The Impact of PHP Exchange Rate Movement on Export Levels from 2005 - 2014: The Case of the Philippines

Frederick P. Romero
De La Salle University Manila, Taft Avenue, Manila
Miriam College, Katipunan Avenue, Quezon City

Abstract— **This paper explores the effects of export level movements to the PHP exchange rate volatility for the period 2005-2014. These two variables have been used by various analysts, investors, regulators and policy-makers as important variables in explaining the economy of countries. The paper used historical monthly time series of PHP exchange rate and export levels in the Philippines from the period January 2005 up to December 2014. Stationary test and differencing methods have been done to address the stationarity issues of time series data. The study employed the LaGrange-Multiplier Test of ARCH Test and the Exponential Generalized Autoregressive Conditional Heteroskedasticity (EGARCH) to test the variables heteroskedasticity and the Granger Test for Causality in order to test the variables' causation. The results shows that, the export level has no significant effects on the PHP exchange rate, and vice versa. The historical movement of the Philippine export level has no significant causal effect on the movement of PHP exchange rate, and vice versa. The result of this study implies that the appreciation or depreciation of the Philippine peso does not provide any benefits or adverse effects on the export level of the Philippines and the increased or decreased level of export levels is not an important function in the determination of the PHP exchange rate.**

Keywords- Exchange rate; Export; ARCH Test; Granger Causality test

I. INTRODUCTION (HEADING 1)

During the last few decades, the level and extent of international trade has been a major function of the total world output. Although the developed countries such as United States, China and some European countries have been the major players in the international trade, the world has witnessed the emergence of developing countries such as the Philippines as vital trading centers through the growing role of high-technology exports and global supply chains (Cheung & Sengupta, 2013). The term export is defined as the movement or shipment of goods, or sometimes services, out of the legal jurisdiction oa a certain country. In international trade, the term export means the selling and distributing of goods and services that are produced or offered in the home/host country to other countries or markets.

On the other hand, a country's exchange rate or the real exchange rate is regarded as of the most important reflection of an economy's current situation; thus, it plays an important role on the country's foreign trade developments. Bakhromov (2011) suggested that a country's exchange rate movements have a substantial effect on exports and imports levels.

Yulu & Chen (2008) mentioned that according to the economic theory, the increase in value of a country's legal tender would provide negative effects on its export level and thus, adversely impact the country's international trade. They added however that given the different characteristics and conditions of the economies, the impact of appreciating currency may provide different effects a country's export levels.

According to Melitz & Ottaviano (2008) the exchange rate volatility and export level has substantial relationship with each other. They reported that the impact of currency level on the value of export of a country can be explained into two parts, namely the intensive and the extensive margins. The intensive margin effect suggests that the prices of exports in the international trade are positively affected by the currency appreciation. However, this would result to depreciation in the free on board (FOB) export price due to incomplete pass-through. This decreasing effect will result to a lower FOB export revenues to fall (the intensive-margin effect). On the other hand, the extensive margin theory suggested that the exporters themselves differ in terms of production efficiency and performance. Some exporters perform poorer than others, thus affecting their export profits. When this happens, the management may choose to exit the foreign markets (the extensive-margin effect).

In terms of diversifying production and investments, many argued that the uncertainty in exchange rate movements make businessmen to become more risk averse about their production and market segmentation. Businessmen tend to move their production or revenue sources to countries with less exchange rate risk which may ultimately impact the international trade, specifically export, negatively (Ozturk and Acaravci, 2002; Hatirli and Onder, 2010 and Sever, 2009).

However, various literatures (Kihangire, 2005; Fang & Miller, 2007; Vergil, 2002 & Saatcioglu & Karaca, 2004) suggested that the changes in currency movement provide positive impact on international trade (export) given that the volatility in the currency movements provides an avenue for the businessmen to make more profit. The literature added that

DOI: 10.5176/2010-4804_4.3.385

any increase in the currency risks can provide increased profit opportunities to the parties involved.

