IMPACTS OF EURO/USD VOLATILITY ON STEEL PRICES OF TURKEY

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Abstract

Steel sector is the driving force of industry as it provides raw or semi-finished materials for the majority of manufacturing industries. Turkey is an important steel producer, importer and exporter. 45% of steel imports are from EU-27 zone while only 24% of the exports are destined to the European countries. The study is concentrated on the effects of EUR/USD volatility on the steel prices of Turkey. VAR models, Impulse Response Functions, Granger Causality Tests and Variance Decomposition analysis are employed for the data covering the period of April 2008- January 2015. The study reveals that EUR/USD currency volatility has significant effect on steel prices explaining about 5-6% of the changes in the prices.

Keywords: *currency volatility, steel prices, VAR models, Granger causality, Turkey*

JEL Classification: *F10, F31, L61, C22*

I. INTRODUCTION

Iron and steel products, which are produced by melting iron ore or steel scrap in the Electric Arc Furnaces (EAF) or in the integrated plants, are classified mainly as long and flat products. Reinforcing bars (rebar) constitute major part of long products while hot rolled coils (HRC) represent major part of flat products. Steel industry supplies raw materials to key sectors such as construction, infrastructure, automotive, household goods and engineering. Thus, development and industrialization of a country directly related to having a strong steel production and consumption. The world steel industry has been changing fast since 2000. Private investors dominate the ownership and sector is consolidated by mergers and acquisitions. High steel demand in China and developing countries increased the profitability but cyclical fluctuations due to excess capacities remain as a major concern. Steel industry of Turkey is among the fastest growing sectors thanks to domestic demand and its favourable geographical location (Akman, 2007). 1,66 billion tonnes of steel produced (capacity is 2,35 billion tonnes) in the world in 2014. Turkey has a 50 million tonnes of capacity but produced 34 million tonnes of steel in 2014. Turkey is the 8th largest steel producer and consumer in the World. It is the 7th largest steel exporter and importer in the World (Yayan, 2015). Turkey ranks the first among scrap importers and rebar exporters. Despite structural problems, high energy costs, dependency to imported steel scrap and raw materials Turkish steel sector has an important role in the industrial development of Turkey. It has competitive power with its technological infrastructure and experience, high quality products and developing steel markets both in the region and Turkey.

Turkey is a developing country with a growth rate over World average and steel demand is high. 17 million tonnes of long and 15 million tonnes of flat products are consumed in 2013. Major steel consuming sectors are construction with a share of 47%, machinery and equipment industry with 22%, metal products with 13%, automotive with 8% and electrical devices with 4%. Though among the major producers, Turkey also imports a considerable amount of steel. The country is dependent on imports in flat products and exports in long products due to supply-demand imbalances. 15,7 billion USD exports and 12,8 billion USD imports are realized by the steel industry while imports of raw materials (scrap, coal and iron ore) are totalled to 10,6 billion USD in 2013. The steel sector is highly internationalized as the numbers show (TÇÜD, 2014).

Steel prices are determined by supply and demand dynamics like other commodities. However, excess capacities in the World and different policies adopted across the countries increase the complexity. Energy and raw materials are major cost constituents for steel production which Turkey is dependent on foreign suppliers predominantly. Steel is an established sector and trends are mainly determined by emerging countries where demand originates. Overcapacities make steel industry more sensitive to macroeconomic factors and the prices are affected almost instantly in all parts of the world.

