Export Demand Models

<i>Industries</i>	<i>F</i>	$\hat{\lambda}_0(t - test)$	<i>LM</i>	<i>RESET</i>	<i>CSM(SQ)</i>	<i>Adj. R²</i>	<i>Wald-S</i>	<i>Wald-L</i>
07 Edible vegetables and certain roots and tubers	5.44 **	-0.33 (4.28) **	0.79	1.85	S(S)	0.44	2.13	0.02
08 Edible fruits and nuts, peel of melons or citrus fruits	8.58 **	-0.43 (4.86) **	0.04	2.47	S(S)	0.52	3.45 *	24.97 **
09 Coffee, tea, mate and spices	18.75 **	-0.62 (6.89) **	0.01	5.80 **	S(U)	0.5	0.48	50.96 **
11 Products of the millings industry, malt and starches, gluten, inulin	6.44 **	-0.33 (4.11) **	0.11	5.74 **	S(S)	0.47	5.74 **	13.62 **
12 Oil seeds and oleaginous fruit, industrial plants, straw and fodder	4.77 **	-0.34 (4.2) **	0.2	1.17	S(U)	0.32	1.59	6.77 **
15 Animals and vegetable fats and oils and their cleavage products	4.15 **	-0.21 (3.95) *	0.05	0.79	S(S)	0.27	1.56	0.79
17 Sugar and sugar confectionery	3.79 *	-0.08 (1.51)	0.01	3.50 *	S(U)	0.42	0.27	101.13 **
18 Cocoa and cocoa preparations	13.68 **	-0.57 (5.03) **	0.61	1.14	S(U)	0.54	0.38	87.23 **
19 Preparations of cereals, flour or starch or milk	2.93	-0.02 (0.38)	2.18	0	U(S)	0.56	0	224.47 **
20 Preparations of vegetables, fruits or other parts of plants	1.65	-0.06 (1.04)	1.09	1.98	S(S)	0.47	0.01	53.92 **
21 Miscellaneous edible preparations	4.48 **	-0.04 (0.91)	0.15	0.23	S(S)	0.5	0.85	312.13 **
22 Beverages, spirits and vinegar	18.31 **	-0.67 (6.54) **	1.47	0.34	S(S)	0.54	0.05	76.97 **
24 Tobacco and materials instead of tobacco	3.69 *	-0.90 (2.72)	0.12	0.97	U(S)	0.57	2.71	3.49 *
25 Salt, sulphur, earths and stones, plastering materials, lime and cement	3.11	-0.52 (2.47)	0.68	0.6	S(U)	0.63	2.56	0.14
28 Inorganic chemicals, organic or inorganic compounds	8.98 **	-0.55 (4.93) **	1.1	3.06 *	S(S)	0.67	1.41	27.77 **
29 Organic chemicals	15.77 **	-0.69 (6.95) **	0	4.49 **	S(S)	0.58	0.47	19.84 **
33 Essential oils and resinoids, perfumery, cosmetic or toilet prep.	22.32 **	-1.06 (9.52) **	0.23	0.32	S(S)	0.59	0.32	10.95 **
34 Soap, organic surface-active agents, washing preparations ext.	8.46 **	-0.74 (6.16) **	0.04	3.19 *	S(U)	0.49	4.05 **	0.02
39 Plastic and articles thereof	4.79 **	-0.07 (1.2)	2.29	0.08	S(S)	0.54	7.80 **	83.26 **
40 Rubber and articles thereof	7.06 **	-0.07 (1.71)	4.42 **	0.01	S(S)	0.45	0	138.26 **
41 Row hides and skins (other than furskins) and sole leather	15.16 **	-0.64 (6.56) **	0.39	0.45	S(U)	0.51	1.26	34.61 **
42 Articles of leather, saddlery, harness, travel goods, articles	4.64 **	-0.19 (2.13)	1.14	0	S(S)	0.54	1.06	43.11 **
43 Furskins and artificial fur manufactures thereof	15.70 **	-0.64 (5.53) **	1.15	5.75 **	S(U)	0.51	2.1	77.38 **
44 Wood and articles of wood, wood charcoal	2.39	-0.38 (2.78)	1.18	6.46 **	S(S)	0.46	0.95	2.38
48 Paper and paperboard, articles of paper pulp of paper or of paperboard	5.61 **	-0.40 (4.13) **	0.22	14.28 **	S(S)	0.4	4.69 **	9.36 **
49 Printed books, newspapers, pictures and other products of print industry	19.71 **	-0.85 (9.48) **	0.01	0.01	S(S)	0.48	1.27	3.70 *
51 Wool and other animal hair	15.49 **	-0.60 (6.94) **	0.67	0.09	S(S)	0.39	0.21	26.60 **
52 Cotton, cotton yarn and cotton textiles	8.20 **	-0.30 (4.6) **	0.73	0.1	S(S)	0.47	1.03	34.06 **
54 Man-made filament	2.91	-0.13 (1.76)	0.14	0.02	S(S)	0.55	4.06 **	4.76 **
55 Man-made fibres (discontinuous)	2.1	-0.07 (0.78)	0	0.89	S(S)	0.45	0.32	33.00 **
56 Wadding and felt, twine, cordage, special fabrics and thereof	4.38 **	-0.06 (1.6)	0.31	0.33	S(S)	0.44	6.45 **	31.85 **
57 Carpets, mats matting and tapestries	5.94 **	0.01 (0.53)	0.34	2.06	S(S)	0.56	7.79 **	1292.99 **
58 Special fabrics, lace, wall carpets, embroidery	9.11 **	-0.61 (5.59) **	0.97	0.16	S(U)	0.55	1.43	15.98 **
60 Knitted and crocheted goods	5.60 **	-0.20 (2.94)	0.41	5.87 **	U(S)	0.39	4.68 **	28.16 **
61 Knitted and crocheted goods and articles thereof	10.25 **	-0.09 (3.75) *	0.53	2.94 *	S(S)	0.43	3.81 *	345.60 **
62 Non knitted and crocheted goods and articles thereof	3.4	-0.08 (3.81) *	0.68	0	S(S)	0.42	0.46	0.59
63 Old clothing and other textile articles, rags	2.36	-0.12 (2.87)	0.37	4.67 **	S(S)	0.61	0.64	3.06 *
64 Footwear, gaiters and the like, parts of such articles	14.15 **	-0.72 (7.28) **	0.49	2.99 *	S(S)	0.49	0.83	14.82 **
68 Articles of stone, of plaster, of cement, of asbestos of mica	5.06 **	-0.08 (1.15)	1.02	9.71 **	S(S)	0.56	2.02	22.53 **
69 Ceramic products	3.34	-0.14 (2.73)	0.41	1.5	S(S)	0.37	0	2.55
70 Glass and glassware	2.14	-0.55 (3.14)	0.06	0.08	S(S)	0.54	0.61	0.19
71 Precious stones, precious metals, pearls and articles thereof	6.69 **	-0.09 (2.19)	0.21	3.01 *	S(S)	0.62	7.75 **	12.83 **
72 Iron and steel	6.78 **	-0.45 (5.32) **	1.04	18.56 **	S(U)	0.33	0.38	0.1
73 Articles of iron and steel	2.48	-0.23 (2.13)	1.28	0.06	S(S)	0.53	2.53	0.21
74 Copper and articles thereof	2.76	-0.12 (2.09)	0.19	0.09	S(S)	0.27	0	5.58 **
76 Aluminium and articles thereof	5.54 **	-0.19 (3.17)	0	0.72	S(S)	0.48	1.23	0.73
82 Tools, implements, cutlery, spoons, forks of base metal, parts thereof	8.07 **	-0.44 (4.14) **	0.13	0	S(S)	0.55	2.74 *	43.23 **
83 Miscellaneous articles of base metal	10.69 **	-0.60 (6.67) **	3.05 *	14.81 **	U(U)	0.36	0.02	7.20 **
84 Boilers, machineries and mechanical appliances, parts thereof	3.65 *	-0.04 (0.99)	1.05	2.02	S(S)	0.64	0.04	711.73 **
85 Electrical machinery and equipment, parts thereof	6.89 **	-0.34 (2.21)	0.07	0.54	S(S)	0.56	0.71	23.12 **
87 Vehicles other than railway or tramway rolling-stock, parts thereof	7.20 **	-0.07 (1.7)	0.07	0.06	S(S)	0.41	0.03	161.72 **
88 Aircraft and parts thereof	12.67 **	-0.59 (6.55) **	0.99	0.31	S(U)	0.51	0.28	22.99 **
90 Optical, photographic, cinematographic, measuring checking, precision	23.13 **	-0.67 (7.21) **	1.6	3.14 *	S(S)	0.56	1.02	79.83 **
93 Arms and ammunition, parts thereof	1.94	-0.14 (2.16)	0.09	0.01	S(S)	0.57	0.61	9.94 **
94 Furniture	3.57 *	-0.12 (2.03)	1.64	4.38 **	S(S)	0.35	4.41 **	17.20 **
96 Miscellaneous manufactured articles (pens and brushes etc)	2.27	-0.13 (0.88)	0.04	1.52	S(S)	0.46	1.04	7.71 **

