THE ELASTICITY OF EXPORTING THE MINING & QUARRYING PRODUCTS TO FOREIGN EXCHANGE RATE CHANGES

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ABSTRACT

Elasticity examining the exporting the products to foreign exchange rates, has been subject to so many studies. Exports are expected to increase in the case of the depreciation of the domestic currency in the economies where exports and imports are sensitive to foreign exchange rate. While foreign currency appreciation increases the profitability of the firms also increases because their costs are in domestic currency. This paper investigates how exchange rate changes affect mining & quarrying exports in Turkey. In this paper we aim to identify the elasticity of mining & quarrying exports to dollar exchange rate changes. Mining & quarrying whose development are mostly dependent on nature sector exports which is predominantly sensitive to the dollar exchange rate, was tried to be analysed by using the least squares method. Data representing the exchange rate for monthly average dollar-selling prices between the years of 2005-2017, obtained from the data system of the TCMB (The Central Bank of the Republic of Turkey) is used. In addition this, export data denominated in dollars for mining & quarrying products for the same period, were also obtained from the TUIK (Turkish Statistical Institute). Data obtained from those for 156 periods were analysed through the SPSS statistical packaged software program. As a result, mining & quarry exports are sensitive to the dollar exchange rate and a 1% increase in dollar exchange rate increases mining & quarrying exports by approximately $ 8,8 million. Besides this result, a one percent (1%) standard deviation increase in dollar exchange rate leads to a 0.65 standard deviation increase in exports of mining & quarrying products. These findings are consistent with the literature on elasticity to foreign exchange rate changes.

***Keywords**: Elasticity, Foreign exchange rate, Exporting, Mining and quarrying products*

INTRODUCTION

Competitively, valued exchange rates are often seen as crucial to promote exports (Freund and Pierola, 2012; Eichengreen and Gupta, 2013). However, in the aftermath of the Global Crisis, some episodes of large depreciations appeared to have had little impact on exports (e.g. Japan). This has led some researchers to question the effectiveness of lower exchange rates (Financial Times, 2015).

The exchange rate is often discussed in macroeconomics because of its impact on the economy as a whole. Fluctuations in the exchange rate have large influences on wages, interest rates, prices, production levels, and employment. These variables have a large impact on people's everyday life and the standard of living.

The exchange rate and its ultimate effects on trade, national income, and welfare of a nation are of importance for policymakers. The size on the effects of changes in exchange rates is critical information for trade and exchange rate policymakers (Demirden and Pastine, 1995).

Economists have during a long period of time put emphasize on the relation between exchange rates and the trade balance. Since the middle of the twentieth century, there has been development in macroeconomic analysis that shows results on this issue. For an open economy, the reaction of the exchange rate fluctuations on the trade balance is important to understand because of the possibility to target the trade balance to get the optimal national income. Devaluation under a fixed exchange rate regime is typically expected to eliminate persistent trade balance deficits. A devaluation of the currency will decrease prices of the home country's exports abroad and increase the price of imports at home, inducing export quantity to rise and import quantity to decrease, thereby influencing the trade balance

positively. The impact of the exchange rates can be different in the long-run compared to the short-run due to the slow adjustment of the trade quantity to the new exchange rate level. A theory that explains this relationship and makes it easier to predict the outcome of devaluation or a depreciation of the exchange rate for policymakers is the theory of the J-curve. According to the J-curve theory, after a real depreciation or devaluation the trade balance is expected to deteriorate at first due to increased import value in terms of domestic currency due to sticky prices. Subsequently, over time the volume of export will increase and the volume of import will decrease when adjusting for the new exchange rate and the trade balance will then improve (Anderson and Styf, 2010).

Today, mining & quarrying sector is one of the emerging industries of Turkey. The Turkish natural stone sector is one of the most important economic sectors because it exports around $ 2 billion annually to 160 countries. The sector, which is among the top 5 countries in natural stone trade in the world, has grown about 100 times in the last thirty years and is ranked first in mine exports with a share of 50% (Altındag et al., 2017). In this paper, the elasticity of exporting the mining & quarrying products was tried to be measured against the exchange rate changes.

