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The effects of real exchange rate volatility on sectoral export flows under intermediate and flexible exchange rate regimes: Empirical evidence from Turkey

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Abstract

The aim of this paper is to analyse empirically the effects of real exchange rate volatility on sectoral exports in Turkey under intermediate and flexible exchange rate regimes. The cointegration test and error correction models are used to test the long-run relationship and short-run effects, respectively. The estimation results show that the real exchange rate volatility has negative and significant effects on sectoral exports in both intermediate and flexible exchange rate regimes. These empirical results are consistent with the theory. However, the impact of real exchange rate and foreign income appeared to be quite different for the two exchange rate regimes. Further, research is required to analyse the impacts of real exchange rate and foreign income on sectoral exports.

Keywords: Real exchange rate volatility, real exchange rate, intermediate exchange rate regime, flexible exchange rate regime, sectoral export.

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1. Introduction

The adoption of the flexible exchange rate regime in 1973 by many developed and emerging market economies put into agenda the exchange rate volatility or uncertainty and its effects on international trade flows. It is argued that exchange rate volatility creates an uncertain environment for international trade flows and this may reduce trade flows. Both theoretical and empirical literature gives mixed results about the effects of exchange rate volatility on international trade flows. While some of the studies find negative effects of exchange rate volatility on international trade flows, some of them find positive or statistically insignificant effects of exchange rate volatility on international trade flows.

In this study, the effects of real exchange rate volatility on Turkish sectoral export flows with the rest of the world under intermediate and flexible exchange rate regimes are analysed. In other words, we investigate long-run and short-run effects of real exchange rate volatility on Turkish sectoral export flows under intermediate and flexible exchange rate regimes. The rest of this study is organised as follows: In Section 2, a brief literature review is presented. In Section 3, theoretical framework of the study is explained. In Section 4, variable definitions and data sources are explained. In Section 5, empirical result are presented. Section 6 concludes the paper.

2. A brief literature reviews

There are both theoretical and empirical studies about the effects of exchange rate volatility on international trade flows. However, both theoretical and empirical studies give mixed results about the effects of volatility of exchange rates on international trade flows. While some of the studies find negative effects of exchange rate volatility on international trade flows, some of them find positive or statistically insignificant effects of exchange rate volatility on trade flows. McKenzie (1999) and Auboin and Ruta (2013) give theoretical and empirical literature surveys about exchange rate volatility and international trade flows. The empirical results that examine the relationship between exchange rate volatility and international trade flows in Turkey are few. Vergil (2002) found a negative relationship between real exchange rate volatility and export flows in Turkey. Kasman and Kasman (2005) found a positive relationship between exchange rate volatility and export flows in Turkey.

The existing empirical studies about Turkey as well as other countries used aggregate trade flows of countries with the rest of the world or with their major trading partners. However, the current debate about this issue is that sectoral data can be helpful to distangle the linkages between the exchange rate volatility and trade flows that may exist across sectors but not in total trade flows (Auboin & Ruta, 2013; Bahmani-Oskooee & Durmaz, 2016). In this framework, Caglayan and Di (2010) investigated empirically the effects of real exchange rate volatility on sectoral bilateral trade flows between the United States and its top 13 trading partners. They found little effect of exchange rate volatility on sectoral trade flows of advanced and emerging economies. Bahmani-Oskooee, Hegerty and Satawatananon (2015) examined the effect of exchange rate risk on Japan–Thailand trade using data from 117 Japanese exporting and 54 importing industries. They found that in the short run, slightly more than half of 117 exporting industries and 54 importing industries are affected by exchange rate volatility. In the long-run, 6 exporting and 2 importing industries are affected positively and 22 exporting and 9 importing industries are affected negatively. Besides, they also found the evidence that small exporting industries and exports of manufacturing and certain machinery and transport equipment industries might be relatively more affected by exchange rate risk.

Regarding Turkey, Caglayan, Dahi and Demir (2013) examined the effects of exchange rate uncertainty on manufacturing goods exports of 28 emerging economies, including Turkey. They find that exchange rate uncertainty affects trade flows of 24 of the 28 emerging economies, including Turkey. Bahmani-Oskooee and Durmaz (2016) investigated the short-run and long-run effects of exchange rate volatility on exports of 23 industries and imports of 39 industries including one-digit and

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two-digit industries in Turkey. They found significant short-run effects of exchange rate volatility in many industries, but its long-run effects are significant on 24 Turkish importing industries and 12 Turkish exporting industries.