Notes: a. At the 5% (10%) significance level when there are three exogenous variables (k=3), the upper bound critical value of the F test is 4.35(3.77). These come from Pesaran *et al* (2001 P 300 Table CI-Case III).
b. Number inside the parenthesis is the absolute value of the t-ratio. Its upper bound critical value at the 5%(10%) significance level is -3.99(-3.66) when k=4. These come from Pesaran *et al* (2001 p 303 Table CII-Case

III). c. LM is Lagrange Multiplier test of residual serial correlation. It is distributed as χ^2 with one degree of freedom (first order). Its critical value at 5% (10%) significance level is 3.84(2.71). d. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. e. Both Wald tests are also distributed as χ^2 with one degree of freedom. e. * and ** show level of significance at 10% and 5%, respectively.

Table 5: Short-run Coefficient Estimates of ΔPOS

(Increased Volatility) on Nonlinear Turkish Import Models

Code	# Lags on ΔPOS											
	0	1	2	3	4	5	6	7	8	9	10	11
12 Oil seeds and oleaginous fruit, industrial plants, straw and fodder	0.14	0.13	-0.36 *									
13 Lacs, gums, resins and other vegetables saps and extracts	-0.33 **	-0.57 **	-0.94 **	-0.65 **	-0.23	-0.07	-0.22	-0.08	-0.46 **	-0.16		
15 Animals and vegetable fats and oils and their cleavage products	0.23 *	0.07	-0.15	0.19	0.1	0.33	0.55 **	0.54 **	0.62 **	0.75 **		
17 Sugar and sugar confectionery	0.18											
21 Miscellaneous edible preparations	-0.10 *	0.64 **	0.64 **	0.54 **	0.33 **	0.43 **	0.32 **	0.30 **	0.23 **			
22 Beverages, spirits and vinegar	0.05	0.21	0.13	-0.13	-0.13	-0.04	-0.15	0.16	-0.01	0.02	0.32 **	0.06
23 Residues and waste from the food industries, prepared animal fodder	-0.1	-0.51 **										
24 Tobacco and materials instead of tobacco	-0.20 **											
25 Salt, sulphur, earths and stones, plastering materials, lime and cement	0.13	0.24	0.08	-0.22 *	0.08	-0.05	-0.16	0.12	-0.06	-0.08	0.20 *	-0.1
27 Mineral fuels, minerals oils and product of their distillation	-0.08											
28 Inorganic chemicals, organic or inorganic compounds	-0.04	0.19 *										
29 Organic chemicals	0.01											
30 Pharmaceutical products	0											
31 Fertilisers	-0.16											
32 Tanning and dyeing extracts, fillers and stoppings, inks	0.01	-0.01	0.03	0.03	0.01	-0.07 **						
33 Essential oils and resinoids, perfumery, cosmetic or toilet prep.	0.01											
34 Soap, organic surface-active agents, washing preparations ext.	0.02	-0.09 **										
35 Albuminoidal substances, glues, enzymes	0.06											
37 Photographic and cinematographic goods	0.09											
38 Miscellaneous chemical products	0.06											
39 Plastic and articles thereof	0.04	0	-0.01	0.03	0.09 **	0.07 *	0.06 *	-0.05	-0.04	0.04		
40 Rubber and articles thereof	0.03	-0.23 **	-0.19 **	-0.11 *	-0.09 *	-0.08	-0.03	-0.06 *	-0.06 **	-0.02	0.05 **	0.01
41 Row hides and skins (other than furskins) and sole leather	0.19											
42 Articles of leather, saddlery, harness, travel goods, articles	0.14											
44 Wood and articles of wood, wood charcoal	-0.05											
47 Wood and wood nature and scraps	0.06 *											
48 Paper and paperboard, articles of paper pulp of paper or of paperboard	0.09 **											
49 Printed books, newspapers, pictures and other products of print industry	-0.05	-0.19	-0.32	-0.07	-0.2	-0.49 **	-0.44 **	-0.44 **				
52 Cotton, cotton yarn and cotton textiles	0	-0.11										
54 Man-made filament	-0.07	0.31	0.36 **									
55 Man-made fibres (discontinuous)	-0.1											
56 Wadding and felt, twine, cordage, special fabrics and thereof	0.17											
57 Carpets, mats matting and tapestries	-0.28 **											
58 Special fabrics, lace, wall carpets, embroidery	-0.24											
59 Impregnated and coated fabrics textile articles of kind suitable	-0.19	0.22										
61 Knitted and crocheted goods and articles thereof	-0.17	-0.3	-0.08	-0.16	-0.07	0.07	0.24 **	-0.16				
62 Non knitted and crocheted goods and articles thereof	-0.09											
63 Old clothing and other textile articles, rags	0.11	0.25										
64 Footwear, gaiters and the like, parts of such articles	0.14	0.58	0.44 *									
65 Headgear and parts thereof	-0.06											
68 Articles of stone, of plaster, of cement, of asbestos of mica	0.04											
69 Ceramic products	-0.05	-0.06	0.36 *									
70 Glass and glassware	-0.02											
71 Precious stones, precious metals, pearls and articles thereof	0.31 **											
72 Iron and steel	-0.05	-0.19										
73 Articles of iron and steel	-0.03	-0.07	0.04	0.01	0	-0.1	-0.12	-0.16	-0.16	0.02	0.16 *	0.18 **
74 Copper and articles thereof	-0.09											
75 Nickel and articles thereof	-0.02											
76 Aluminium and articles thereof	-0.09											
81 Other base metals employed in metallurgy and articles thereof	-0.05	-0.33 **	-0.19 *	-0.07	-0.16 *							
82 Tools, implements, cutlery, spoons, forks of base metal, parts thereof	-0.08 **											
83 Miscellaneous articles of base metal	0.03	-0.26 *	-0.31 **	-0.07								
84 Boilers, machineries and mechanical appliances, parts thereof	-0.05	-0.05	-0.06	0.01	-0.07 **	-0.01	-0.01	0.06 **				
85 Electrical machinery and equipment, parts thereof	-0.06 *	-0.03	0.06									
87 Vehicles other than railway or tramway rolling-stock, parts thereof	0.07 *	0.14 **	0.1									
88 Aircraft and parts thereof	0.41 **											
90 Optical, photographic, cinematographic, measuring checking, precision	-0.01											
91 Clocks and watches and parts thereof	-0.27 *	-0.28										
92 Musical instruments, parts and accessories of such articles	-0.13											
94 Furniture	0.05											
95 Toys, games and sports requisites, parts thereof	0.1											
96 Miscellaneous manufactured articles (pens and brushes etc)	0.13											