The impact of currency rates on the commodity prices and foreign trade is discussed in the literature. Akat and Yazgan (2012), Campa and Goldberg (2005), Strasser (2012), Vigfusson et al. (2007), Choudri and Hakura (2015), Tekin and Yazgan (2009) and Bussiere et al. (2014) state a significant effect of currency volatility on export and import prices. The studies show that producers surcharge the costs of currency fluctuations to the commodity prices. Currency parities have an impact on prices. However, the impact of parities on exports and imports volume of Turkey is ambiguous. Kızıldere et al. (2014) and Senturk et al. (2013)

report no significant effect of exchange rate volatilitiy on foreign trade while Nazlioglu (2012) and Saatcioglu and Karaca (2010) state that USD/Euro parity has significant effect on foreign trade. Our study is aimed at investigating the effects of Euro/USD parity on the steel prices of Turkey, an issue hasn't been focused on empirically. The effect on the steel prices is important as it is used in many major industries and the effects are expected to be reflected in steel consuming sectors.

The article is organized as follows. After a brief introduction, the second part presents literature review. The third part explains the empirical methodology and fourth part is dedicated to empirical analysis and results. Conclusion is presented in the last part of the paper.

II. LITERATURE REVIEW

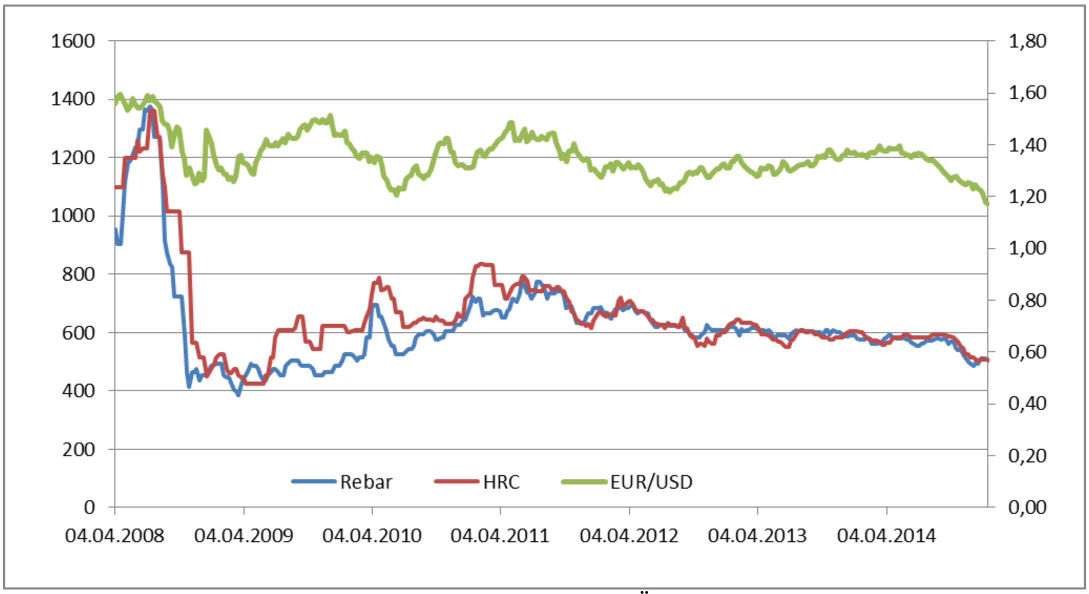
Majority of Turkish imports are realized in USD while Euro is dominant currency in the exports. The shares of Euro and USD in exports of Turkey are 48% and 45% respectively in 2009. On the other hand, 34% of imports are realized with Euro while USD covers 60% of the imports in the same year (Saatcioglu and Karaca, 2010). However, the status in the steel industry is contrary to the overall situation as seen in Table 1. Euro dominates steel imports as 45% of steel imports are from EU-27 countries while exports to the region makes only 24% of total exports in 2014. Therefore, the volatility of Euro/USD parity is expected to have an impact on Turkish steel prices. A stronger Euro is expected to decrease European exports and increase imports. Turkish producers may find an opportunity to increase their prices under lower steel supply and higher demand. This part of the study represents some of the recent studies on the impact of currency rates on export or import prices.