3. Theoretical framework

The traditional long-run export demand function is as follows:

$$\ln EXP_t = B_0 \ln FX_t + B_1 \ln Y_t + B_2 SDVFX_t + u_t \quad (1)$$

where EXP_t is the volume of a country's real export goods at time t , FX_t is the bilateral real exchange rate at time t , Y_t is the real foreign economic activity at time t , $SDVFX_t$ is the standard deviation of real exchange rate that measures exchange rate volatility and as proxy to risk at time t and u_t is the error term. The expected signs of the coefficients are as follows:

B_0 = The sign of the coefficient is expected to be positive. An increase in exchange rate shows depreciation of domestic currency and export volume should increase.

B_1 = The sign of the coefficient is expected to be positive. An increase in foreign income or foreign demand should increase export volume.

B_2 = The sign of the coefficient is expected to be negative. An increase in exchange rate volatility should decrease export volume. But, empirical studies give ambiguous results about the sign of the coefficient. So, this may be an empirical issue.

4. Variable definitions and data sources

In the empirical part of the study, the effects of real exchange rate volatility on sectoral export data are examined for Turkey under intermediate (January 1991–February 2001) and flexible exchange rate (March 2001–June 2013) regimes. To do that, firstly, the augmented dickey fuller (ADF) test is done if the variables have a unit root. Then, cointegration analysis is conducted and error correction models are estimated. The following export demand equation is estimated for the intermediate and flexible exchange rate regimes:

$$\ln EXP_t = B_0 \ln FX_t + B_1 \ln Y_t + B_2 SDVFX_t + u_t \quad (2)$$

where EXP_t is the real sectoral export of Turkey with the rest of the world, FX_t is the real exchange rate, the amount of Turkish lira per unit of U.S. dollar, Y_t is the real foreign income or foreign demand, $SDVFX_t$ is the standard deviation of real exchange rate. All the variables are in the logarithmic forms. The variables are constructed as follows:

EXP_t (real sectoral exports) = Nominal sectoral exports/U.S. consumer price index (CPI)

FX_t (real exchange rate) = Nominal exchange rate* (U.S. CPI/Turkish CPI)

Y_t (foreign income or demand) = Organisation for Economic Cooperation and Development (OECD) index of industrial production as a proxy to foreign real GDP

$SDVFX_t$ (real exchange rate volatility) = standard deviation of real exchange rate. One year's worth of monthly data were used.

The data are monthly and data sources are as follows: the nominal exchange rate (i.e., Turkish lira per U.S. dollar, period average rate) and consumer price indices (2010 = 100) are taken from the International Monetary Fund's International Financial Statistics. The export data (millions, U.S. dollars) are taken from the OECD's Monthly Statistics of International Trade. The index of industrial production of OECD countries is used a proxy to foreign real GDP and are taken from the OECD's main economic

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indicators (2010 = 100). The sectors are classified by sections of Standard Industrial Trade Classification at one-digit level. The codes and names of sectors are given as follows:

- 0: Food and live animals
- 1: Beverages and tobacco
- 2: Crude materials, inedible, except fuels
- 3: Mineral fuels, lubricants and related materials
- 4: Animal and vegetable oils, fats and waxes
- 5: Chemical and related products
- 6: Manufactured goods
- 7: Machinery and transport equipment
- 8: Miscellaneous manufactured articles
- 9: Commodities and transactions

Since, there are not fully time-series data for Sector 9 (i.e., commodities and transactions), it is not included in the empirical part of the study.

5. Procedure of study and empirical results

Firstly, each of the variable was tested using ADF test whether the variable has a unit root. The ADF test consists of regressing each series on its lagged value and lagged difference terms. The ADF test results are shown in Table 1. The results suggest that all variables used in export demand function are nonstationary in their levels and they are integrated of order one. Therefore, their first differences are used in the estimation of regressions. In order to analyse the long-run and short-run effects of real exchange rate volatility on sectoral trade flows, cointegration analysis and error correction models are used.

5.1. Cointegration analysis

The Johansen's test statistics (trace and maximum eigenvalue) are used. The cointegration test results for real export volume, real exchange rate, real foreign income, standard deviation of real exchange rate for the periods of intermediate (January 1994–February 2001) and flexible exchange rate (March 2001–September 2012) regimes are presented in Tables 2 and 3, respectively. The existence of cointegration between variables means that there is a long-run equilibrium among real exports, real exchange rate, real exchange rate volatility and foreign income.