Notes: * and ** indicate significance at 10% and 5% levels, respectively. The critical values of standard t-distribution. i.e. 1.64 and 1.96 are used to arrive at * and **. The t-ratios themselves are not reported

due to space constraints but they are available from the authors upon request.

Table 6: Short-run Coefficient Estimates of Δ NEG

(Decreased Volatility) in Nonlinear Turkish Import Models

Code	# Lags on Δ NEG											
	0	1	2	3	4	5	6	7	8	9	10	11
12 Oil seeds and oleaginous fruit, industrial plants, straw and fodder	-0.17											
13 Lacs, gums, resins and other vegetables saps and extracts	0.18	-0.37 *										
15 Animals and vegetable fats and oils and their cleavage products	0.1	-0.16	-0.08	0.01	0.3	0.36	0.49 **	0.71 **	0.28	-0.34 **		
17 Sugar and sugar confectionery	-0.34	0.3	0.64 **	-0.05	0.58 **	0	0.17	0.40 *	0.35 *	0.70 **	0.33	
21 Miscellaneous edible preparations	-0.14 *	0.74 **	0.58 **	0.49 **	0.49 **	0.36 **	0.49 **	0.31 **	0.11	-0.14 **	-0.03	-0.04
22 Beverages, spirits and vinegar	-0.05											
23 Residues and waste from the food industries, prepared animal fodder	-0.07	0.30 **										
24 Tobacco and materials instead of tobacco	0.01	0.05	0.05	0.06	-0.11 *	-0.19 **	-0.04	-0.09	-0.01	-0.01		
25 Salt, sulphur, earths and stones, plastering materials, lime and cement	-0.12											
27 Mineral fuels, minerals oils and product of their distillation	0.15	0.1	-0.26 **									
28 Inorganic chemicals, organic or inorganic compounds	-0.18											
29 Organic chemicals	0.01											
30 Pharmaceutical products	-0.04											
31 Fertilisers	-0.04											
32 Tanning and dyeing extracts, fillers and stoppings , inks	-0.03											
33 Essential oils and resinoids, perfumery, cosmetic or toilet prep.	-0.02	-0.05	0.04	-0.05 *	-0.02	0	-0.01	0.03	-0.07 **	-0.05	-0.04	
34 Soap, organic surface-active agents, washing preparations ext.	0											
35 Albuminoidal substances, glues, enzymes	0.07	-0.24 **	-0.23 **									
37 Photographic and cinematographic goods	0.01	0.13 **										
38 Miscellaneous chemical products	-0.07											
39 Plastic and articles thereof	0.03											
40 Rubber and articles thereof	-0.01	-0.18 **	-0.11 **	-0.11 **	-0.13 **	-0.05						
41 Row hides and skins (other than furskins) and sole leather	-0.17											
42 Articles of leather, saddlery, harness, travel goods, articles	-0.18											
44 Wood and articles of wood, wood charcoal	-0.29 *	0.13	-0.21 *	-0.17	-0.09	-0.20 *	0.26 **					
47 Wood and wood nature and scraps	-0.03											
48 Paper and paperboard, articles of paper pulp	-0.10 **											
49 Printed books, newspapers, pictures and other products of print.	-0.18	-0.28	-0.08	-0.47 **	-0.44 **	-0.31 **						
52 Cotton, cotton yarn and cotton textiles	-0.15 **	0	-0.12 **	-0.01	-0.06	-0.04	0.13 **					
54 Man-made filament	-0.09											
55 Man-made fibers (discontinuous)	-0.37 **											
56 Wadding and felt, twine, cordage, special fabrics and thereof	0.11											
57 Carpets, mats matting and tapestries	0.05											
58 Special fabrics, lace, wall carpets, embroidery	0.17	0.26	-0.26									
59 Impregnated and coated fabrics textile articles of kind suitable	-0.38 **											
61 Knitted and crocheted goods and articles thereof	-0.11											
62 Non knitted and crocheted goods and articles thereof	0.03											
63 Old clothing and other textile articles, rags	-0.21											
64 Footwear, gaiters and the like, parts of such articles	-0.38											
65 Headgear and parts thereof	-0.47	0.36										
68 Articles of stone, of plaster, of cement, of asbestos of mica	-0.14											
69 Ceramic products	0.21											
70 Glass and glassware	0.15											
71 Precious stones, precious metals, pearls and articles thereof	-0.53 **											
72 Iron and steel	-0.03											
73 Articles of iron and steel	0.07	0.07	-0.04	-0.13	-0.09	-0.09	-0.09	-0.05	0.11	0.13 *	0.05	-0.16 **
74 Copper and articles thereof	0.26											
75 Nickel and articles thereof	0.11 *	-0.15 **	-0.01	-0.07	0.04	0	0.03	0.05	-0.09 **	-0.14 **	-0.03	0
76 Aluminium and articles thereof	0.04											
81 Other base metals employed in metallurgy and articles thereof	0.01	-0.27 **	-0.09	-0.01	0.16 **	-0.03	0.07	-0.01	0.09	0.05	0.03	0.1
82 Tools, implements, cutlery, spoons, forks of base metal, parts thereof	-0.03	-0.06	-0.11 **	-0.06								
83 Miscellaneous articles of base metal	-0.26 **											
84 Boilers, machineries and mechanical appliances, parts thereof	-0.02											
85 Electrical machinery and equipment, parts thereof	-0.07	0.07	0.03	-0.02	-0.05	-0.04	0.02	-0.01	-0.07 **	0.05	0.04	0.03
87 Vehicles other than railway or tramway rolling-stock, parts thereof	0.05	0	-0.12 **									
88 Aircraft and parts thereof	-0.39											
90 Optical, photographic, cinematographic, measuring checking,	-0.04											
91 Clocks and watches and parts thereof	0.05											
92 Musical instruments, parts and accessories of such articles	0.01											
94 Furniture	-0.17	0.37 **	0.09	0.46 **								
95 Toys, games and sports requisites, parts thereof	0.01											
96 Miscellaneous manufactured articles (pens and brushes etc)	-0.14											

