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The Impact of Real Effective Exchange Rate Volatility on the Trade between the U.S. and Turkey: An ARDL Approach

Reel Efektif Döviz Kuru Volatilitesinin Türkiye ve ABD arasındaki Ticarete Etkisi: ARDL Yaklaşımı

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Abstract: This paper analyses the relationship between the trade volume and the volatility of the real effective exchange rate for the case of the U.S. and Turkey. The exchange rate volatility is modeled as a GARCH(1,1) process. We employ the popular ARDL bounds testing approach to investigate the existence of a long-run relationship. Unlike most other studies, this paper uses disaggregated monthly data from ten major industries, to make the identification of industry specific effects possible. We find that, the volatility of the real effective exchange rate is soley in one industry a significant regressor in the long run. Exports from Turkey to the U.S. mostly depend on the real effective exchange rate, imports of Turkey from the U.S., on the other hand, depend mostly on the Turkish industrial production index. The results of the bounds test confirm the ambiguity of the findings of previous studies.

Keywords: Volatility, ARDL Bounds Test, Real Effective Exchange Rate, Trade, Turkey, United States.

Öz: Bu çalışma, reel efektif döviz kuru volatilitisi ile Türkiye - ABD ticaret hacmi arasındaki ilişkiyi analiz etmektedir. Döviz kuru GARCH (1,1) süreci olarak modellenmiştir. Uzun dönem ilişkilerin varlığını tespit etmek için ARDL sınır testi uygulanmıştır. Diğer çalışmalardan farklı olarak, bu çalışma sektör bazlı, aylık veri kullanarak, on farklı sektör için sektöre özgün etkileri ortaya çıkarmaktadır. Uzun vadeli ilişkide, sadece bir sektörde döviz kur volatilitesinin anlamlı bir açıklayıcı değişken olduğu tespit edilmiştir. Türkiye'den ABD'ye ihraçların en önemli etkeni döviz kuru olduğu ortaya çıkmıştır. Türkiye'nin ABD'den ithal ettiği ürün gruplarında ise en önemli etkenin Sanayi Üretim Endeksi olduğu gösterilmiştir. Sınır testinin sonucu, önceki çalışmalarının kararsızlıklarını teyit etmektedir.

Anahtar Kelimeler: Volatilite, ARDL Sınır Testi, Reel Efektif Döviz Kuru, Ticaret, Türkiye, ABD.

1. Introduction

The Republic of Turkey was founded in 1923 by Mustafa Kemal Ataturk. The Turkish Government's publicly declared aim for 2023, the year of the 100th anniversary of the republic, is to raise the Turkish economy into the group of the greatest ten of the world. According to the data of the Organisation for Economic Co-operation and Development (OECD) Turkey's economy was the fastest growing worldwide in 2004, possibly outraced only by the Chinese economy which is not included in the data. In 2014 the growth rate fell to 2.9%, but is still higher than the average of the 19 Euro Area countries. Turkey as the only Muslim state in the NATO, acting as a bridge to the orient, is becoming more and more important as a trading partner for the European Union as well as the United States. The ongoing civil war in Syria, which seems to be spilling over to Turkey, will likely result in increased volatility and depreciation of the Turkish currency. Hence, an improved understanding of the relationship between macroeconomic variables, especially the exchange rate volatility, and trade is desirable.

Table 1 provides an overview over the most important trading partners of Turkey, sorted by the sum of exports and imports for the year 2015. The data is obtained from the Turkish Statistical Institute (TURKSTAT). Having a share of 5% of the total trade of Turkey, the United States are one of her most important trading partners, ranking fourth after Germany, China and Russia. The fragile and ambigous relationship between Turkey and Russia is making the United States even more important for Turkey in the upcoming years. Therefore we focus our analysis on the trade relationship between Turkey and the United States. For this purpose we use the most recent data that is available at TURKSTAT. As shown in the detailed literature survey on the exchange rate volatility and trade in Ozturk (2006), there is a large body of studies dealing with the effects of exchange rate volatility on trade.

Theoretical studies as conducted by Hooper and Kohlhagen (1978) and Ethier (1973) suggest that increasing exchange rate volatility will lead to decreasing foreign trade. The widely accepted and plausible key assumption for this causal relationship is that the trading individuals and institutions are risk-averse. Therefore, the risk-averse traders will face higher costs in situations with high volatility of the exchange rate. As Baron (1976) points out, there is a variety of risk reduction possibilities like forwards and futures. However, not all traders will be able to fully eliminate their risk due to the limited customizability of the contracts, because of standardized volumes and maturity dates. On the other hand, papers like Viaene and Devries (1992), Franke (1991), Degrauwe (1988) and Sercu and Vanhulle (1992) argue that volatility of the exchange rate will have a positive effect on trade. Côté (1994), as well as many others, conclude that the results of the analysis are rather ambiguous.