Table 1. Augmented dickey fuller unit root test results for the intermediate and flexible exchange rate regimes (including intercept)

Variable	Intermediate exchange rate regime	Flexible exchange rate regime
$\ln EXP_t^{total}$	-1.40	-1.72
$\ln FX_t$	-3.00*	-1.59
$\ln Y_t$	-0.53	-2.29
$SDVFX_t$	-2.93*	-3.62
$\ln EXP_t^{sector0}$	-0.63	-0.86
$\ln EXP_t^{sector1}$	-5.76	-0.31
$\ln EXP_t^{sector2}$	-3.94	-1.36
$\ln EXP_t^{sector3}$	-5.94	-2.26
$\ln EXP_t^{sector4}$	-3.29	-1.85
$\ln EXP_t^{sector5}$	-1.11	-1.02
$\ln EXP_t^{sector6}$	-1.97	-1.88
$\ln EXP_t^{sector7}$	-0.88	-2.18
$\ln EXP_t^{sector8}$	-1.99	-1.54
$\Delta \ln EXP_t^{total}$	-4.53**	-5.36**
$\Delta \ln FX_t$	-6.54**	-8.57**
$\Delta \ln Y_t$	-2.58	-4.33**
$\Delta SDVFX_t$	-4.84**	-5.91**
$\Delta \ln EXP_t^{sector0}$	-4.89**	-3.97**
$\Delta \ln EXP_t^{sector1}$	-9.31**	-10.77**
$\Delta \ln EXP_t^{sector2}$	-18.60**	-20.65**
$\Delta \ln EXP_t^{sector3}$	-13.32**	-17.15**
$\Delta \ln EXP_t^{sector4}$	-16.28**	-16.17**
$\Delta \ln EXP_t^{sector5}$	-3.42*	-4.60**
$\Delta \ln EXP_t^{sector6}$	-3.38*	-18.75**
$\Delta \ln EXP_t^{sector7}$	-8.20**	-3.15*
$\Delta \ln EXP_t^{sector8}$	-4.15**	-3.67**

Note: ‘***’ shows the rejection of null hypothesis of a unit root at the 1% level and ‘**’ shows the rejection of the null hypothesis at the 5% level. The McKinnon critical values for intermediate exchange rate regime period -3.48 at the 1% level and -2.88 for the 5% level. The McKinnon critical values for flexible exchange rate regime period -3.47 at the 1% level and -2.88 for the 5% level. ‘Δ’ shows the first difference of the variable.

Table 2. Cointegration test results for the intermediate exchange rate regime

Sector	Eigenvalue	Trace statistic	0.05 Critical value	Probability****	Number of observations
Total sector**					116
None***	0.196	48.739	47.856	.04	
At most 1	0.113	23.327	29.797	.23	
At most 2	0.069	9.298	15.494	.33	
At most 3	0.007	0.891	3.841	.34	
0 Sector**					
None***	0.265	61.363	47.856	.001	
At most 1	0.126	25.542	29.797	.14	
At most 2	0.079	9.850	15.494	.29	
At most 3	0.001	0.198	3.841	.65	

1 Sector**				
None***	0.298	65.500	47.856	.0005
At most 1	0.120	24.441	29.797	.18
At most 2	0.077	9.504	15.494	.32
At most 3	0.001	0.122	3.841	.72
2 Sector*				
None***	0.166	42.140	47.856	.15
At most 1	0.098	21.052	29.797	.35
At most 2	0.071	8.969	15.494	.36
At most 3	0.003	0.418	3.841	.51
3 Sector**				
None***	0.301	69.940	47.856	.0001
At most 1	0.156	28.271	29.797	.07
At most 2	0.070	8.512	15.494	.41
At most 3	0.000059	0.006	3.841	.93
4 Sector*				
None***	0.136	36.306	47.856	.38
At most 1	0.082	19.265	29.797	.47
At most 2	0.072	9.236	15.494	.34
At most 3	0.004	0.484	3.841	.48
5 Sector**				
None***	0.193	51.540	47.856	.02
At most 1	0.142	26.616	29.797	.11
At most 2	0.072	8.799	15.494	.38
At most 3	0.0004	0.051	3.841	.82
6 Sector*				
None***	0.203	46.445	47.856	.06
At most 1	0.100	20.067	29.797	.41
At most 2	0.058	7.739	15.494	.49
At most 3	0.006	0.783	3.841	.37
7 Sector*				
None***	0.150	42.602	47.856	.14
At most 1	0.104	23.662	29.797	.21
At most 2	0.08	10.871	15.494	.21
At most 3	0.003	0.442	3.841	.50
8 Sector **				
None***	0.214	52.681	47.856	.01
At most 1	0.120	24.640	29.797	.17
At most 2	0.071	9.807	15.494	.29
At most 3	0.010	1.219	3.841	.26