Notes: * and ** indicate significance at 10% and 5% levels, respectively. The critical values of standard t-distribution. i.e. 1.64 and 1.96 are used to arrive at ** and *. The t-ratios themselves are not reported

due to space constraints but they are available upon request.

Table 7: Long-Run Coefficient Estimates of Nonlinear Turkish Import Demand Models

Industries	Trade Share	Constant	Ln Y_t^{TR}	Ln REX_t	POS _t	NEG _t
12 Oil seeds and oleaginous fruit, industrial plants, straw and fodder	1.64	12.47 (2.43) **	-1.17 (-0.74)	-1.34 (-1.40)	-0.03 (-0.09)	-0.05 (-0.16)
13 Lacs, gums, resins and other vegetables saps and extracts	0.02	3.50 (0.86)	0.80 (0.69)	0.88 (1.09)	0.56 (1.73) *	0.57 (1.74) *
15 Animals and vegetable fats and oils and their cleavage products #	0.14	9.82 (2.55) **	1.23 (1.31)	-4.62 (-5.70) **	0.08 (0.20)	0.14 (0.35)
17 Sugar and sugar confectionery	0.01	14.22 (2.17) **	-1.32 (-1.03)	-0.33 (-0.43)	-0.31 (-1.84) *	-0.35 (-2.05) **
21 Miscellaneous edible preparations ##	0.32	15.05 (5.00) **	-0.80 (-1.75) *	0.39 (1.60)	-0.70 (-4.54) **	-0.72 (-4.58) **
22 Beverages, spirits and vinegar #	0.21	-3.75 (-0.89)	4.06 (1.54)	-4.51 (-2.43) **	-0.25 (-0.42)	-0.29 (-0.46)
23 Residues and waste from the food industries, prepared animal fodder ##	3.01	10.25 (2.60) **	-2.33 (-1.31)	1.80 (1.69) *	0.19 (0.58)	0.14 (0.41)
24 Tobacco and materials instead of tobacco ##	0.44	7.94 (4.17) **	0.03 (0.06)	1.37 (3.81) **	-0.15 (-2.24) **	-0.15 (-2.24) **
25 Salt, sulphur, earths and stones, plastering materials, lime and cement	0.07	2.73 (0.87)	1.09 (1.38)	0.84 (1.58)	-0.25 (-1.37)	-0.25 (-1.33)
27 Mineral fuels, minerals oils and product of their distillation	8.61	8.40 (2.38) **	-0.67 (-0.50)	-1.80 (-2.01) **	0.16 (0.81)	0.11 (0.55)
28 Inorganic chemicals, organic or inorganic compounds	0.30	8.82 (3.16) **	-1.10 (-1.18)	0.13 (0.26)	-0.39 (-2.51) **	-0.43 (-2.70) **
29 Organic chemicals #	2.14	5.18 (3.70) **	0.69 (1.35)	-0.53 (-1.72) *	0.02 (0.21)	0.03 (0.35)
30 Pharmaceutical products	4.95	10.69 (5.28) **	-0.56 (-1.56)	-0.08 (-0.41)	-0.01 (-0.12)	-0.03 (-0.53)
31 Fertilisers	0.08	12.80 (2.25) **	-3.26 (-1.45)	-0.15 (-0.12)	-0.24 (-0.80)	-0.30 (-0.97)
32 Tanning and dyeing extracts, fillers and stoppings , inks	0.50	5.67 (4.70) **	0.21 (0.46)	-0.59 (-2.39) **	-0.00 (-0.05)	-0.01 (-0.12)
33 Essential oils and resinoids, perfumery, cosmetic or toilet prep.	0.52	-0.47 (-0.29)	4.37 (1.07)	-3.45 (-1.52)	-0.28 (-0.59)	-0.22 (-0.45)
34 Soap, organic surface-active agents, washing preparations ext. #	0.42	11.27 (8.97) **	0.05 (0.24)	-1.23 (-8.39) **	0.08 (2.79) **	0.05 (1.91) *
35 Albuminoidal substances, glues, enzymes #	0.18	2.46 (0.72)	1.39 (1.65)	-0.23 (-0.60)	0.20 (1.94) *	0.19 (1.80) *
37 Photographic and cinematographic goods	0.08	1.97 (0.91)	0.80 (0.50)	-0.91 (-0.60)	-0.12 (-0.50)	-0.07 (-0.28)
38 Miscellaneous chemical products	1.73	5.90 (3.17) **	0.86 (2.29) **	0.27 (1.24)	-0.05 (-1.06)	-0.05 (-1.00)
39 Plastic and articles thereof #	3.27	2.36 (1.69) *	1.40 (1.73) *	-1.48 (-2.97) **	0.16 (1.08)	0.15 (1.05)
40 Rubber and articles thereof #	0.77	-1.15 (-1.17)	3.45 (4.89) **	-1.97 (-5.18) **	0.50 (3.17) **	0.53 (3.30) **
41 Row hides and skins (other than furskins) and sole leather #	0.04	-2.54 (-0.68)	3.66 (1.72) *	0.66 (0.54)	-0.11 (-0.38)	-0.01 (-0.05)
42 Articles of leather, saddlery, harness, travel goods, articles	0.01	3.06 (0.61)	0.81 (0.68)	-0.44 (-0.75)	-0.09 (-0.63)	-0.10 (-0.66)
44 Wood and articles of wood, wood charcoal	0.95	1.73 (0.48)	1.35 (0.63)	-1.75 (-0.90)	-0.21 (-0.67)	-0.23 (-0.71)
47 Wood and wood nature and scraps	1.26	5.58 (4.66) **	0.06 (0.14)	-0.20 (-0.85)	0.04 (0.59)	0.02 (0.36)
48 Paper and paperboard, articles of paper pulp of paper or of paperboard #	1.74	6.06 (4.97) **	0.54 (1.67) *	-2.20 (-5.96) **	0.02 (0.50)	0.01 (0.12)
49 Printed books, newspapers, pictures and other products of print industry	0.08	8.45 (2.59) **	0.02 (0.02)	-0.77 (-1.40)	0.15 (0.52)	0.15 (0.50)
52 Cotton, cotton yarn and cotton textiles	6.18	11.19 (4.03) **	0.13 (0.24)	-0.70 (-2.35) **	0.06 (0.86)	0.06 (0.82)
54 Man-made filament ##	0.15	10.83 (2.78) **	-1.04 (-1.01)	2.70 (3.76) **	-0.45 (-2.16) **	-0.46 (-2.12) **