Table 1. Turkish Steel Imports and Exports by Regions of World

	2000		2005		2010		2014	
Imports	(000 USD)	%	(000 USD)	%	(000 USD)	%	(000 USD)	%
USA	49.305	1,9	75.711	1,1	128.978	1,3	121.211	1,0
EU-27	1.354.389	51,3	3.830.466	54,4	4.940.012	49,5	5.417.778	45,0
CIS	901.945	34,2	2.466.912	35,0	2.785.060	27,9	3.042.883	25,3
North Africa	1.861	0,1	15.524	0,2	89.429	0,9	68.981	0,6
Middle East	22.747	0,9	6.742	0,1	12.017	0,1	28.221	0,2
Southeast Asia	214.692	8,1	448.654	6,4	1.728.032	17,3	2.849.214	23,7
Others	93.072	3,5	195.032	2,8	288.816	2,9	508.289	4,2
Total	**2.638.011**	100,0	**7.039.042**	100,0	**9.972.343**	100,0	**12.036.576**	100,0
	2000		2005		2010		2014	
Exports	(000 USD)	%	(000 USD)	%	(000 USD)	%	(000 USD)	%
USA	203.336	9,0	698.515	9,2	414.857	3,1	1.446.942	9,5
EU-27	930.166	41,2	2.603.175	34,3	2.890.562	21,8	3.582.650	23,6
CIS	47.558	2,1	284.144	3,7	712.242	5,4	1.207.731	7,9
North Africa	159.594	7,1	720.507	9,5	1.885.529	14,2	1.506.685	9,9
Middle East	399.849	17,7	2.315.594	30,5	5.225.467	39,3	4.328.897	28,5
Southeast Asia	234.891	10,4	314.695	4,1	570.865	4,3	326.980	2,2
Others	281.517	12,5	663.573	8,7	1.586.101	11,9	2.807.278	18,5
Total	**2.256.912**	100,0	**7.600.202**	100,0	**13.285.622**	100,0	**15.207.163**	100,0

Source: Turkish Steel Producers Association (TÇÜD)

Campa and Goldberg (2005) examined the currency volatiliy on the import prices of 23 OECD countries. They documented that the effects of currency prices are reflected in the import prices of the sample countries. This also shows that the export prices of the countries exporting to them are affected to the same extent. Bussiere et al. (2014) investigated effects of exchange rates on the export and import prices of 40 countries comprised of 18 developed and 22 emerging countries. The results revealed that currency parities influence commodity export and import prices. However, the significance varies across the countries. Higher exhange rate pass through is observed in developing countries and the effect is lower for the countries with wide range of export markets. Choudri and Hakura (2015) estimated the effects of currency rates on the import and export prices of 18 developed countries and 16 developing countries utilizing both regression and VAR models for the period of 1979-2010. They showed that the surcharge of currency volatility is varied across the countries and import prices are more affected than export prices. Akat and Yazgan (2012) focused on the effects of currency rates on the export prices in Turkey for the period of 2004-2012. They expressed that weaker local currency rates lower export prices and thus increase the exports. The impact of currency rates on export prices is observed in a slower pace. Campa et al. (2005) analysed transmission rates of currency exchange rates to import prices in the Euro area. They stated that the existing impact is varied accross countries and industries and strenghtens in the longer periods. Uckun (2010) investigated the effects of EUR/USD parity on the prices of stainless steel. The study applied regression analysis using monthly data for the period of 2003-2009 and concluded that the parity and stainless steel prices have a positive but weak relation.



Source: Turkish Steel Producers Association (TÇÜD) and Central Bank of Turkey

Figure 1. The trends of EUR/USD and Turkish domestic prices of Rebar and HRC (weekly data)

III. RESEARCH METHODOLOGY

Granger causality tests are utilized to examine the relationship between Euro/USD parity and steel prices in Turkey. Weekly domestic prices of rebar and hot rolled coil for the period between 04.04.2008 to 16.01.2015 are used to present steel prices. The significance of relation between the series of prices and parity and optimum lag lengths are determined by Vector Autoregressive (VAR) Models. The results produced through the models are assessed by considering impulse response functions (IRF) and variance decomposition tests.