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

The Relationship Between Foreign Exchange Rate and Export

The sensitivity, or rather lack of, of prices to exchange rate movements has been well documented by Goldberg and Knetter (1997) and Campa and Goldberg (2005 and 2008) who provide estimates of the pass-through of exchange rates into import prices. There is also evidence indicating a decline in exchange rate pass-through to import prices in the U.S. On the quantity side, the elasticity of aggregate exports to real exchange rate movements is typically found to be low in industrialized countries, a bit below unity for example in Hooper, Johnson, and Marquez (2000) and above unity but rarely above 2 in others studies. In international real business cycle models, the elasticity used for simulations is typically between 0.5 and 2 (Berman et al., 2009).

While there is no evidence that an appreciation in the importing country would substantially increase imports for processing, there is both theoretical and empirical evidence indicating that exchange rate volatility between supply chain countries would deter processing trade. This effect arises because the service link cost for production blocks separated by national borders is an increasing function of risk and uncertainty, and exchange rate volatility increases risk and uncertainty. In a recent survey of Japanese MNCs, Ito et al. (2008) found that exchange rate stability between Asian currencies is essential for the uninterrupted flow of parts and components within regional production networks. Interestingly, exchange rate volatility may not be as harmful to production networks centered on the US. Turkcan and Keskinel (2009) examined the impact of exchange rate volatility on fragmentation in the US auto parts industry. Using DOLS estimation over the 1996–2008 period, they reported that exchange rate volatility has a positive but insignificant effect on US auto industry exports. Future research should investigate whether exchange rate volatility has different effects on production networks centered in East Asia and those centered in the US (Thorbecke, 2011).

The top four exporters in 2011 were China, USA, Germany, and Japan. China, USA and Japan have all been criticized for trying to depreciate their currencies to increase net exports (Beattie et al., 2012). How do exchange rates affect the exports of mining & quarrying products in Turkey?

The exchange rate is expressed as the rate of exchange of the two countries' money. While the exchange rate is determined at the point where the foreign exchange supply and the foreign exchange demand are balanced by a classical approach, it is influenced in two ways by the decisions of international economic decision-makers, especially central banks.

One of the major problems that developing countries face in their growth process is the current account deficit. While imports, which are increasing due to economic growth in developing countries, cause a decrease in foreign exchange stabilities; economic managers, especially the central bank, prefer to apply the most favorable exchange policy for their countries. While the spot exchange rate level may affect other economic variables in the economy, the two-way causality relationship between exchange rate and foreign trade has been emphasized in many studies (Karacor and Gercekler, 2011).

The relationship between the value of domestic money and foreign trade is examined with the help of the Marshall-Lerner condition. According to this condition, if the sum of the sensitivity of imports and exports to exchange rate is more than one, the exchange of value of domestic money against foreign currencies affects the foreign trade of the country. If the condition occurs, the depreciation of the domestic currency will make the price of the country's goods relatively cheap and will lead to an increase in exports. The relationship between exports and the exchange rate has been studied by many economists in the world and Turkey. In these studies, many methods have been used, from Regression models to VAR models, from Co-integration tests to Conditional variance models.

Several studies have been done within this subject on how exchange rates affect the export and foreign trade. Different researchers have different ways to assess the impacts of exchange rate. Yurtoglu (2017) investigated export elasticities. She used the Granger Causality Test as her theoretical foundation. She reported that while there is a long-run relationship between real exchange rate and exports, no short-term relationship was found. Barısık and Demircioglu (2006) also investigated export elasticities for export. They used the full convertibility model for their theoretical foundation. They found that there is a weak relationship between exchange rate and exports. Arize (1994) employed the co-integration test to estimate foreign trade elasticities. He reported that there has been a long-term relationship in the same way determined between the Real Exchange Rate and Foreign Trade. A literature table on the work done on the subject in Turkey and in the world is given below:

Table 1. Summary of Literature

Researcher	Model	Results
Yurtoglu, Y., (2017)	Granger Causality Test	While there is a long-run relationship between real exchange rate and exports, no short-term relationship was found.
Karacor, Z., Gerceker, M., (2011)	Vector Autoregressive Model	Two-way causality relation between real exchange rate and foreign trade volume was determined.
Aktaş, C., (2010)	Vector Autoregressive Model	There is no relation between real exchange rate and foreign trade.
Altıntaş, H., Öz, B., (2010)	Vector Autoregressive Model	There is no negative correlation between exchange rate volatility and exports.
Barısık, S., Demircioglu, E., (2006)	Full Convertibility	There is a weak relationship between exchange rate and exports.
Gul, E., Ekinci, A., (2006)	Co-integration Test	Co-integration was detected between the real exchange rate and exports.
Yılmaz, O., Kaya, V., (2007)	Vector Autoregressive Model	A change in the real exchange rate has no statistically significant effect on foreign trade.
Arize, A., (1994)	Co-integration Test	There has been a long-term relationship in the same way determined between the Real Exchange Rate and Foreign Trade.
Akhtar, M.A., & Hilton, R.S., (1984)	Regression Model	There is a negative relationship between the exchange rate and the balance of foreign trade.
Zhe, W., (2005)	Co-integration Test	There is a permanent relation between real exchange rate and balance of foreign trade.
Lee. K., & Saucier, P., (2003)	ARCH-GARCH Method	There is a negative relationship between the nominal exchange rate and the balance of foreign trade.

Export of Mining and Quarrying Products

Turkey is a developing open economy with about 80.8 million inhabitants (TUIK, 2017), GDP Growth rate 11.1% (TUIK, 2017) and annual per capita income at current market prices equal to $14,117 in 2016 (World Bank, 2016), and it is surviving in an unstable region.

Exports and imports of goods and services are significant sectors in Turkish economy. When we look at Turkey's exports on a sectoral basis, the mining sector's contribution to the national economy compared to the previous year showed the highest increase (23.8%). According to data from 2017, the share of Turkey's exports constitute the main Industry group (77.4%), Agriculture (13.5) and Mining (3.1%), respectively (TIM, 2018).

Table 2. Turkey's Sectoral Export Figures

Sector	Amount (1000$) 2016	Amount (1000$) 2017	Variation (%)	Share (%)
Agriculture	20.211.119	21.235.089	5,1	13,5
Industry	107.600.041	121.392.773	12,8	77,4
Mining	*3.787.244*	*4.688.011*	*23,8*	*3,1*
Total	**131.598.404**	**147.315.873**	**11,9**	**94**
Exemption from Registration of Exporters' Associations	10.471.157	9.466.385	-9,6	6,0
T OTAL (TIM+TUIK*)	**142.069.560**	**156.782.257**	**10,4**	**100,0**

** First month for January – December period TUIK, Last month TIM number were used*

The share of the mining and quarrying sector in the gross domestic product in Turkey has declined relatively nominal by years. The gross domestic product ratio of the sector, which was 1.09 in 2012, declined to 0.82 by the year 2016 (http://www.mta.gov.tr/v3.0/bilgi-merkezi/maden-dis-ticaret, 30.01.2018).

Table 3. Share of Mining & Quarrying in GDP by Years

Years	Mining & Quarrying (TL)	GDP (TL)	Mining & Quarrying / GDP (%)
2016	21.369.179.272	2.608.525.749.333	0.82
2015	19.255.080.173	2.338.647.493.683	0.82
2014	19.409.823.725	2.044.465.875.822	0.95
2013	19.419.988.447	1.809.713.086.703	1.07
2012	17.117.464.397	1.569.672.114.915	1.09

The natural stone and mining export figures of Turkey in the last 5 years are given in Table 4. When these data are examined, it has been seen that the share of natural stone exports in total mining exports is between 43-49%. The rate of exports of natural stone in mining exports was the lowest (43.7%) in the year 2017, the highest (48.9%) in the year 2015. In 2013, mining exports reached the highest level with $5,034,886,000. Natural stone export amount realized in the same year is $2,222,387,000 (IMIB, 2017).