The trade-exchange rate volatility relationship between Turkey and the U.S. has already been analyzed by Vergil (2002) and Kasman and Kasman (2005). Both of the studies employ the vector autoregressive approach proposed by Johansen (1995) to test for co-integrating relationships. Altintaş, Cetin, and Öz (2011) model the relationship using the ARDL approach of Pesaran, Shin, and Smith (2001). However, they use the moving average of the standard deviation of the real effective exchange rate as the risk measure. The main contribution of this study is to examine the relationship on disaggregated data of ten industries using a GARCH(1,1) process to model the volatility.

Table 1. Turkey's Most Important Trade Partners in 2015

Countries	Exports		Imports		Total	
	Value (million $)	Share	Value (million $)	Share	Value (million $)	Share
Germany	12 285 086	9.30%	19 314 352	10.20%	31 599 438	9.80%
China	2 187 628	1.70%	22 710 821	12.00%	24 898 450	7.70%
Russia	3 381 226	2.60%	18 713 697	9.90%	22 094 923	6.90%
USA	5 811 182	4.40%	10 167 179	5.40%	15 978 361	5.00%
Italy	6 255 308	4.70%	9 680 647	5.10%	15 935 955	5.00%
United Kingdom	9 804 621	7.40%	5 070 035	2.70%	14 874 656	4.60%
France	5 302 277	4.00%	7 032 027	3.70%	12 334 304	3.80%
Spain	4 362 785	3.30%	5 111 784	2.70%	9 474 569	2.90%
Iran	3 292 154	2.50%	5 657 068	3.00%	8 949 222	2.80%
Iraq	8 072 721	6.10%	273 229	0.10%	8 345 950	2.60%
Switzerland	5 617 144	4.20%	2 248 242	1.20%	7 865 386	2.40%
South Korea	508 049	0.40%	6 500 991	3.40%	7 009 040	2.20%
Total Top 12	66 880 181	50.60%	112 480 073	59.40%	179 360 253	55.80%
Total	132 194 403		189 219 303		321 413 706	

Data Source: Turkish Statistical Institute

2. Model, Data and Method

Bahmani-Oskooee and Hegerty (2007) offer a detailed survey of the literature about modeling exchange rate volatility and trade flows. Eqs. (1) and (2) are adaptations from De Vita and Abbott (2004). We assume that the exports and imports are autoregressive processes and additionally depend on lagged values of other macroeconomic variables. One of the most important variables is the gross domestic product (GDP) of the importing countries. Because the GDP is a commonly employed measure for economic activity in a specific region, it is plausible to assume that a higher GDP will result in more imports into this region.

$$lnEXP_t = \alpha_0 + \sum_{i=1}^{p}\alpha_i lnEXP_{t-i} + \sum_{i=0}^{q}\beta_i lnh_{t-i} + \sum_{i=0}^{r}\gamma_i lnIPI_{USA,t-i} + \sum_{i=0}^{s}\delta_i lnREER_{t-i} \quad (1)$$

$$lnIMP_t = \alpha_0 + \sum_{i=1}^{p}\alpha_i lnIMP_{t-i} + \sum_{i=0}^{q}\beta_i lnh_{t-i} + \sum_{i=0}^{r}\gamma_i lnIPI_{TR,t-i} + \sum_{i=0}^{s}\delta_i lnREER_{t-i} \quad (2)$$

In this paper, $REER$ denotes the real effective exchange rate, h stands for the real effective exchange rate volatility and the industrial production index is denoted as *IPI* and serves as a proxy for the GDP. Seabra (1995) evaluates many of the volatility measures commonly employed in the literature. He concludes that ARCH-based methods are the most efficient. Therefore the volatility is estimated like in Sukar and Hassan (2001) as a GARCH(1,1) process proposed by Bollerslev (1986). Eqs. (3) to (5) were used to obtain the volatility measure h .