Given the above, this paper ultimately would like to know if the movement of the export level has something to do with the volatility of the PHP exchange rate. The remainder of the paper proceeds as follows. The Section 2 provides a short review of literature concerned between the variables used in this study. Section 3 explains the data to be used, data sources and methodology. The data description and the empirical results are presented in Section 4. Then, the conclusion of the study is described in Section 5. Lastly, Section 6 provides the limitations and recommendations for future researches.

II. Review of Related Literature

The topic of the relationship between export level and currency movement has been covered by numerous studies across developed and emerging countries from different time period and different contexts. However, there have been differencing results across the studies which suggest that we cannot have a general prediction on how the two variables affect one another.

There are a handful of studies that proved exchange rate's movement impacts the size and improvement of international trade in mature markets (Onafowora & Owaye, 2008; Byrne, Darby & McDonald 2008; Choudhury, 2005; Bahmani-Oskooee, 2005). In contrast, some studies suggest otherwise (Doyle, 2001; Chou, 2000 and Qian & Varangis, 1994)

Using a three-monthly data from 1980-1996, Doganlar (2002) found out that, using the exchange rate and exports level in Turkey, South Korea, Malaysia, Indonesia and Pakistan, there is a negative directional relationship between exchange rate fluctuations and real exports in these countries.

On the other hand, Kroner and Lastrapes (1993) used a multivariate generalized autoregressive conditional heteroskedasticity (GARCH)-in-mean model of the reduced form of multilateral export market in order to investigate the relationship between the export flows and prices and the nominal exchange-rate movements in developed countries such as the United States, UK, France and Germany. The results show that exchange-rate volatility significantly discourages export volumes of the countries used in the study.

On a different methodology for the export and exchange rate data in India, Malaysia and South Korea, Doorodian (1999) measured the variables' volatility using autoregressive moving average (ARMA) residuals and also as conditional variances generated from GARCH models. The paper found out that there is a negative relationship between exchange-rate risk and export volume.

Using another methodology, Bahmani-Oskooee (2002) looked at the Iran setting using the Johansen method and the black-market exchange rate rather than frequently used official rates. The paper found out that the Iranian trade flows are significantly reduced by the movements from the black-market exchange rates.

In addition to this, Hall et al. (2010) studied the relationship between exchange rates and export levels from ten emerging economies and eleven developed countries using panel data estimation models. The study suggested that the relationship between variables is negatively significant, which proved the adverse effects of variability in exchange rates to level of exports of the developing countries.

Saatcioglu and Karaca (2004) also obtained similar results when looking at the monthly data for the 1981–2000 time periods. The export level was negatively affected by the real exchange rate volatility using the co-integration method. The negative effect is also evident in a short term time frame using the error correction method. The study ultimately obtained a statistically significant relationship of 10% in a negative direction for the variables used.

Similarly, Ozturk and Acaravci (2002) examined the impact of currency appreciation on export level in Turkey from 1989 up to 2002 on a monthly time period. The result shows that there is an inverse relationship between the variables used where in the decreased level of export demand is caused by the appreciation in the Turkey's exchange rate.

Lastly on negative effects, Doganlar (2002) used the moving standard deviation of the real exchange rate for the measure of volatility in selected countries and found out that exchange rate variability adversely impacts the export levels in Turkey, South Korea, Malaysia, Indonesia, and Pakistan.

In contrast, Asseery and Peel (1991) found positive relationship between the exchange rate and export levels in selected countries. The study examined the reaction of the export volume to income, relative prices, and volatility using the data from 1972 up to 1987 of Japan, West Germany, the United States, the United Kingdom (UK), and Australia. The authors pointed out the importance of looking at the stationarity issue of the variables which the previous studies neglected that may hamper the results. The study then obtained results showing that the volatility of the exchange rate has a desirable impact on export levels of the selected countries.