55 Man-made fibres (discontinuous)	0.48	0.67 (0.17)	1.53 (0.44)	-3.07 (-1.44)	-1.11 (-2.17) **	-1.13 (-2.20) **
56 Wadding and felt, twine, cordage, special fabrics and thereof	0.04	9.22 (1.87) *	-1.87 (-0.90)	-1.82 (-1.63)	0.38 (1.46)	0.34 (1.30)
57 Carpets, mats matting and tapestries	0.01	6.23 (1.50)	0.48 (0.44)	-0.27 (-0.45)	-0.07 (-0.49)	-0.04 (-0.26)
58 Special fabrics, lace, wall carpets, embroidery	0.01	-0.43 (-0.10)	1.84 (0.96)	0.86 (0.73)	-0.13 (-0.46)	-0.07 (-0.25)
59 Impregnated and coated fabrics textile articles of kind suitable ##	0.08	20.55 (4.00) **	-2.74 (-2.82) **	2.65 (5.17) **	-0.40 (-3.08) **	-0.45 (-3.41) **
61 Knitted and crocheted goods and articles thereof	0.01	3.55 (0.89)	1.11 (1.03)	-2.50 (-3.86) **	0.21 (0.99)	0.22 (1.01)
62 Non knitted and crocheted goods and articles thereof	0.05	3.08 (0.88)	1.41 (1.62)	-1.37 (-2.88) **	-0.05 (-0.44)	-0.04 (-0.36)
63 Old clothing and other textile articles, rags	0.02	3.88 (0.93)	0.31 (0.27)	1.45 (2.11) **	-0.26 (-1.27)	-0.27 (-1.28)
64 Footwear, gaiters and the like, parts of such articles	0.01	-2.72 (-0.46)	1.48 (0.94)	2.48 (2.52) **	-0.98 (-2.78) **	-0.95 (-2.65) **
65 Headgear and parts thereof	0.02	3.64 (0.57)	-0.96 (-0.38)	2.72 (1.68) *	-1.05 (-2.77) **	-1.09 (-2.79) **
68 Articles of stone, of plaster, of cement, of asbestos of mica	0.15	-2.03 (-0.56)	2.13 (2.68) **	2.06 (3.15) **	-0.14 (-1.26)	-0.11 (-1.00)
69 Ceramic products	0.05	1.89 (0.39)	1.33 (0.84)	-1.29 (-1.41)	0.10 (0.32)	0.10 (0.31)
70 Glass and glassware	0.42	0.28 (0.12)	2.04 (2.18) **	0.16 (0.36)	0.09 (0.76)	0.09 (0.77)
71 Precious stones, precious metals, pearls and articles thereof	0.98	2.00 (0.46)	1.71 (1.30)	0.20 (0.26)	-0.30 (-1.56)	-0.28 (-1.42)
72 Iron and steel	9.59	-2.91 (-0.92)	5.65 (2.60) **	-3.32 (-1.60)	0.09 (0.21)	0.14 (0.34)
73 Articles of iron and steel	1.56	2.88 (1.24)	0.52 (0.33)	-0.10 (-0.14)	0.27 (0.49)	0.25 (0.45)
74 Copper and articles thereof	0.10	-0.16 (-0.05)	2.01 (2.14) **	-0.74 (-1.31)	0.09 (0.66)	0.09 (0.63)
75 Nickel and articles thereof	0.78	5.35 (3.21) **	0.35 (0.59)	-0.17 (-0.51)	0.12 (1.73) *	0.10 (1.44)
76 Aluminium and articles thereof #	0.45	3.13 (1.90) *	0.93 (1.29)	0.88 (2.19) **	-0.08 (-0.81)	-0.08 (-0.81)
81 Other base metals employed in metallurgy and articles thereof #	0.51	-2.68 (-1.20)	3.28 (3.72) **	-0.31 (-0.77)	0.40 (2.26) **	0.42 (2.29) **
82 Tools, implements, cutlery, spoons, forks of base metal, parts thereof #	0.26	3.29 (2.51) **	1.23 (2.39) **	-1.02 (-3.26) **	-0.03 (-0.47)	-0.03 (-0.42)
83 Miscellaneous articles of base metal	0.18	2.94 (1.22)	1.10 (1.43)	0.19 (0.42)	0.01 (0.05)	-0.00 (-0.01)
84 Boilers, machineries and mechanical appliances, parts thereof	13.47	7.91 (3.52) **	-0.74 (-1.20)	0.60 (1.95) *	0.08 (0.78)	0.05 (0.52)
85 Electrical machinery and equipment, parts thereof ##	4.92	4.65 (2.01) **	0.43 (0.68)	0.89 (2.18) **	-0.13 (-1.31)	-0.14 (-1.29)
87 Vehicles other than railway or tramway rolling-stock, parts thereof	2.19	3.10 (1.70) *	0.90 (0.99)	-0.85 (-1.81) *	-0.16 (-1.07)	-0.17 (-1.15)
88 Aircraft and parts thereof	9.77	9.47 (1.91) *	-0.94 (-0.44)	-3.81 (-2.91) **	0.20 (0.68)	0.14 (0.48)
90 Optical, photographic, cinematographic, measuring checking, precision	6.02	3.31 (2.13) **	0.31 (0.44)	0.05 (0.15)	-0.10 (-1.41)	-0.11 (-1.44)
91 Clocks and watches and parts thereof	0.01	-7.15 (-1.69) *	3.11 (2.98) **	2.39 (3.75) **	-0.10 (-0.52)	-0.03 (-0.15)
92 Musical instruments, parts and accessories of such articles	0.02	7.10 (1.78) *	-0.26 (-0.24)	-1.22 (-1.85) *	0.19 (1.14)	0.16 (0.96)
94 Furniture	0.17	6.88 (2.32) **	0.47 (0.68)	1.14 (2.50) **	-0.14 (-1.30)	-0.13 (-1.24)
95 Toys, games and sports requisites, parts thereof #	0.07	3.94 (1.24)	1.30 (1.84) *	-0.62 (-1.47)	-0.08 (-0.76)	-0.06 (-0.59)
96 Miscellaneous manufactured articles (pens and brushes etc)	0.06	4.18 (1.12)	0.82 (0.85)	0.80 (1.70) *	-0.25 (-2.28) **	-0.24 (-2.10) **

Notes: a. Numbers inside parentheses are t-ratios. b. * and ** indicate significance at 10% levels and 5% level respectively. c. # (##) indicates that the Global Financial Crisis Dummy was negative (positive) and significant.