$$100\Delta lnREER_t = \eta + \varepsilon_t \quad (3)$$

$$\sigma_t^2 = a_0 + a_1\varepsilon_{t-1}^2 + a_2\sigma_{t-1}^2 \quad (4)$$

$$h_t = \sigma_t^2 \quad (5)$$

We develop an ARDL model like Pesaran, Shin, and Smith (2001) by transforming eqs.(1) and (2) into the co-integrating form presented in eqs. (6) and (7).

$$\Delta lnEXP_t = \alpha_0 + \sum_{i=1}^{p-1}\alpha_i'\Delta lnEXP_{t-i} + \sum_{i=0}^{q-1}\beta_i'\Delta lnh_{t-i} + \sum_{i=0}^{r-1}\gamma_i'\Delta lnIPI_{USA,t-i} + \sum_{i=0}^{s-1}\delta_i'\Delta lnREER_{t-i}$$

$$+\theta_0 lnEXP_{t-1} + \theta_1 lnh_{t-1} + \theta_2 lnIPI_{USA,t-1} + \theta_3 lnREER_{t-1} \quad (6)$$

$$\Delta lnIMP_t = \alpha_0 + \sum_{i=1}^{p-1}\alpha_i'\Delta lnIMP_{t-i} + \sum_{i=0}^{q-1}\beta_i'\Delta lnh_{t-i} + \sum_{i=0}^{r-1}\gamma_i'\Delta lnIPI_{TR,t-i} + \sum_{i=0}^{s-1}\delta_i'\Delta lnREER_{t-i}$$

$$+\theta_0 lnIMP_{t-1} + \theta_1 lnh_{t-1} + \theta_2 lnIPI_{TR,t-1} + \theta_3 lnREER_{t-1} \quad (7)$$

Although Pesaran, Shin, and Smith (2001) do not restrict the regressors to be integrated of order 1 or 0, the dependent variable has to be of order 1 to make a cointegrating relationship possible. Therefore, we conduct an augmented Dickey-Fuller unit root test as proposed by Dickey and Fuller (1979). The test also makes sure that the ARDL bounds testing approach should be preferred over other more basic methods like the error correction approach of Engle and Granger (1987).

Table 2. Augmented Dickey-Fuller Unit Root Test

SITC	Exports	Imports	Macroeconomic Variables	
0	-4.56**	0.17	ln IPI_{TR}	-1.76
1	-3.28*	-2.52	ln IPI_{US}	-2.51
2	-2.28	-2.91*	ln h	-7.06**
3	-2.76	-5.08**	ln REER	-3.25*
4	-2.63	-3.00*		
5	-2.85	-1.44		
6	-2.94	-3.00*		
7	-3.11*	-2.48		
8	-2.97*	-1.44		
9	-3.96**	-3.40*		

*Note: *, ** denote significance on the 5% and 1% level, respectively.*
SITC denotes the Standard International Trade Classification, Rev.3.

The test results in Table 2 suggest that we have a mix of $I(0)$ and $I(1)$ dependent variables. Hence, employing the ARDL approach of Pesaran, Shin, and Smith (2001) is justified. However, some independent variables are stationary at level, i.e. establishing a meaningful relationship with the ARDL approach is not possible. Consequently, we limit our analysis to those dependent variables, which can be assumed to be integrated at order 1, namely SITC 2, 3, 4, 5, 6 and SITC 0, 1, 5, 7, 8, for exports and imports respectively. The equations of the long-run relationship of eqs. (6) and (7) are

$$lnIMP_t = \theta_0' + \theta_1' lnh_t + \theta_2' lnIPI_{TR,t} + \theta_3' lnREER_t \quad (8)$$

$$lnEXP_t = \theta_0' + \theta_1' lnh_t + \theta_2' lnIPI_{USA,t} + \theta_3' lnREER_t \quad (9)$$

respectively. The corresponding coefficients of eqs. (8) and (9) are obtained by devising the coefficients of the one period lagged independent variables by the coefficient of the one period lagged dependent variable of eqs. (6) and (7) $\theta_1' = -\theta_1/\theta_0$, $\theta_2' = -\theta_2/\theta_0$ and $\theta_3' = -\theta_3/\theta_0$ respectively. The estimates of the standard errors are computed using the delta method. The constant is calculated by $\theta_0' = \alpha_0/\theta_0$.

Our dataset consists of 153 monthly observations ranging from January 2003 to September 2015. Due to the fact that there is no monthly GDP data, we follow McKenzie and Brooks (1997) and use the industrial production index (IPI) as a proxy for the GDP. The data is obtained from the website of the OECD. From the website of the Central Bank of Turkey we get the real effective exchange rate based on currencies of developed countries. If the overall effective exchange rate increases, it suggests that the Turkish Lira is becoming stronger.