Weekly data of Euro/USD parity (PAR), domestic prices of Rebar (REBAR) and hot rolled coil (HRC) are employed in this study to find out the relationship between steel prices and Euro/USD currency volatility. Euro and USD curreny rates are obtained from the official website of Central Bank of Turkey and the data of steel prices are obtained from Turkish Steel Producers Association (TÇÜD). The visual trend of the three variables are shown in Figure 1. Logarithms of weekly changes used in empirical analysis are shown in Equations 1,2,3.

$$\Delta PAR_{it} = \ln (PAR_{it} / PAR_{i,(t-1)}) \quad (1)$$

$$\Delta REBAR_{it} = \ln (REBAR_{it} / REBAR_{i,(t-1)}) \quad (2)$$

$$\Delta HRC_{it} = \ln (HRC_{it} / HRC_{i,(t-1)}) \quad (3)$$

Stationarity of the series used in econometric analysis is essential to obtain reliable and unbiased results. Augmented Dickey Fuller (ADF) (1981) unit root tests are used to examine the stationarity of the series. If the null hypothesis (H_0: δ =0) of the regression model for the specific variable (x) shown in Eq. 4 is rejected with ADF test, the stationarity of the variable is accepted. Results of ADF Tests given in Table 2 exhibit that time series of PAR, REBAR and HRC used in the analysis are stationary.

$$\Delta x_t = \sum_{i=1}^{L} \beta_i \Delta x_{t-1} + \alpha x_t + \beta_1 t + \beta_2 + e_t \quad (4)$$

Table 2. Results of ADF Tests

	PAR	REBAR	HRC
Intercept	-18.04640*	-13.08338*	-17.52043*
Trend and Intercept	-18.02024*	-13.06860*	-17.51824*

* *means ADF test results are statistically significant at 1% level.*

VAR models, developed by Sims (1981), are utilized when the endogeneity of the variables are not certain. The mathematical expression of VAR model including two variables can be shown as Equation 5 and Equation 6. These equations describe the assumption of a model consisting of time series like y_t and z_t where present values of the both variables (y_t, z_t) affected by the past values of itself and the other variable (Barışık and Kesikoglu; 2006).

$$y_t = b_{10} - b_{12} z_t + \gamma_{11} y_{t-1} + \gamma_{12} z_{t-1} + \varepsilon_{yt} \quad (5)$$

$$z_t = b_{20} - b_{12} y_t + \gamma_{21} y_{t-1} + \gamma_{22} z_{t-1} + \varepsilon_{zt} \quad (6)$$

Granger causality tests are sensitive to lag lengths and determination of optimum lag lengths for each variable is important. Therefore, optimum of lag lengths are found by using Akaike Information Criteria (AIC), FPE (Final Prediction Error), HQ (Hannan-Quinn) and SC (Schwarz) criteria. Granger causality tests are realized by testing the regression models given in Equations 7 and 8 (Tarı, 2002:269):

$$Y_t = \alpha_0 + \sum_{i=1}^{n} \beta_i X_{t-i} + \sum_{i=1}^{n} \alpha_i Y_{t-i} + u_i \quad (7)$$

$$X_t = \beta_0 + \sum_{i=1}^{n} \alpha_i Y_{t-i} + \sum_{i=1}^{n} \beta_i X_{t-i} + u_i \quad (8)$$

The hypothesis tested in in the equations are as follows:

$H_0 : \sum \beta_i = 0$ (There is no Granger causality running from X to Y)

$H_1 : \sum \beta_i \neq 0$ (There is a Granger causality running from X to Y)

The results are supported by impulse response function (Pesaran and Shin, 1998) and variance decomposition in VAR analysis. Impulse response functions show the reaction of a variable to the changes in another variable in a specific time. The changes are measured as one standard deviation shock of the affecting variable. Variance decomposition is the extent of the effect each variable contributes to other variables in VAR models. Variance decompositon shows how much of the change in a spesific variable can be explained by the impact of the other variable.