Table 8: Diagnostic Statistics Associated with Nonlinear Turkish Import Demand Models

Industries	F	$\bar{\pi}_0(t - test)$	LM	RESET	CSM(SQ)	Adj. R ²	Wald-S	Wald-L
12 Oil seeds and oleaginous fruit, industrial plants, straw and fodder	9.51 **	-0.70 (6.7) **	0.19	0.08	S(S)	0.29	0.02	1.06
13 Lacs, gums, resins and other vegetables saps and extracts	6.90 **	-0.67 (4.65) **	0.04	0.39	S(S)	0.6	13.64 **	0.36
15 Animals and vegetable fats and oils and their cleavage products	19.61 **	-0.81 (7.94) **	0.82	0.12	S(U)	0.55	1.95	20.94 **
17 Sugar and sugar confectionery	14.44 **	-1.17 (7.97) **	1.63	0.01	S(S)	0.54	6.28 **	6.04 **
21 Miscellaneous edible preparations	8.64 **	-0.64 (2.76)	0.69	27.92 **	S(S)	0.61	0.07	10.63 **
22 Beverages, spirits and vinegar	3.69 *	-0.26 (3.12)	10.38 **	5.18 **	S(S)	0.3	0.26	0.72
23 Residues and waste from the food industries, prepared animal fodder	9.61 **	-0.45 (6.03) **	0.01	0.44	S(S)	0.32	5.02 **	4.01 **
24 Tobacco and materials instead of tobacco	12.13 **	-0.78 (7.1) **	0.08	8.33 **	S(U)	0.38	0.06	0.48
25 Salt, sulphur, earths and stones, plastering materials, lime and cement	17.83 **	-0.95 (9.28) **	1.4	0.05	S(U)	0.52	0.13	0.2
27 Mineral fuels, minerals oils and product of their distillation	4.44 **	-0.40 (4.17) **	0.18	0.13	S(U)	0.4	0.08	5.88 **
28 Inorganic chemicals, organic or inorganic compounds	12.12 **	-0.61 (6.91) **	2.41	3.46 *	S(U)	0.38	2.43	7.79 **
29 Organic chemicals	5.59 **	-0.48 (5.1) **	0.74	0.06	S(S)	0.39	0	1.79
30 Pharmaceutical products	7.47 **	-0.52 (5.08) **	0.13	0.98	S(U)	0.53	0.49	13.42 **
31 Fertilisers	8.75 **	-0.55 (6.38) **	0.23	10.49 **	S(S)	0.3	0.09	3.17 *
32 Tanning and dyeing extracts, fillers and stoppings , inks	9.88 **	-0.56 (7.02) **	0.01	0.34	S(S)	0.42	0.03	0.58
33 Essential oils and resinoids, perfumery, cosmetic or toilet prep.	1.95	-0.25 (1.97)	1.88	0.18	S(S)	0.54	2.42	0.1
34 Soap, organic surface-active agents, washing preparations ext.	30.04 **	-0.75 (8.37) **	1.63	1.04	S(S)	0.66	1.27	60.38 **
35 Albuminoidal substances, glues, enzymes	28.26 **	-1.00 (11.43) **	1.51	2.21	S(U)	0.55	4.11 **	0.52
37 Photographic and cinematographic goods	2.73	-0.18 (1.37)	0.26	1.01	S(U)	0.55	0.15	2.39
38 Miscellaneous chemical products	5.33 **	-0.77 (5.02) **	2.89 *	0.03	S(S)	0.51	2.4	0.08
39 Plastic and articles thereof	2.84	-0.27 (3.09)	0.37	0.87	S(S)	0.34	0.84	0.1
40 Rubber and articles thereof	6.19 **	-0.26 (2.56)	0.27	1	S(S)	0.48	0.68	14.54 **
41 Row hides and skins (other than furskins) and sole leather	4.93 **	-0.31 (3.95) *	0.1	3.48 *	S(S)	0.37	1.72	9.94 **
42 Articles of leather, saddlery, harness, travel goods, articles	21.10 **	-1.01 (10.29) **	0.31	0.41	S(S)	0.49	1.23	0.16
44 Wood and articles of wood, wood charcoal	3.77 *	-0.43 (3.48)	0.17	1.76	U(S)	0.61	1.27	0.17
47 Wood and wood nature and scraps	7.47 **	-0.45 (5.59) **	0.67	0.1	S(S)	0.38	2.22	4.54 **
48 Paper and paperboard, articles of paper pulp of paper or of paperboard	10.24 **	-0.44 (5.76)	0.45	3.34 *	S(S)	0.38	10.27 **	14.12 **
49 Printed books, newspapers, pictures and other products of print industry	16.73 **	-0.88 (9.14) **	0.07	0.88	S(U)	0.46	0.47	0.04
52 Cotton, cotton yarn and cotton textiles	4.70 **	-0.68 (4.19) **	0.02	2.64	S(S)	0.52	0.37	0.01
54 Man-made filament	9.85 **	-0.89 (6.75) **	0.28	0.53	S(U)	0.48	2.63	0.05
55 Man-made fibres (discontinuous)	3.86 *	-0.27 (2.8)	1.97	0.41	S(U)	0.35	1.36	0.18
56 Wadding and felt, twine, cordage, special fabrics and thereof	4.45 **	-0.50 (4.52) **	0.09	14.99 **	S(S)	0.4	0.05	1.03
57 Carpets, mats matting and tapestries	18.74 **	-0.86 (9.16) **	0.34	0.29	S(S)	0.48	1.28	3.62 *
58 Special fabrics, lace, wall carpets, embroidery	5.10 **	-0.47 (4.69) **	1.49	4.71 **	S(S)	0.47	1.03	4.34 **
59 Impregnated and coated fabrics textile articles of kind suitable	13.73 **	-0.97 (6.84) **	0.39	0.01	S(S)	0.53	1.92	16.04 **
61 Knitted and crocheted goods and articles thereof	16.02 **	-0.86 (8.85) **	0.01	0.63	S(S)	0.46	0.67	0.32
62 Non knitted and crocheted goods and articles thereof	13.30 **	-0.96 (8.08) **	0.11	3.65 *	S(U)	0.48	0.34	0.45
63 Old clothing and other textile articles, rags	15.21 **	-0.89 (8.65) **	0	0.39	S(S)	0.44	2.39	0.22
64 Footwear, gaiters and the like, parts of such articles	15.37 **	-0.87 (8.03) **	0.53	6.00 **	S(S)	0.55	4.89 **	1.64
65 Headgear and parts thereof	4.23 **	-0.63 (4.06) **	0.16	1.28	S(S)	0.48	0.01	0.87
68 Articles of stone, of plaster, of cement, of asbestos of mica	4.12 **	-0.93 (3.71) *	0.03	2.58	S(S)	0.56	0.42	5.58 **
69 Ceramic products	5.65 **	-0.76 (5.32) **	1.27	6.39 **	S(S)	0.48	0.01	0
70 Glass and glassware	8.20 **	-0.61 (6.38) **	0.69	7.46 **	U(S)	0.44	1.69	0.05
71 Precious stones, precious metals, pearls and articles thereof	15.10 **	-0.80 (8.42) **	1.05	4.05 **	S(S)	0.41	6.91 **	1.06
72 Iron and steel	3.90 *	-0.39 (4.16) **	0.58	1.03	U(S)	0.59	0.69	1.28
73 Articles of iron and steel	2.82	-0.30 (3.4)	0.16	0.18	S(S)	0.41	0	0.65
74 Copper and articles thereof	15.95 **	-0.93 (9.01) **	0.06	3.39 *	S(U)	0.46	1.79	0.02
75 Nickel and articles thereof	23.27 **	-0.46 (7.12) **	17.84 **	14.77 **	S(S)	0.6	0.8	2.87 *
76 Aluminum and articles thereof	10.01 **	-0.57 (7.07) **	0.01	3.07 *	S(S)	0.42	1.24	0.02
81 Other base metals employed in metallurgy and articles thereof	11.80 **	-0.65 (5.6) **	0	1.48	S(U)	0.64	5.11 **	1.11
82 Tools, implements, cutlery, spoons, forks of base metal, parts thereof	6.93 **	-0.63 (5.06) **	0.57	1.54	S(S)	0.62	2.95 *	0.13
83 Miscellaneous articles of base metal	14.16 **	-0.79 (8.37) **	1.55	5.19 **	S(U)	0.43	1.15	0.67
84 Boilers, machineries and mechanical appliances, parts thereof	3.54 *	-0.32 (3.26)	1.28	0.12	S(S)	0.58	0.79	7.62 **
85 Electrical machinery and equipment, parts thereof	3.04	-0.41 (3.42)	0.97	3.71 *	S(S)	0.52	0	0.06
87 Vehicles other than railway or tramway rolling-stock, parts thereof	6.77 **	-0.39 (5.38) **	0.17	8.69 **	S(S)	0.46	5.86 **	1.5
88 Aircraft and parts thereof	8.25 **	-0.51 (6.09) **	1.14	1.08	S(S)	0.46	5.54 **	2.95 *
90 Optical, photographic, cinematographic, measuring checking, precision	1.55	-0.27 (2.33)	0.19	0.03	S(S)	0.62	0.55	0.23
91 Clocks and watches and parts thereof	19.87 **	-0.84 (8.57) **	0.09	1.31	S(S)	0.52	2.55	19.74 **
92 Musical instruments, parts and accessories of such articles	14.04 **	-0.80 (7.99) **	1.39	1.79	S(S)	0.46	0.23	2.45
94 Furniture	20.31 **	-0.98 (9.91) **	0.31	0	S(S)	0.52	5.48 **	0.06
95 Toys, games and sports requisites, parts thereof	13.98 **	-1.03 (7.98) **	0.36	1.16	S(S)	0.52	0.13	2.76 *
96 Miscellaneous manufactured articles (pens and brushes etc)	17.45 **	-0.90 (8.94) **	0.49	0	S(S)	0.54	1.55	0.68