In relation to the above study, the paper by Fidan (2006) also found positive effect of exchange rate volatility to the movement of export level. The study looked at the agricultural export level using the Granger Causality Test, the Vector Autoregressive (VAR) Model and the co-integration test. The variables used are historical year-end data from 1970-2004 data range. The study provides evidence that there is a one-way causality from the real exchange rate to agricultural exports. The paper further explained that a one unit change in the real exchange rate impacts the agricultural exports in a positive way in the first five years.

Lastly, Dekle, Jeong and Ryoo (2008) found insignificant relationship between the elasticity of exports with respect to exchange rate. The impact of the variables to each other was found to be statistically indifferent from zero for each of the G-7 countries using the date from 1982-1997 time periods.

III. Methodology

Research Goal

This paper examines the impact of the export levels movement on the volatility of the currency exchange rate in the Philippines. The study used historical time series data of the

given variables from January 2005 to December 2014 as sourced from the Bangko Sentral ng Pilipinas website and other financial information database (e.g. Bloomberg, Factset, etc.). The research goal is to establish if the export level is an important factor in causing the variability of the PHP exchange rate for the given time period.

Unit Root test

Unit root test will be employed in order to test if the data set is stationary. Stationarity of data can strongly influence the dataset's behavior and properties; stationarity in data can provide spurious regression. Many suggest that if there are two variables and both are trending over time, a regression of one variable on the other variable could result to a high R^2 even though the variables are totally unrelated. Furthermore, if there are non-stationary variables in the regression model, the standard assumptions for asymptotic analysis will be invalid.

To test for the stationary of the variables, this paper will use the Augmented Dickey Fuller (ADF) test of unit root to test for the stationary of data. The process of differencing will then be done if the data sets are non-stationary.

Autoregressive Conditional Heterskedastic (ARCH)/ exponential general autoregressive conditional heteroskedastic (E-GARCH)

The ARCH models are being utilized to describe and model time series data such as export levels and exchange rate movement. The GARCH model or process was developed to define further a process to estimate financial market volatilities. This model is preferred by financial modeling practitioners since it gives a more realistic context as compared to other forms when trying to estimate the prices and rates of financial instruments or macroeconomic variables. The GARCH model is often being done by a three-way process. First, a best-fitting autoregressive model should be estimated. Second, the autocorrelations of the error term is calculated. Lastly, the significance will then be tested.

The GARCH model has the nonnegative constraints on the parameters, α_i and β_j, while there are no restrictions on these parameters in the EGARCH model. In the EGARCH model, the conditional variance, σ_t^2, is an asymmetric function of lagged disturbances ϵ_{t-i}. The EGARCH model has 2p,q,2 parameters and is expressed as EGARCH(p,q):

$$x_t = \mu + a_t$$

$$\ln \sigma_t^2 = \alpha_0 + \sum_{i=1}^{p} \alpha_i \left(\left| \varepsilon_{t-i} \right| + \gamma i \varepsilon_{t-i} \right) + \sum_{j=1}^{q} \beta_j \ln \sigma_{t-j}^2$$

$$a_t = \sigma_t \times \varepsilon_t$$

$$\varepsilon_t \sim \mathrm{P}_\nu(0,1)$$

Where:

- x_t is the time series value at time t.
- μ is the mean of GARCH model.
- a_t is the model's residual at time t.
- σ_t is the conditional standard deviation (i.e. volatility) at time t.
- p is the order of the ARCH component model.
- $\alpha_o, \alpha_1, \alpha_2, ..., \alpha_p$ are the parameters of the the ARCH component model.
- q is the order of the GARCH component model.
- $\beta_1, \beta_2, ..., \beta_q$ are the parameters of the the GARCH component model.
- $[\epsilon_t]$ are the standardized residuals:

$$[\varepsilon_t] \sim i.i.d$$

$$\mathrm{E}[\varepsilon_t] = 0$$

$$VAR[\varepsilon_t] = 1$$

- P_ν is the probability distribution function for ϵ_t. Currently, the following distributions are supported:

Normal distribution P_{\nu} = N(0,1)