IV. EMPIRICAL ANALYSIS AND RESULTS

Optimum lag lengths for FPE, AIC, SC and HQ information Criteria are shown in Table 3. VAR(x) symbolizes the best suitable lag length of VAR models that will be formed for each variable. The optimal lag lengths of VAR models are determined by considering the results of FPE, AIC, SC and HQ.

Table 3. Optimum Lag Lengths for FPE, AIC, SC and HQ information Criteria

Inf. Criteria	REBAR	HRC
FPE	1	8
AIC	1	8
SC	1	1
HQ	1	8
VAR (**x**)	**1**	**8**

Table 4 shows the results of the VAR analysis performed to decipher the explaining power of EUR/USD parity for rebar and hot rolled coil prices. The results indicate that the volatility in PAR is reflected in the reinforcing bar prices in the first period. Optimal lag lengths shown in Table 3 support VAR analysis findings. A change observed in PAR has an impact on REBAR and 1% of increase in PAR causes 0,45% of increase in REBAR. Rebar prices adopt the change caused by currency volatility and stabilized in the following seven periods. Rebar is commonly used in a single major industry: construction. The behavior of REBAR may reflect the response of construction sector to currency volatility which stabilizes after a certain time period. However, VAR analysis results of HRC and PAR are mixed. The first impact of PAR on HRC is observed in the second period and the effects are obvious during eight periods. 1% of increase in PAR causes 0.31% of increase in HRC in the second period. The same impact is 0.02%, 0.48%, 0.24% and 0,03% in the third, fourth, fifth and sixth periods. The mixed effect of PAR on HRC is an interesting price behaviour and this may stem from the different responses of different industries where HRC is used.

Table 4. Results of the VAR Analysis

	PAR(-1)	PAR(-2)	PAR(-3)	PAR(-4)	PAR(-5)	PAR(-6)	PAR(-7)	PAR(-8)	Adj. R squared	F statistic
HRC	-0.16014	0.308190	0.023686	0.486503	0.249476	0.030799	-0.52506	0.323656	0.15181	4.7139
	[-1.2449]	[2.3931]*	[0.1901]*	[3.8992]*	[1.9546]*	[0.2403]*	[-4.1101]	[2.4880]*		
REBAR	0.455901								0.15939	33.802
	[4.2046]*									

Values in in [ ] are values of t-statistics. * means test results are statistically significant at 10% level respectively.

The Results of Granger Causality Tests for steel prices and EUR/USD parity are given in Table 5. The results reveal that there is a Granger Causality running from PAR to REBAR. This outcome is consistent with the assumption that increases in EUR/USD parity is one of the causes of the increases in steel prices. There is a bidirectional causality between PAR and HRC. EUR/USD parity has a positive impact on HRC prices. The causality from HRC to PAR may stem from the wide usage of hot rolled coils in many industries affecting the demand and price of commodities. This result is interesting to show that prices of a single commodity providing raw materials to majority of industries have an effect on macroeconomic factors. Steel is the key commodity in our case.

Table 4. Results of Granger Causality Tests

Variables	Chi-sq	df	Causality
PAR-REBAR	17.67894	1	→
PAR-HRC	51.2921	8	↔

Variance decomposition analysis is also performed for the pairs of PAR-REBAR and PAR-HRC. It is seen that the estimation error variance of REBAR is due to 0.22% to the changes in PAR in the first period. 5.1% of the changes in REBAR stems from the volatility of PAR in the second period and 5.7% in the third period. The effect is in force and stable until the eighth period. When we consider average effect of PAR on rebar prices, it is seen that 5.17% of the change in REBAR depends on the changes in PAR for the eight period. Variance decomposition of PAR-HRC pair reveals that 5.97% of the changes in hot rolled coil prices are due to the changes of EUR/USD parity for the eight period on average. However, the effect of PAR on HRC is more sophisticated when compared with REBAR. In the first two periods 0.05% and 0.53% of the changes in HRC in due to the changes in PAR. The explanation power of parity volatility reaches as much as 12% in the seventh and eighth periods after fluctuating in the considered periods.