Exports and Imports data is supplied by the Turkish Statistical Institute. The data is disaggregated into ten major industries according to the Standard International Trade Classification (SITC) Revision 3. As proposed by many previous studies, we deflate the exports and imports using the consumer price index from the website of the OECD. Table 3 provides a summary about the data series and their sources.

Table 3. Definition of Variables and Sources of Data

Data Series	Data Source
Gross Domestic Product (GDP)	Industrial Production Index (IPI) from the website of the OECD
Real Effective Exchange Rate (REER)	The website of the Central Bank of Turkey
Exports (EXP) and Imports (IMP)	Turkish Statistical Institute

As pointed out earlier, we have 12 different lag length possibilities for the dependent variable and 13 for each of the three independent variables. This leads to $12 \times 13^3 = 26.364$ possible models which have to be estimated and compared. For the sake of parsimony we employ the Schwarz Information Criterion (SIC) developed in Schwarz (1978). Following Pesaran, Shin, and Smith (2001) we additionally consider the LM statistics for testing no residual serial correlation against order 12 as a model selection criterion. We estimate 26,364 models and select the one with the smallest SIC value and no residual serial correlation.

3. Empirical Results

First, a bounds test is conducted to check for the existence of co-integrating relationships. Therefore, we test the hypothesis that the long-run coefficients of eqs. (6) and (7) are jointly zero ($\theta_0 = \theta_1 = \theta_2 = \theta_3 = 0$) using a Wald-test. The critical values for the F-statistics are supplied by Pesaran, Shin, and Smith (2001). The results of the bounds test are presented in Table 3.

Table 4. Bounds Testing Results

	Exports to the USA		Imports from the USA	
SITC	F-statistic	ECT_t	F-statistic	ECT_t
0			3.35	-0.4 (-5.47)***
1			4.34*	-1.9 (-4.19)***
2	3.21	-0.21 (-3.47)**		
3	3.51	-0.26 (-3.23)*		
4	2.21	-0.26 (-2.88)		
5	2.53	-0.16 (-1.97)	5.62***	-0.56 (-3.77)**
6	2.48	-0.13 (-3.18)**		
7			2.68	-0.38 (-3.55)**
8			3.39	-0.04 (-1.49)

*Note: *, **, *** denote significance on the 10%, 5% and 1% level, respectively.*

The Bounds test concludes that there are significant long-run relationships in two industries' imports (SITC 1, 5). However, Bahmani-Oskooee and Nasir (2004) indicate that the F-statistic is very sensitive to the selected lag length. Consequently, for every industry and for both, exports and imports, it is possible to find some models among the 26,365, which have significant long-run relationships. Using the SIC and the residual serial correlation for lag length selection leads to the models presented in this paper. The predominantly significant and negative t-ratios of the error correction term on the other hand suggest that export industries 2,3 and 6 and all import industries except SITC 8 have significant long-run relationships. The coefficient less than -1 of the error correction term for product group 1 of the imports constitutes a special case, in which the long-run deviation is overcorrected, leading to an overshooting.

However, these coefficients are greater than -2. Hence, the overshooting won't lead to an instable behavior of the model. An error impulse will rather be correct like in any other case, except that the deviation's sign will oscillate and its amplitude will eventually fade away.

Table 5. Long-Run Coefficients

STIC	Long Run Coefficients Exports			
	ln h	ln IPI^{US}_t	ln $REER_t$	c
2 Crude materials, inedible, except fuels	0.98	1.66	4.29***	-11.2
3 Mineral fuels, lubricants and related materials	-1.88	1.06	4.6	-5.07
6 Manufactured goods classified chiefly by material	-0.67	1.44	2.74**	-0.54

STIC	Long Run Coefficients Imports			
	ln h	ln IPI^{TR}_t	ln $REER_t$	c
0 Food and live animals	0.1	2.35***	0.58	3.16
1 Beverages and tobacco	-0.59**	0.65**	-2.32***	25.09***
5 Chemicals and related products, n.e.s.	-0.08	1.67***	1.07	3.65
7 Machinery and transport equipment	-0.29	2.46***	0.55	4.93

*Note: *, **, *** denote significance on the 10%, 5% and 1% level, respectively.*

The coefficients of the long-run relationships according to eqs. (8) and (9) are shown in Table 4. As mentioned earlier, the industrial production index represents the economic activity. Therefore, its coefficient is expected to be positive. The volatility of the exchange rate should depress trade, if traders are assumed to be risk-averse. However, as explained in section 1, there are theoretical and empirical studies which suggest that there is a positive effect of the exchange rate volatility on trade. The real effective exchange rate as some kind of measure of prices of Turkish goods in the U.S. and vice versa, is expected to influence imports and exports in opposite directions. Exports should benefit, imports should suffer from a decreasing real effective exchange rate.