Note: (*) Trace test indicates no cointegrating equation at the .05 level. (**) Trace test indicates 1 cointegrating equation at the .05 level. (***) denotes rejection of null hypothesis at the .05 level. (****) MacKinnon-Haug-Michelis (1999) *p* values.

Table 3. Cointegration test results for the flexible exchange rate regime

Sector	Eigenvalue	Trace statistic	0.05 Critical value	Probability****	Number of observations
Total sector*****					148
None***	0.196	62.745	47.856	.001	
At most 1	0.108	30.392	29.797	.04	
At most 2	0.066	13.472	15.494	.09	

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At most 3	0.022	3.295	3.841	.06
0 Sector **				
None***	0.182	57.247	47.856	.005
At most 1	0.096	27.422	29.797	.09
At most 2	0.065	12.395	15.494	.13
At most 3	0.016	2.393	3.841	.12
1 Sector*****				
None***	0.245	81.709	47.856	.000
At most 1	0.171	39.949	29.797	.002
At most 2	0.060	12.150	15.494	.14
At most 3	0.019	2.970	3.841	.08
2 Sector*				
None***	0.180	47.625	47.856	.05
At most 1	0.069	18.179	29.797	.55
At most 2	0.035	7.541	15.494	.51
At most 3	0.014	2.135	3.841	.14
3 Sector*****				
None***	0.173	61.302	47.856	.001
At most 1	0.115	33.023	29.797	.02
At most 2	0.073	14.813	15.494	.06
At most 3	0.023	3.480	3.841	.06
4 Sector**				
None***	0.215	55.602	47.856	.007
At most 1	0.074	19.622	29.797	.44
At most 2	0.042	8.126	15.494	.45
At most 3	0.011	1.728	3.841	.18
5 Sector**				
None***	0.175	48.931	47.856	.03
At most 1	0.069	20.332	29.797	.40
At most 2	0.049	9.735	15.494	.30
At most 3	0.015	2.259	3.841	.13
6 Sector*****				
None***	0.194	63.661	47.856	.0009
At most 1	0.097	31.598	29.797	.03
At most 2	0.086	16.466	15.494	.03
At most 3	0.020	3.020	3.841	.08
7 Sector*****				
None***	0.255	80.465	47.856	.0000
At most 1	0.126	36.873	29.797	.006
At most 2	0.081	16.834	15.494	.031
At most 3	0.027	4.177	3.841	.04
8 Sector**				
None***	0.228	62.013	47.856	.001
At most 1	0.077	23.640	29.797	.21
At most 2	0.058	11.724	15.494	.17
At most 3	0.019	2.859	3.841	.09

Note: (*) Trace test indicates no cointegrating equation at the.05 level. (**) Trace test indicates 1 cointegrating equation at the.05 level. (***) denotes rejection of null hypothesis at the.05 level. (****) MacKinnon-Haug-Michelis (1999) p values. (*****) Trace test indicates two cointegrating equations at the.05 level. (*****) Trace test indicates three cointegrating

equations at the.05 level. (*****) Trace test indicates 4 cointegrating equations at the.05 level.

The estimation of cointegrating relationship for intermediate and flexible exchange rate regimes are given in Tables 4 and 5, respectively. As can be seen in Table 4, the cointegration test results show that under the intermediate exchange rate regime, the signs of the explanatory variables are as expected as a whole. The sign of the real exchange rate volatility coefficient is negative and statistically significant as expected. The impacts of real exchange rate and foreign income are positive and significant. However, as can be seen in Table 5, the estimation results are not the same under the flexible exchange rate regime. The impact of exchange rate volatility is negative and statistically significant for total sector and all sub-sectors except Sector 1. However, the real exchange rate and foreign income appear to be statistically insignificant or negatively significant contrary to expected.