Table 4. Distribution of Turkey's Mining & Natural Stone Exports by Years

Years	Natural Stone Export (*1000$) (A)	Mining Export (*1000$) (B)	(A/B) * 100 (%)
2017	2.048.049	4.688.240	43,7
2016	1.815.599	3.787.505	47,7
2015	1.906.251	3.895.258	48,9
2014	2.128.230	4.641.566	45,9
2013	2.222.387	5.034.886	44,1

RESEARCH METHOD

Sample and Data Collection

In this paper, data representing the exchange rate for monthly average dollar-selling prices between the years of 2005-2017, obtained from the data system of the Central Bank is used. In addition this, export data denominated in dollars for mining & quarrying products for the same period, were also obtained from the Turkey Statistical Institute. Data obtained from those for 156 periods were analysed through the SPSS statistical packet program.

Analyses

At the beginning of the analyses, a linear model was established in which the logarithm of the independent variable is the dollar exchange rate and the dependent variable is the mining & quarry export data, by using the least squares method.

Findings

In this paper, weighted least squares method (WLSM) is conducted to test the elasticity of exporting the mining and quarrying products to foreign exchange rate changes.

In accordance with the analyses results, research model is being shaped as it has been shown at Figure 1 below:

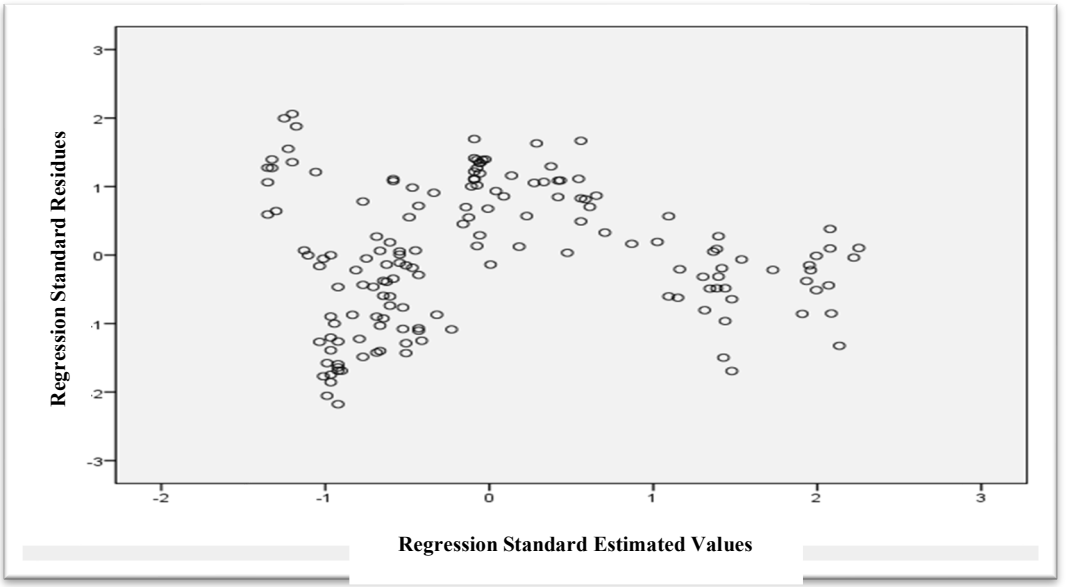

Figure 1. Scattering Diagram for Model Residuals

Although there is a positive relationship between the exchange rate and export data in accordance with the general theoretical model, the perfusion of the residues showing too much scatter seen in Figure 1 reveals the problem of varying variance. One of the important assumptions of the least squares method is the unchanging variance status. According to this assumption, the variance of the error terms must remain constant against the changes of independent variables (Tarı, 2008: 173). If the variances change, our model coefficients and coefficients tests will lose their meaning. In literature, weighted least squares method is recommended for the correction when the varying variance problem is encountered (Tarı, 2008: 187). In the weighted least squares method, where the error variance is not known, it is assumed that the dependent variable is proportional to the square of the expected value.

In this paper to obtain the weighting factor residuals are estimated initially by using least squares method, then these residuals are made a dependent variable and the expected values of the dependent variable are estimated.