Student's t-distribution: $P_\nu = t_\nu(0,1)$ where: $\nu \succ 4$

Generalized error distribution (GED): $P_\nu = GED_\nu(0,1)$ where: $\nu \succ 1$

Granger Causality Test

According to various literatures, the term "Granger causality" is a term to denote the notion of causation in a time – series analysis. The Granger Causality test can provide inference to know if variable *X* can Granger-cause (G-cause) *Y* statistically significantly. This would mean that the information about *X* helps predict the future values of *Y*. To be more specific, a data *X* Granger-causes *Y* if the value *Y* can be predicted using the historical data of both *X* and *Y* than it can when using the history of *Y* alone.

According to this test, there are three results that can be obtained namely: uni-directional, bi-directional and non-directional (variables move in independent direction).

IV. Results and Discussion

TABLE 1: Descriptive Statistics of Factors

	Exchange Rate	Exports
Original		
Mean	46.244	6508.782
Standard Deviation	4.132	1486.966
Median	44.941	6378.259
Minimum	40.360	3593.022
Maximum	56.160	9835.206
Transformed		
Mean	-	80.150
Standard Deviation	-	9.245
Median	-	79.863
Minimum	-	59.942
Maximum	-	99.173

Table 1 presents the Descriptive Statistics of the parameters of the study from Year 2005-2014. To normalize the data, current accounts (exports) were transformed using square root and logarithmic methods. After the transformation, the value of median (the central tendency when extreme values were treated with caution) became nearer to the actual mean.

Exchange Rate has an average of 46.244 ± 4.132. This variable ranges from 40.360 to 56.160. For Current account Exports, the average value is 6508.782 ± 1486.966 (transformed: 80.150 ± 9.245) and its minimum and maximum ranges from 3593.022to 9835.206.

	Without Differencing		
	T-stat	P-value	Interpretation
Exchange Rate	-2.143	0.228	Non-Stationary
Current account Exports	-1.802	0.380	Non-Stationary

	With Differencing			
	Order	T-stat	P-value	Interpretation
Exchange Rate	1	-12.085	0.000	Stationary
Current account Exports	1	-9.501	0.000	Stationary

Stationary Testing was done using Dickey-Fuller Test wherein $p<0.05$ indicates that the data is stationary; Otherwise non-stationary. Dickey-Fuller Test without Differencing (lag zero) presents a p-value above 0.05 on Exchange Rate and CA – Exports which means that these values are non-stationary. Therefore, the differencing will be used.

Collinearity was present on Exchange rate and Current account - exports. That is, the current value could have been affected by the values of the previous years. Through differencing, the variables are able to satisfy the assumption of stationarity.