Table 4. Estimation of cointegrating relationship for intermediate exchange rate regime

Sector	Normalised cointegrated vector
Total sector	$\ln EXP_t = 2.02 \ln FX_t^{**} + 1.19 \ln Y_t^{**} - 2.73 \text{SDVFX}_t^{**}$ (5.31) (3.96) (3.00)
0: Food and live animals	$\ln EXP_t = 2.42 \ln FX_t^{**} - 0.92 \ln Y_t - 3.38 \text{SDVFX}_t^{**}$ (3.84) (1.87) (2.25)
1: Beverages and tobacco	$\ln EXP_t = 5.21 \ln FX_t^{**} - 0.01 \ln Y_t - 8.95 \text{SDVFX}_t^{**}$ (3.47) (0.01) (2.43)
2: Crude materials, inedible, except fuels	$\ln EXP_t = 3.94 \ln FX_t^{**} - 0.73 \ln Y_t - 2.43 \text{SDVFX}_t$ (3.71) (0.90) (0.96)
3: Mineral fuels, lubricants and related materials	$\ln EXP_t = -3.18 \ln FX_t^{**} + 3.26 \ln Y_t^{**} - 10.98 \text{SDVFX}_t^{**}$ (3.24) (4.34) (4.71)
4: Animal and vegetable oils, fats and waxes	$\ln EXP_t = -40.72 \ln FX_t^{**} - 2.94 \ln Y_t + 13.23 \text{SDVFX}_t$ (2.94) (0.27) (0.4)
5: Chemical and related products	$\ln EXP_t = 1.81 \ln FX_t^{**} + 1.23 \ln Y_t^{**} - 3.76 \text{SDVFX}_t^{**}$ (5.48) (4.92) (4.75)
6: Manufactured goods	$\ln EXP_t = 2.50 \ln FX_t^{**} + 1.14 \ln Y_t^{**} - 3.08 \text{SDVFX}_t^{**}$ (7.35) (4.22) (3.75)
7: Machinery and transport equipment	$\ln EXP_t = 2.26 \ln FX_t^{**} + 5.12 \ln Y_t^{**} - 1.88 \text{SDVFX}_t$ (3.05) (9.30) (1.08)
8: Miscellaneous manufactured articles	$\ln EXP_t = 2.27 \ln FX_t^{**} + 0.57 \ln Y_t - 4.28 \text{SDVFX}_t^{**}$ (5.40) (1.72) (4.28)

Note: '**' shows that the variable is significant at 5% level.

Table 5. Estimation of cointegrating relationship for flexible exchange rate regime

Sector	Normalised cointegrated vector
Total sector	$\ln EXP_t = -0.81 \ln FX_t^{**} - 1.16 \ln Y_t - 11.31 \text{SDVFX}_t^{**}$ (2.79) (1.16) (5.16)
0: Food and live animals	$\ln EXP_t = -0.33 \ln FX_t - 5.40 \ln Y_t^{**} - 21.09 \text{SDVFX}_t^{**}$ (0.66) (2.27) (5.52)
1: Beverages and tobacco	$\ln EXP_t = -0.60 \ln FX_t^{**} + 1.03 \ln Y_t - 0.29 \text{SDVFX}_t$ (3.00) (1.10) (0.18)
2: Crude materials, inedible, except fuels	$\ln EXP_t = 0.04 \ln FX_t - 8.65 \ln Y_t^{**} - 34.09 \text{SDVFX}_t^{**}$ (0.04) (2.16) (5.30)
3: Mineral fuels, lubricants and related materials	$\ln EXP_t = -1.49 \ln FX_t^{**} - 1.75 \ln Y_t - 20.18 \text{SDVFX}_t^{**}$ (2.52) (0.62) (4.48)
4: Animal and vegetable oils, fats and waxes	$\ln EXP_t = 1.09 \ln FX_t - 7.92 \ln Y_t - 42.33 \text{SDVFX}_t^{**}$ (1.2) (1.88) (6.12)