Notes: a. At the 5% (10%) significance level when there are three exogenous variables (k=3). the upper bound critical value of the F test is 4.35(3.77). These come from Pesaran *et al* (2001 p 300 Table CI-Case III). b. Number inside the parenthesis is the absolute value of the t-ratio. Its upper bound critical value at the 5%(10%) significance level is -3.99(-3.66) when k=4. These come from Pesaran *et al* (2001 p 303 Table CII-Case

III). c. LM is Lagrange Multiplier test of residual serial correlation. It is distributed as χ^2 with one degree of freedom (first order). Its critical value at 5% (10%) significance level is 3.84(2.71). d. RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. e. Both Wald tests are also distributed as χ^2 with one degree of freedom. e. * and ** show level of significance at 10% and 5%. respectively.

attached to the *POS* and *NEG* variables were insignificant, it is possible for their difference to be significant, which will confirm long-run asymmetric effects of volatility on exports. Indeed, the Wald test, reported as Wald-L in Table 4, is significant in 45 industries, supporting long-run asymmetric effects of volatility.

Finally, we consider estimates of the Turkish nonlinear import demand models for each importing industry. The results are reported in Tables 5-8. Again, from the short-run estimates in Tables 5 and 6 we gather that in 42 industries either ΔPOS or ΔNEG carries at least one significant coefficient, providing support for the short-run effects of increased or decreased volatility. Once again, the increase from 31 linear models to 42 nonlinear models must be attributed to the introduction of the nonlinear adjustment of exchange rate volatility. The short-run effects appear to be asymmetric in most industries given that, at a given lag order j , the estimate attached to ΔPOS_{t-j} is different from the one attached to ΔNEG_{t-j} . However, cumulative or impact short-run asymmetric effects of volatility are established in 12 industries, coded as 13, 17, 23, 35, 48, 64, 71, 81, 82, 87, 88, and 94. In these industries the Wald-S test reported in Table 8 is significant, rejecting the equality of the sum of the coefficients attached to the ΔPOS_{t-j} and to the ΔNEG_{t-j} variables.

In order to determine whether short-run asymmetric effects last into asymmetric effects in the long run, we consider the long-run estimates in Table 7. As can be seen, in 16 industries either the *POS* or the *NEG* variable carries a significant coefficient. The estimates are meaningful in all industries since cointegration is supported either by the F or the t-test reported in the diagnostic Table 8. The estimates are positive in industries coded as 13, 34, 35, 40, 75, and 81 and 17, 21, 24, 28, 54, 55, 59, 64, and 65. Again, the results are industry-specific, and each industry must be considered by itself. Finally, the long-run effects are asymmetric in 22 industries since the Wald-L test is significant in 22 cases (Table 8).¹²

4. SUMMARY AND CONCLUSION

Interest in the effects of exchange rate volatility or uncertainty on trade flows still receives a great deal of attention. Availability of trade data at the industry level has helped researchers to undertake more disaggregated analyses. Since aggregation bias is reduced, more significant evidence is discovered. Further, significant evidence has been discovered recently as researchers have separated increased exchange rate volatility from declines and engaged in asymmetry analysis, which requires the application of nonlinear models. We add to these new developments by assessing symmetric and asymmetric effects of real lira-dollar volatility on the trade flows of 56 2-digit industries that trade between Turkey and the USA.

Our findings could be best summarised by saying that when a traditional linear ARDL model was estimated for each industry, we found significant short-run effects of real lira-dollar volatility on the Turkish exports of 23 industries to the USA and on the Turkish imports of 31 industries from the USA. The

short-run effects lasted into the long-run in only 6 exporting and 18 importing industries. There were positive and negative effects in both groups. However, when we estimated nonlinear ARDL models, the number of affected industries was much higher in the short-run and somewhat higher in the long run. Indeed, in the short run, exports of 41 industries and imports of 42 industries were affected either by increased volatility or by decreased volatility. In the long run, however, trade flows of only 9 exporting and 16 importing industries were affected. Additional analysis revealed that while short-run effects are asymmetric in almost all industries, significant long-run asymmetric effects were restricted to 45 Turkish exporting industries and 22 Turkish importing industries. The findings were industry-specific.