Table 5. Model Results with Residuals as Dependent Variables

Independent Variables	F Value	F Sig.	T Value	T Sig.	β	Standardized β
Log dollar exchange rate	23.094	.000	13.617	.000	-2,709,070	-.361

When the model results that residuals are dependent variables, are examined T Sig. value for independent variables and F Sig. value for model integrity is less than ,05. Therefore these results are statistically significant. Expected values of model result are estimated, these values (by taking 1/square of the expected value) were used to obtain the weighting coefficient. With this coefficient, a new model without changing variance problem is estimated by re-using the weighted least squares method.

Table 6. Weighted Least Squares Coefficients Results

Independent Variables	T Value	T Sig.	β	Standardized β
Log dollar exchange rate	25.378	.000	8,814,570.434	.656

In Table 6 by using weighted least squares method a new model is estimated in which the independent variable is the dollar exchange rate, and the dependent variable is the exports. Due to T distribution probability value, lower than .05, the beta value was statistically significant. In other words, one percent (1%) increase in dollar exchange rate increases the export of mining and quarrying products by nearly 8,8 million dollars. In addition, a one percent (1%) standard deviation increase in dollar exchange rate leads to a 0.65 standard deviation increase in exports of mining & quarrying products.

Table 7. Weighted Least Squares Model Results

Independent Variables	F Value	F Sig.	Adjusted R^2	Durbin Watson	Estimated Standard Error
Log dollar exchange rate	116.265	.000	.426	.65	1.183

Table 7 shows the basic statistical results of the model obtained using the weighted least squares method. According to these results, the model is meaningful as a whole because F test probability value is less than .05. The adjusted R2 value is .426. This value indicates that 42% of the changes in exports of mining and quarrying products can be explained by the dollar rate. The small amount of the standard error in the model also shows the realism of the model.

Table 8. Weighted Least Squares Methods Basic Statistical Results of Residuals

Independent Variables	N	Skewness	Kurtosis	Mean	Variance
Log dollar exchange rate	156	-.219	-.829	-3.4020	3.79

One of the important assumptions of the least squares method is the normal distribution of model residuals. The normal distribution of model residues was investigated with the help of values of Kurtosis and Skewness. When the values of Kurtosis and Skewness given in Table 4 are examined, it seems to be in the range of normal accepted values (±1.5) (Tabachnick & Fidell, 2013).

CONCLUSION AND DISCUSSIONS

Exports are expected to increase in the case of the depreciation of the domestic currency in the economies where exports and imports are sensitive to foreign exchange rate. While foreign currency appreciation increases the profitability of the firms also increases because their costs are in domestic currency. As a result, firms that prefer to maintain the same profitability can achieve an international competitive advantage by lowering their product/service prices. While there are many policies such as R&D, innovation, export incentives in the increase of exports, the reason why the most debated relationship is foreign exchange policy is that the depreciation of domestic currency in a controlled way starting with China in the world is successful in increasing the exports. By this way, China's exports in 2017 reached 2.3 trillion dollars.

In this paper, mining & quarrying whose development are mostly dependent on nature sector exports which is predominantly sensitive to the dollar exchange rate, was tried to be analysed by using the least squares method. As a result, mining and quarry exports are sensitive to the dollar exchange rate and a 1% increase in dollar exchange rate increases mining & quarrying exports by approximately $ 8,8 million. When the central bank data is examined, the dollar exchange rate, which was 1.36 TL in January 2005, has been reached to 3.80 TL at the end of February 2018. The fact that dollar exchange rate increased by 2.8 times in 13 years shows that the exchange policy applied in the country or by the result of the world finance conjuncture is in favour of the mining and quarrying sector. The sector should support these developments with their own work and target more market share. Although there are so many studies examining the elasticity to foreign exchange rate in literature; the elasticity of the mining & quarrying sector exports to dollar exchange rate is examined and revealed for the first time through that study, which differentiates this study from others.

However, this study is conducted on mining & quarrying sector of Turkey; findings might not be transferable to all sectors. Thus, it is recommended that further researches can be conducted on other sectors and, also in different foreign exchange rates for the generalizability of findings.

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