5: Chemical and related products	$\ln EXP_t = 0.17 \ln FX_t - 11.42 \ln Y_t^{**} - 40.22 SDVFX_t^{**} (0.16) (2.38) (5.27)$
6: Manufactured goods	$\ln EXP_t = -0.80 \ln FX_t^{**} - 2.07 \ln Y_t - 11.49 SDVFX_t^{**} (2.58) (1.39) (4.91)$
7: Machinery and transport equipment	$\ln EXP_t = -1.37 \ln FX_t^{**} + 1.33 \ln Y_t^{**} - 3.36 SDVFX_t^{**} (12.45) (2.41) (3.77)$
8: Miscellaneous manufactured articles	$\ln EXP_t = -0.49 \ln FX_t^{**} - 0.34 \ln Y_t - 5.46 SDVFX_t^{**} (3.76) (0.63) (5.30)$

Note: '**' shows that the variable is significant at 5 % level.

The summary of the estimation of cointegrating relationships for intermediate and flexible exchange rate regimes are presented in Table 6. As can be seen in Table 6, under the flexible exchange rate regime, the volatility of real exchange rate is negative and statistically significant, except for beverages and tobacco (Sector 1). It is significantly negative also under the intermediate exchange rate regime; except, for crude materials, inedible, except fuels (Sector 2); animal and vegetable oils fats and waxes (Sector 4); machinery and transport equipment (Sector 7).

Table 6. Summary of the long-run effects*

Sector	Intermediate exchange rate regime			Flexible exchange rate regime		
	$\ln FX_t$	$\ln Y_t$	$SDVFX_t$	$\ln FX_t$	$\ln Y_t$	$SDVFX_t$
Total sector	+	+	-	-	0	-
0: Food and live animals	+	0	-	0	-	-
1: Beverages and tobacco	+	0	-	-	0	0
2: Crude materials, inedible, except fuels	+	0	0	0	-	-
3: Mineral fuels, lubricants and related materials	-	+	-	-	0	-
4: Animal and vegetable oils, fats and waxes	-	0	0	0	0	-
5: Chemical and related products	+	+	-	0	-	-
6: Manufactured goods	+	+	-	-	0	-
7: Machinery and transport equipment	+	+	0	-	+	-
8: Miscellaneous manufactured articles	+	0	-	-	0	-

Note: (*) '+' shows positive and statistically significant effect, '-' shows negative and statistically significant effect and '0' shows statistically insignificant effect.

However, the impacts of real exchange rate and foreign income or foreign demand seem to be quite different for two different exchange rate regimes. Under the intermediate exchange rate regime, the impact of real exchange rate appeared to be positive and statistically significant for almost all the sub-sectors except, mineral fuels, lubricants and related materials (Sector 3); animal and vegetable oils fats and waxes (Sector 4), which are negative and statistically significant. On the other hand, under the flexible exchange rate regime, the coefficient of real exchange rate is negative and statistically significant for total sector exports and five of the nine sub-sectors, that is, food and live animals (Sector 0); beverages and tobacco (Sector 1); mineral fuels, lubricants and related materials (Sector 3); manufactured goods (Sector 6); machinery and transport equipment (Sector 7); miscellaneous manufactured articles (Sector 8). The coefficient of real exchange rate is statistically insignificant for four sub-sectors, that is, food and live animals (Sector 0); crude materials, inedible, except fuels (Sector 2); animal and vegetable oils, fats and waxes (Sector 4); chemical and related products (Sector 5).

As can be seen in Graphs 1 and 2, the highest share of total exports belongs to manufactured goods (Sector 6); machinery and transport equipment (Sector 7) and miscellaneous manufactured articles (Sector 8). As we give special attention to these sectors, we could see that real exchange rate is positive and significant for these sectors under intermediate exchange rate regime and negative and significant under flexible exchange rate regime. Kizildere, Kabadayi, and Emsen (2014) also found that the depreciation of Turkish lira decreased exports. Hepaktan, Cinar and Dundar (2011) also found weak effects of real exchange rate on exports.

Similar estimation results also appeared for foreign income or foreign demand. Under the intermediate exchange rate regime, while it is positive and significant for total sector exports and four of the nine sub-sectors, that is, mineral fuels, lubricants and related materials (Sector 3); chemical and related products (Sector 5); manufactured goods (Sector 6); machinery and transport equipment (Sector 7). It is statistically insignificant for five sub-sectors, that is, food and live animals (Sector 0); beverages and tobacco (Sector 1); crude materials, inedible, except fuels (Sector 2); animal and vegetable oils, fats and waxes (Sector 4); miscellaneous manufactured articles (Sector 8).