FIGURE 1: TIME SERIES LINE OF EXCHANGE RATE BEFORE THE DIFFERENCING

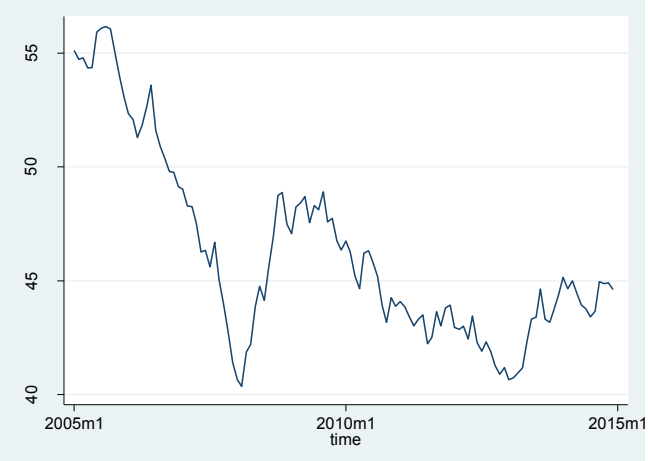

FIGURE 2: TIME SERIES OF EXCHANGE RATE AFTER THE DIFFERENCING

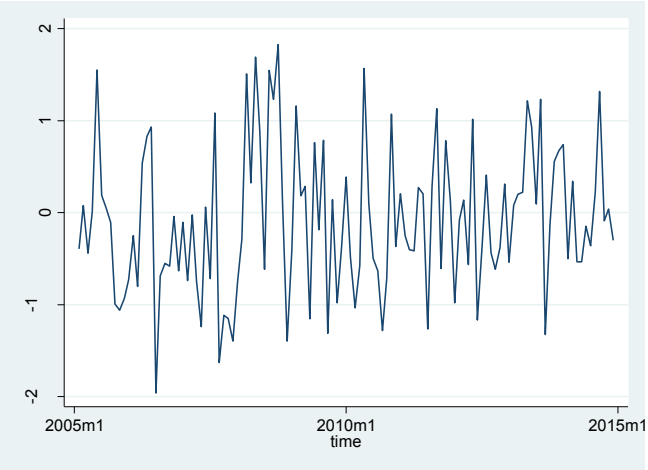

FIGURE 3: TIME SERIES LINE OF EXPORTS BEFORE DIFFERENCING

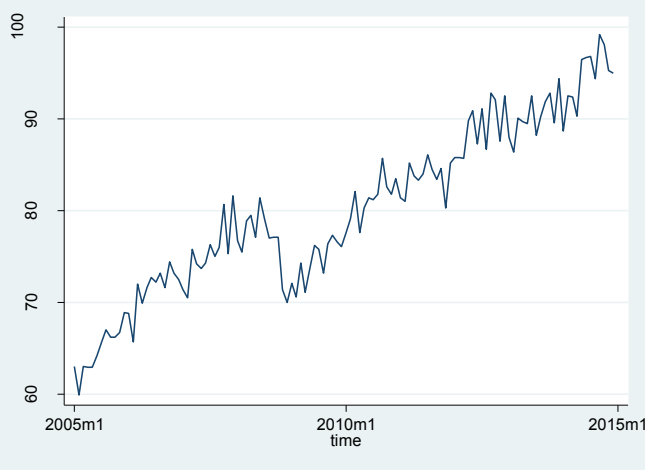

FIGURE 4: TIME SERIES LINE OF EXPORTS AFTER DIFFERENCING

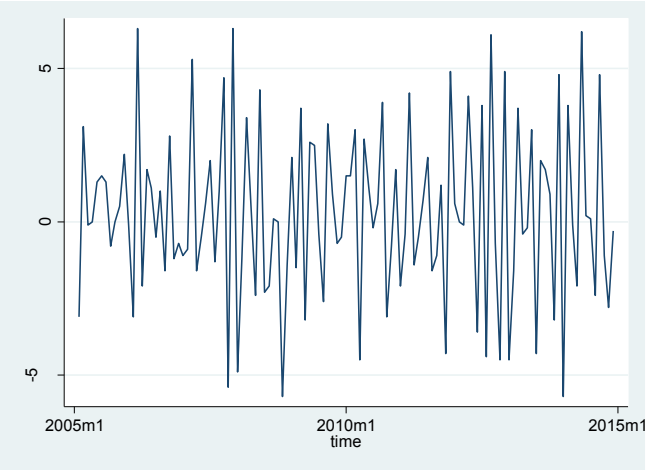

TABLE 2: THE LAGRANGE-MULTIPLIER TEST OF ARCH TEST FOR HETEROSCEDASTICITY.

	Chi-square Statistic	P-value	Decision
Current account Exports	0.031	0.861	Homoscedastic

This table presents the preliminary test for heteroscedasticity of a time series model. In STATA, it is advisable to test first if the data has an ARCH effect or none. If the p-value is above 0.05, null hypothesis is rejected and therefore conclude that there is no ARCH effect in the model which means that the model is Homoscedastic. Using the differenced values, the ARCH Effect was tested. The p-values of the 2 models are above 0.05 which means that there are no ARCH effects.