In the long run, the real effective exchange rate volatility is a significant explanatory variable only for the imports' SITC 1 industry, Beverage and tobacco. The negative sign confirms our expectations, that greater volatility should lead to smaller trade volume. Consequently, the trade volumes of the remaining product groups are not significantly influenced by the real effective exchange rate volatility in the long run. The effect of the industrial production index differs strongly with regard to the products' destination. For all of the four product groups (SITC 0,1,5,6) the imports into Turkey are significantly determined by the Turkish industrial production index. Furthermore, all signs are positive as expected, which means that a stronger economy causes a higher demand for U.S. goods. These findings are consistent with the theory. On the other hand, the imports of the U.S. don't depend on the domestic industrial production index at all.

The real effective exchange rate and the constant are significant regressors for three product groups. Higher real effective exchange rates are causing Turkish goods to be more expensive for foreign buyers. Hence, the real effective exchange rate is expected to influence Turkish exports negatively. However, all of the coefficients of the real effective exchange rate in Table 4 are positive. A possible explanation could be that growing Turkish exports are likely to lead to an increased demand for its currency, causing the latter to appreciate.

Tables 6 to 9 in the appendix depict the short-run relationships. AIC, SIC and $HQIC$, denote the Akaike Information Criterion, the Schwarz Information Criterion and Hannan–Quinn Information Criterion respectively. χ^2_{SC}, χ^2_N and χ^2_H denote chi-squared statistics to test for no residual serial correlation, normal distribution and homoscedasticity respectively, F_{FF} is the F statistics to test for no functional form mis-specification. The tables for the short-run relationship show that in most of the models, the autoregressive component of the model has the highest lag length. In three models the dependent variable even has a lag length of 12. On the other hand, the independent variables tend to have significantly shorter lag lengths. In nine models, only the contemporary components of the independent variables have a influence on the exports and imports. Hence, one might conclude that the explanatory power of the autoregressive components seem to be more important for the exports and imports of Turkey in the short-run.

4. Concluding Remarks

This paper analyses the relationship between trade and exchange rate volatility using disaggregate monthly data ranging from 2003 - 2015. We apply the ARDL bounds testing approach to ten major industries for exports and imports separately. This relatively novel approach has never been used with evidence from Turkey before. Considering only the bounds test, we can’t conclude that there is strong evidence for the existence of a long-run co-integrating relationship throughout all the 20 industries. Among the models for the different industries, there are two with a long-run relationship. However, the coefficients of the error correction terms suggest that there is a long-run relationship in seven industries. The exchange rate volatility, modeled as a GARCH(1,1) process, doesn’t appear to be a significant explanatory variable for trade in the long run. Further studies using different volatility measures may be required. Unsurprisingly, the industrial production index of Turkey is a significant regressor for Turkish imports for most of the industries in the long run. The exports, on the other hand, are mainly influenced by the real effective exchange rate of the Turkish Lira and a constant. In the short run, the autoregressive components have the biggest influence on themselves, i.e. the exports and imports, respectively. The previously expressed ambiguity of the result of preceding studies remains.

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Appendix

Table A.6: Imports SITC 0,1

	SITC 0	ARDL (12,0,0,1)			SITC 1	ARDL (12,0,0,0)		
Lag	Δ ln IMP	Δ ln h	Δ ln IPI_{TR}	Δ ln REER	Δ ln IMP	Δ ln h	Δ ln IPI_{TR}	Δ ln REER
0		0.04	0.95***	-0.84**		1.24*	-4.4***	-1.13**
1	-0.35***				0.95**	0.15		
2	-0.33***				0.82**	-0.85		
3	-0.31***				0.62*	0.08		
4	-0.52***				0.49	-0.41		
5	-0.49***				0.45	0.27		
6	-0.39***				0.2	-1.00*		
7	-0.55***				-0.04	-0.91		
8	-0.59***				-0.21	-0.11		
9	-0.58***				-0.27**	0.8		
10	-0.6***				-0.33***	-1.34**		
11	-0.4***				-0.26***			