Under the flexible exchange rate regime, the coefficient of foreign income is only positive and significant for machinery and transport equipment (Sector 7). The coefficient of foreign income is negative and significant for food and live animals (Sector 0); crude materials, inedible, except fuels (Sector 2); chemical and related products (Sector 5). It is statistically insignificant for total sector exports; beverages and tobacco (Sector 0); mineral fuels, lubricants and related materials (Sector 3); animal and vegetable oils, fats and waxes (Sector 4); manufactured goods (Sector 6); miscellaneous manufactured articles (Sector 8).

5.2. Error correction models (ECMs)

As a third step, ECMs are estimated. To do that, three-period lags of the independent variables are included in the regressions, and they are estimated for intermediate and flexible exchange rate regimes. Then, the statistically insignificant variables are dropped from the regressions and the statistically significant ones are kept in the regressions and they are reestimated. These estimation results are presented in Tables 7 and 8, respectively. The cointegration will be supported if $ECMt_{-1}$ carries a negative and statistically significant coefficient. Besides, the coefficient of $ECMt_{-1}$ represents the proportion of disequilibrium in long-run values in one period corrected in the next period.

Table 7. ECM Results for the Intermediate Exchange Rate Regime

	$\Delta \ln EXPt$	$\Delta \ln FX_t$	$\Delta \ln Y_t$	$\Delta SDVFX_t$	$ECM(-1)$	R^2	DW
Total sector	-0.61** (-1.85)	5.12** (2.10)	-1.14 (-0.93)	-0.64** (-7.44)	0.37	2.28	
0: Food and live animals	-2.14** (-3.24)	11.60** (2.40)	2.11 (0.89)	-0.18** (-1.98)	0.14	1.78	
1: Beverages and tobacco	2.11 (1.13)	-0.05 (-0.33)	-15.6 (-2.36)	-0.24** (-2.43)	0.07	1.70	
2: Crude materials, inedible, except fuels	-0.19 (-0.37)	7.58** (2.05)	-2.64 (-1.43)	-0.65** (-7.57)	0.36	2.10	
3: Mineral fuels, lubricants and related materials	-0.53 (-0.37)	12.32 (1.14)	9.37** (1.84)	-0.46** (-4.52)	0.20	1.87	
4: Animal and vegetable oils, fats and waxes	-0.29 (-0.26)	0.47 (0.05)	-3.06 (-0.77)	-0.47** (-5.13)	0.19	2.01	
5: Chemical and related products	-0.01 (-0.02)	0.02 (0.60)	-1.95 (-1.14)	-0.78** (-8.19)	0.37	2.15	
6: Manufactured goods	-0.36 (-0.87)	7.75** (2.51)	0.96 (0.63)	-0.03** (-4.39)	0.17	2.55	

7: Machinery and transport equipment	-0.93 (-1.81)	11.39** (2.99)	-0.51 (-0.27)	-0.70** (-7.80)	0.40	2.14
8: Miscellaneous manufactured articles	-0.35 (-0.91)	0.13 (0.04)	-2.17 (-1.50)	-0.59** (-6.76)	0.29	2.18

Note: '**' shows that the variable is significant at 5 % level. Δ shows the first difference of the variable.

As can be seen in Tables 7 and 8, the ECM_{t-1} coefficients for all sectors have a negative sign and statistically significant, which confirm all the variables are cointegrated. The coefficients of ECM_{t-1t} also show that about half of the deviations from the long-run values are corrected in the following period for the total sector and all other sub-sectors. The first difference of foreign income appeared to be positive and significant also for almost all sub-sectors.