TABLE 3: THE EGARCH TEST
(ALL OF THE MODELS ARE AT FIRST ORDER DIFFERENCE)

Parameters:	Current account Exports
Constant	-0.169
Coefficient	0.014
P-value	0.589
ARCH	
EARCH	0.251
p-value	*0.012*
EARCH A	-0.111
p-value	*0.421*
EGARCH	-0.995
p-value	*0.000*

The table above presents the EGARCH model of Exchange Rate, Current account - Export. The positive value of EARCH indicates that an unexpected increase in Exchange rate is more destabilizing on Exchange Rate than its unexpected or sudden decrease. However, if the magnitude is lower than its symmetric effect (EARCH_A) therefore, symmetric affect in Exchange rate dominates than its positive asymmetric effect.

For CA Export, the positive value of EARCH indicates that an unexpected increase in Exchange rate is more destabilizing on Exchange rate than its unexpected or sudden decrease. Its magnitude is higher than its symmetric effect (EARCH_A) which means that asymmetric affect in both CA - Export dominates than its symmetric effect.

TABLE 4: THE GRANGE-CAUSALITY TEST

	Coefficient	**z-statistic**	**P-value**	**Decision**
CA – Exports and Exchange Rate	-0.078	-0.30	0.764	No Granger Causality
Exchange Rate and CA - Exports	0.173	1.85	0.064	

Table 4 presents the Granger-Causality of Exchange Rate to Current account (Export) and vice versa. The model above shows that there is no granger causality between parameters. Therefore, there is no causal effect between exchange rate and current account (export). For CA – Exports and Exchange Rate, a unit increase in CA – Exports leads to an decrease in Exchange Rate while a unit Exchange Rate also leads to an increase in CA – Exports.

V. CONCLUSIONS

Numerous studies have been done to test the effect of the export level to the currency movements and vice versa. Most studies are focused on developed countries; limited literature covers the emerging markets such as the Philippines. This paper revisits the same inquiry of how export levels affect the PHP exchange rate, and vice versa. The study specifically used monthly historical data of the Philippine export level and the Philippine Peso exchange rate from January 2005 to December 2014. The Augmented Dickey Fuller (ADF) test was employed to test the stationarity of the data. The LaGrange-Multiplier Test of ARCH Test and Exponential Generalized Autoregressive Conditional Heteroskedasticity (EGARCH) was used in determining the heteroscedasticity of the variables used. Lastly, the paper investigated the causation between variables using the Granger causality test.

Based from the outcome of the study, the author was not able to accept the alternative hypothesis that is, the level of export in the Philippines has a significant effect on the movement of PHP exchange rate. The Granger Causality test ascertained that there is no causal effect on Exchange Rate to Export level and vice versa. The movement of the export level cannot predict the historical and future movements of the PHP exchange rate.

The result of the study is different compared to most of the studies that covers the topic at hand that reported significant relationship between the variables used. However, the result in this paper is similar with Demez & Ustaoğlu (2012) which reported that export level is not affected by structural turnings in the sale of currencies. Demez & Ustaoğlu (2012) advised that the country's export level is not sensitive to the changes and structural breaks in currency rates.

One of the implications of the results of this study is that the Philippine economy, although has increasing level of exports during the last few decades, has low dependence on exports which may imply that export level cannot be significantly affected by exchange rate appreciation or depreciation. Looking at this, policy makers and regulators may look at other macroeconomic variables that may be used to promote or increase the export level in the Philippines. In addition, they can also look at other variables that can be significantly affected by PHP exchange rate volatility.

VI. LIMITATIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

The study covers only the time period from January 2005 up to December 2014 on a monthly time series data set. Future researchers may extend the time period to obtain a longer time frame for the study. In addition, the researcher can also look at short time horizon to look at the short-term impact of export

levels to the PHP exchange rate. The study used the export level and PHP exchange rate and determined the causation between the two variables. Future research may look at other variables that are affected by the variability of these two data sets and provide inference on the relationships that may be obtained. Lastly, the study employed Autoregressive Conditional Heterskedastic (ARCH)/ exponential general autoregressive conditional heteroskedastic (E-GARCH) for the test of heteroskedasticity and Granger Causality for the test of causation between variables. Further research may use other statistical tools in testing the heteroskedasticity and causation of variables to provide meaningful results as well.