Our findings have major policy implications for the government and policy makers. Our findings that decreased lira-dollar volatility will boost the exports of 12 industries imply that a stable lira helps Turkish industries to export more. These industries engage in almost 25 per cent of Turkish exports to the US, which is a significant share. Reduced volatility was found to boost imports of 10 industries. However, since the import share of these 10 industries is less than 2 per cent, we should not be concerned with the increased imports. A stable lira will also help to manage inflation in Turkey.

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APPENDIX: VARIABLES AND DATA SOURCES

Monthly data over the period January 2003–October 2018 are used in the empirical analysis. The data come from the following sources:

- A. Turkish Statistical Institute (<http://www.turkstat.gov.tr>)
- B. International Financial statistics (IFS)

Variables:

X_i^{TR} = Turkey's real exports of industry i to the USA. In the absence of an industry level price index, we have deflated nominal exports of each industry in US dollars by Turkey's aggregate unit value of exports, also in dollars. While nominal export data come from source A, Turkey's export unit value index comes from source B.

M_i^{TR} = Turkey's real import of industry i from the USA. In the absence of an industry level price index, we have deflated nominal imports of each industry in US dollars by Turkey's aggregate unit value of imports, also in dollars. While nominal import data come from source A, Turkey's import unit value index comes from source B.

Y^{TR} = Turkey's aggregate output measured by the index of industrial production, since this is the only measure available at monthly frequency. (Source: B).

Y^{US} = US aggregate output also measured by her index of industrial production. (Source: B).

REX = The real bilateral exchange rate of the US dollar against the Turkish Lira. It is defined as $REX = (P_{US} \cdot NEX / P_{TR})$ where NEX is the nominal exchange rate defined as number of Lira per US Dollar. Thus, a decline in REX reflects a real depreciation of the US dollar or appreciation of the lira. Both price levels are measured by CPI. All data come from source B.

V: Volatility measure REX based on the Generalised Autoregressive Conditional Heteroskedasticity (GARCH 1, 1) method. Here we closely follow Bahmani-Oskooee and Aftab (2017) and assume that our variable of concern, REX , is random and follows a first order autoregressive process, i.e. $REX_t = \alpha_0 + \alpha_1 REX_{t-1} + \varepsilon_t$, where ε_t is white noise with $E(\varepsilon) = 0$ and $V(\varepsilon) = h^2$. In order to forecast the variance of REX , the conditional variance of ε_t which is a time varying variable needs to be estimated. The following theoretical specification of a GARCH model is used:

$$REX_t = \alpha_0 + \alpha_1 REX_{t-1} + \varepsilon_t \quad (A1)$$

$$h_t^2 = \beta_0 + \beta_1 \varepsilon_{t-1}^2 + \beta_2 \varepsilon_{t-2}^2 + \dots + \beta_q \varepsilon_{t-q}^2 + \phi_1 h_{t-1}^2 + \phi_2 h_{t-2}^2 + \dots + \phi_p h_{t-p}^2 \quad (A2)$$

Where h_t^2 is the conditional variance. The GARCH (p,q) model outlined by Eq. (A2) is used to generate the predicted value of h_t^2 as a measure of the volatility of real exchange rate. Following the literature and Bahmani-Oskooee and Aftab (2017) we too employ a GARCH (1,1) specifications as follows:

$$REX_t = \alpha_0 + \alpha_1 REX_{t-1} + \varepsilon_t \quad (A3)$$

$$h_t^2 = \beta_0 + \beta_1 \varepsilon_{t-1}^2 + \phi_1 h_{t-1}^2 \quad (A4)$$

ENDNOTES

1. The Center for Research on International Economics and Department of Economics, the University of Wisconsin-Milwaukee, Milwaukee, WI 53201. We would like to thank two anonymous referees for their valuable comments. Any remaining error, however, is our own. Corresponding author's e-mail: bahmani@uwm.edu
2. Department of Economics, Karabuk University, Turkey. E-mail: huseyinkaramelikli@karabuk.edu.tr
3. For the latest review of the literature see Bahmani-Oskooee and Hegerty (2007). From the review article we learn that since exchange rate uncertainty is measured by exchange rate volatility, the two words, uncertainty and volatility are used interchangeably.
4. Turkey's top trading partners in terms of export sales in 2018 are: Germany: US\$15.4 billion (9 per cent of total Turkish exports); United Kingdom: \$10.9 billion (6.3 per cent); Italy: \$9.3 billion (5.4 per cent); Iraq: \$9 billion (5.2 per cent); United States: \$8 billion (4.7 per cent); France: \$7.6 billion (4.5 per cent); Spain: \$7.6 billion (4.5 per cent); Netherlands: \$5.4 billion (3.2 per cent); Israel: \$4.4 billion (2.5 per cent); Russia: \$3.9

billion (2.3 per cent); Romania: \$3.8 billion (2.2 per cent); United Arab Emirates: \$3.5 billion (2.1 per cent); Egypt: \$3.3 billion (1.9 per cent); Poland: \$3.3 billion (1.9 per cent); and Belgium: \$3.2 billion (1.9 per cent). Source: <http://www.worldstopexports.com/turkeys-top-import-partners/>

5. This is referred to as normalisation.

6. Estimates of θ_0 and ρ_0 must also be negative if variables in each model are to converge to their long-run equilibrium values. Note that the t-test within the ARDL approach is the same as the t-test used to judge significance of the lagged error-correction term within the Engle and Granger (1987) method. For details and a demonstration see Bahmani-Oskooee (2020).

7. In generating partial sum variables, we have assumed that the volatility measure includes only a stochastic trend. Therefore, $\Delta \ln V$ amounts to de-trending. However, we also checked for the possibility of a deterministic trend by regressing $\ln V$ on a trend term. Since the estimate attached to the trend term was insignificant, we did not de-trend the $\ln V$ variable first. For more see Hatemi-J A and El-Khatib Y (2016).

8. For more applications of these methods see Arize *et al* (2000, 2017), Halicioglu (2008), Nusair (2012, 2016), Kisswani and Nusair (2014), Durmaz (2015), Lima *et al* (2016), and Aftab *et al* (2017).

9. Note that in the linear export demand models, the Lagrange Multiplier test was insignificant in most models, indicating autocorrelation free residuals. Ramsey's RESET test rejected misspecification, also in most models. Coefficient estimates were found to be stable in most industries. These results are also available from the authors upon request.

10. By 'meaningful' we mean estimates were supported by at least one of the cointegration tests.

11. Note that while Turkish real income, i.e., $\ln Y^{TR}$ carried its expected positive sign in most models, in some cases, e.g., industry 15, it carries a negative coefficient. These industries must be those that as the Turkish economy grows, Turkey produces more import substituting goods and therefore, imports less (Bahmani-Oskooee 1986).

12. Other diagnostic statistics are similar to those of the nonlinear export demand models and there is need no to repeat.

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