Table 8. ECM Results for the Flexible Exchange Rate Regime

	$\Delta \ln EXP_t$	$\Delta \ln FX_t$	$\Delta \ln Y_t$	$\Delta SDVFX_t$	$ECM(-1)$	R^2	DW
Total sector		-0.03 (-0.14)	2.66** (2.35)	0.07 (0.08)	-0.58** (-7.90)	0.32	2.36
0: Food and live animals		0.44 (1.22)	1.26 (0.64)	-0.38 (-0.26)	-0.11 (-1.27)	0.02	1.93
1: Beverages and tobacco		-0.002 (-0.003)	-1.79 (-0.50)	-9.80** (-3.69)	-0.54** (-6.31)	0.25	1.89
2: Crude materials, inedible, except fuels		0.08 (0.29)	5.33** (3.61)	0.76 (0.69)	-0.58** (-8.00)	0.33	2.26
3: Mineral fuels, lubricants and related materials		-1.22** (-2.08)	6.14** (1.94)	0.44 (0.18)	-0.60** (-7.28)	0.29	2.00
4: Animal and vegetable oils, fats and waxes		1.30** (2.21)	0.58 (0.18)	1.70 (0.72)	-0.39** (-4.80)	0.16	1.85
5: Chemical and related products		-0.02 (-0.09)	3.79** (2.86)	1.47 (1.50)	-0.41** (-5.39)	0.19	2.16
6: Manufactured goods		-0.20 (-0.85)	3.19** (2.54)	0.23 (0.25)	-0.52** (-6.73)	0.26	2.11
7: Machinery and transport equipment		-0.20 (-0.71)	0.03** (2.26)	0.27 (0.24)	-0.63** (-7.62)	0.30	2.24
8: Miscellaneous manufactured articles		-0.31 (-1.52)	1.91* (1.73)	0.14 (0.17)	-0.73** (-9.71)	0.41	2.36

Note: '**' shows that the variable is significant at 5% level. ' Δ ' shows the first difference of the variable.

6. Summary and conclusions

This paper analysed empirically the effects of real exchange rate volatility on sectoral level export data in Turkey under intermediate intermediate (January 1991–February 2001) and flexible exchange rate (March 2001–June 2013) regimes. The empirical findings show that real exchange rate volatility have negative and significant effects on sectoral level export data in both intermediate and flexible exchange rate regimes. However, the impact of the real exchange rate and foreign income must be scrutinised in more details. The model works for intermediate exchange rate regime, where as the results vary for the flexible exchange rate regimes. Further research is required for the sub-sectors. One point may be the dependency of a particular sector on import in terms of intermediate goods. A second point may be the competitiveness of Turkey in a particular sector.

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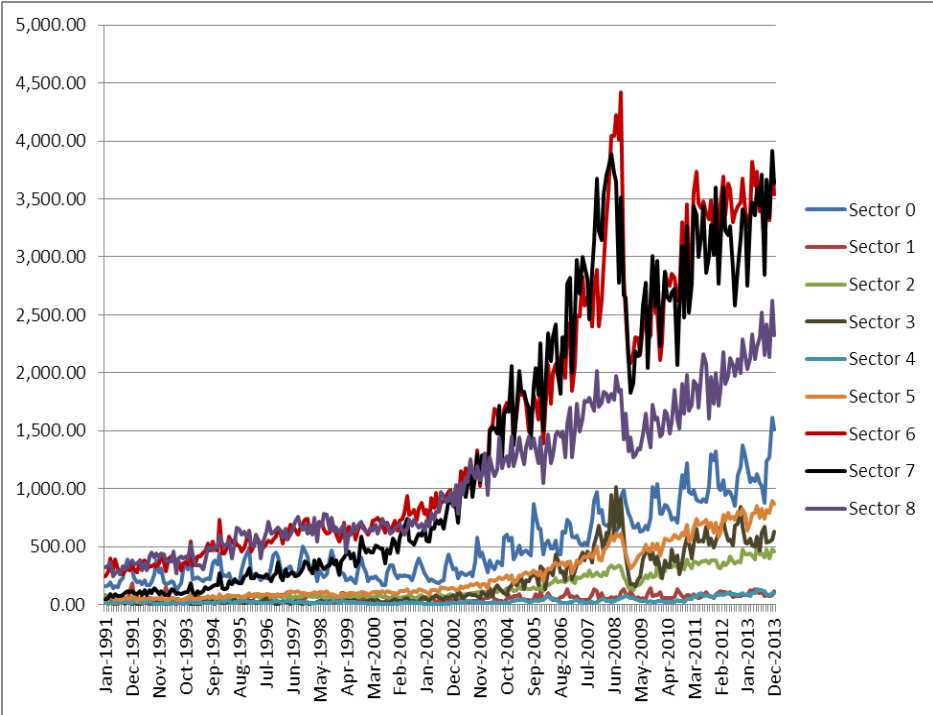
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Appendix

Graph 1. Turkish sectoral export flows between January 1991 and June 2013



Graph 2. Ratio of sectoral export to total exports between January 1991 and June 2013