SITC 0: $\bar{R}^2 = 0.89$, AIC = -1.29, SIC = -0.93, HQIC = -1.15

$\chi^2_{SC} = 13.27[0.35]$, $\chi^2_{N} = 0.17[0.92]$,

$\chi^2_{H} = 15.14[0.49]$, $F_{FF} = 0.80[0.38]$

SITC 1: $\bar{R}^2 = 0.47$, AIC = 2.75, SIC = 3.08, HQIC = 2.89

$\chi^2_{SC} = 13.32[0.35]$, $\chi^2_{N} = 2.62[0.27]$,

$\chi^2_{H} = 8.88[0.12]$, $F_{FF} = 16.75[0.0]$

*Note: *, **, *** denote significance on the 10%, 5% and 1% level, respectively. p-values given in [.].*

Table A.7: Imports SITC 5,7

	SITC 5	ARDL (5,0,0,0)			SITC 7	ARDL(7,0,0,0)		
Lag	Δ ln IMP	Δ ln h	Δ ln IPI_{TR}	Δ ln REER	Δ ln IMP	Δ ln h	Δ ln IPI_{TR}	Δ ln REER
0		-0.05	0.93***	0.59		-0.11	0.94***	0.21
1	-0.53***				-0.47***			
2	-0.56***				-0.26**			
3	-0.45***				-0.11			
4	-0.27***				-0.07			
5					0.04			
6					0.06			

SITC 5: $\bar{R}^2 = 0.46$, AIC = 0.57, SIC = 0.75, HQIC = 0.65

$\chi^2_{SC} = 7.07[0.85]$, $\chi^2_{N} = 0.88[0.64]$,

$\chi^2_{H} = 19.05[0.99]$, $F_{FF} = 0.17[0.68]$

SITC 7: $\bar{R}^2 = 0.69$, AIC = 0.20, SIC = 0.42, HQIC = 0.29

$\chi^2_{SC} = 7.02[0.86]$, $\chi^2_{N} = 238[0.00]$,

$\chi^2_{H} = 8.48[0.42]$, $F_{FF} = 0.67[0.39]$

*Note: *, **, *** denote significance on the 10%, 5% and 1% level, respectively. p-values given in [.].*

Table A.8: Exports SITC 2,3

	SITC 2	ARDL (11,1,0,0)			SITC 3	ARDL (4,0,0,0)		
Lag	Δ ln EXP	Δ ln h	Δ ln IPI_{US}	Δ ln REER	Δ ln EXP	Δ ln h	Δ ln IPI_{US}	Δ ln REER
0		0.08	0.35	0.91**		-0.49	0.27	1.2
1	-0.42***				-0.4***			
2	-0.34***				-0.32***			
3	-0.15				-0.16*			
4	-0.06							
5	-0.24**							
6	-0.18*							
7	-0.33***							
8	-0.26***							
9	-0.15							
10	-0.17**							

SITC 2: $\bar{R}^2 = 0.73$, AIC = 0.31, SIC = 0.64, HQIC = 0.45
$\chi^2_{SC} = 17.95[0.12]$, $\chi^2_{N} = 0.19[0.91]$,
$\chi^2_{H} = 22.88[0.09]$, $F_{FF} = 1.18[0.28]$

SITC 3: $\bar{R}^2 = 0.50$, AIC = 2.29, SIC = 2.45, HQIC = 2.35
$\chi^2_{SC} = 14.00[0.30]$, $\chi^2_{N} = 39.76[0.00]$,
$\chi^2_{H} = 7.18[0.41]$, $F_{FF} = 0.04[0.85]$

*Note: *, **, *** denote significance on the 10%, 5% and 1% level, respectively. p-values given in [.].*

Table A.9: Exports SITC 6

	STIC 6	ARDL (6,0,0,0)		
Lag	Δ ln EXP	Δ ln h	Δ ln IPI_{US}	Δ ln REER
0		-0.09	0.19	0.35*
1	-0.48***			
2	-0.05			
3	0.14			
4	-0.13			
5	-0.25***			

$\bar{R}^2 = 0.88$, AIC = -1.08, SIC = -0.88, HQIC = -1.00
$\chi^2_{SC} = 17.94[0.12]$, $\chi^2_{N} = 0.69[0.71]$,
$\chi^2_{H} = 9.57[0.39]$, $F_{FF} = 0.17[0.68]$

*Note: *, **, *** denote significance on the 10%, 5% and 1% level, respectively. p-values given in [.].*