Table 5. Variance Decomposition of VAR Models

Period	PAR-REBAR	PAR-HRC
1	0.223736	0.048739
2	5.139822	0.526661
3	5.732104	2.027116
4	5.789965	1.988270
5	5.795267	5.862147
6	5.795744	7.138074
7	5.795787	7.408777
8	5.795790	10.04289
9	5.795791	12.33131
10	5.795791	12.33269
Average	5.1659797	5.9706674

After examining variance decomposition we perform impulse response functions which display the impacts of shocks of the proxies on the adjustment trajectory. Impulse response functions are important in assessing how shocks to variables are rebound in the system. Figure 2 shows the results of the impulse response functions analysis. It is observed that price series of REBAR and HRC react to the shocks on PAR in the system. However, the response time and endurance of the shocks are varied supporting the results of both VAR analysis and variance decomposition. The effects of the initial shock of REBAR to PAR are observed in the first period, restrained in the second period and disappeared in the fifth period completely. Response of the HRC to the shocks caused by PAR starts from the first period and exhibits a fluctuating pattern during the eight periods. Reinforcing bar and hot rolled coil prices are affected by currency volatility but exhibit different character concerning responses to exogenous shocks caused by currency behavior.

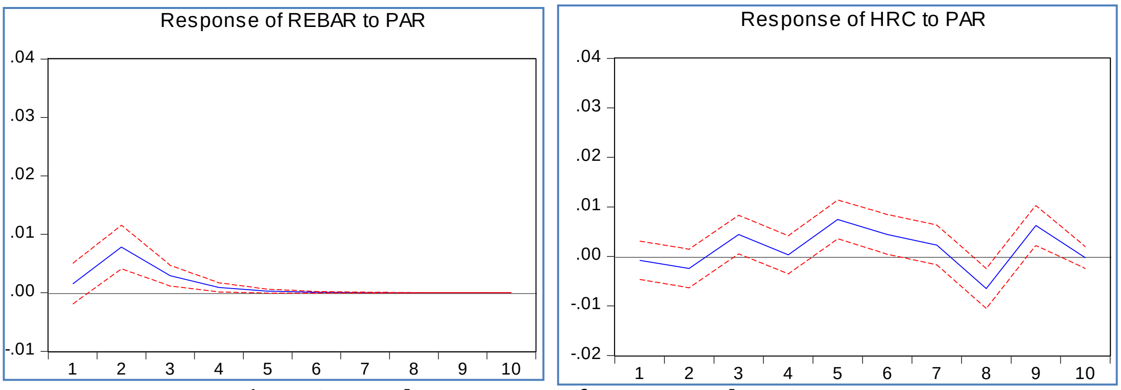


Figure 2. Impulse Responses of REBAR and HRC to PAR

V. CONCLUSION

The impacts of currency volatility on the steel prices of Turkey are investigated in this study. The paper provides empirical evidence that steel prices are affected by currency movements. This result has important implications for exchange rate policies, as exchange rates influence prices of steel which is a crucial commodity for industrialization. Steel prices are important for other manufacturing sectors as Turkey is in its steel-intensive phase of development. Turkish steel industry is highly internationalized industry (when export and import values are considered) and it transmits exchange rate fluctuations to domestic prices implying an integration with Europe and the rest of the world. The results indicate that currency volatility has impact on the steel prices, but the effects are varied for rebar and hot rolled coil prices. The examination of this mixed impacts may be considered in the future works. Another extension to this study would be the effects of currency volatility on steel using industries to get a more precise understanding of the impacts of steel prices.

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