VII. Acknoledgement

The author of this paper would like to extend his gratitude to Dr. Esterlita Romero, Ph.D. and Col. Florido Romero Jr. for the unending support and inspiration. In addition, the author would like to thank Ms. Angelica Fabillar for the guidance on the statistical tools used in this study and for the additional inputs on the data presentation and analysis.

References

[1] Asseery, A. & Peel, A. (1991). The Effects of Exchange Rate Volatility on Exports: Some New Estimates. *Economics Letters*, 37, 173–77.

[2] Bahmani-Oskooee, M. (2002). Does Black Market Exchange Rate Volatility Deter the Trade Flows? Iranian Experience. *Applied Economics*, 2249-2255.

[3] Bakhromov, N. (2011). The Exchange Rate Volatility and the Trade Balance: Case of Uzbekistan. *Journal of Applied Economics and Business Research JAEBR*, 1(3), 149-161.

[4] Byrne, J., Darby, J., & McDonald, R. (2008). US Trade and Exchage Rate Volatility: A Real Sectoral Bilateral Analysis. *Journal of Macroeconomics*, 238-259.

[5] Chen, Y. (2008). International Finance. *Beijing: China Renmin University Press*, 29.

[6] Cheung, Y. W. & Sengupta, R. (2013). Impact of Exchange Rate Movements on Exports: An Analysis of Indian Non-Financial Sector Firms. *Journal of International Money and Finance*, 39, 231–245.

[7] Chou, W. (2000). Exchage Rate Variability and China's Exports. *Journal of Comparative Economics*, 61-79.

[8] Choudhury, T. (2005). Exchage Rate Volatility and the United States Exports: Evidence from Canada and Japan. *Journal of Japanese and International Economies*, 51-71.

[9] Dekle, R., Jeongy, H. & Ryoo, H. (2007). A Microeconomic Analysis of the Aggregate Disconnect between Exchange Rates and Exports. University of Southern California, Mimeo.

[10] Demez, S. & Ustaoğlu, M. (2012). Exchange-Rate Volatility's Impact on Turkey's Exports: An Empirical Analyze for 1992-2010. *Procedia - Social and Behavioral Sciences*, 41, 168 – 176.

[11] Doganlar, M. (2002). Estimating the Impact of Exchange Rate Volatility on Exports: Evidence from Asian Countries. *Applied Economics Letters*, 9, 859–63.

[12] Doroodian, K. (1999). Does Exchange Rate Volatility Deter International Trade in Developing Countries? *Journal of Asian Economics*, 10, 465–74.

[13] Doyle, E. (2001). Exchage Rate Volatility and Irish-UK Trade, 1979-1992. *Applied Economics*, 249-265.

[14] Fang, W. & Miller, S. (2007). Exchange Rate Depreciation and Exports: the Case of Singapore Revisited. *Applied Economics*, 39(3), 273-277.

[15] Fidan, H. (2006). Impact of The Real Effective Exchange Rate (Reer) On Turkish Agricultural Trade. *International Journal of Human and Social Sciences*, 1(2), 70-82.

[16] Hall, S., Hondroyiannis, G., Swamy, P., Tavlas, G. & Ulan, M. (2010). Exchange Rate Volatility and Export Performance: Do Emerging Market Economies Resemble Industrial Countries or Other Developing Countries? *Economic Modelling*, 27, 1514–21.

[17] Hatırlı, S.A. & Onder, K. (2010). An Investigation of Real Exchange Rate Volatility On Turkish Textile and Apparence Export. *Anadolu University Journal of Social Sciences*, 10(2), 41-54.

[18] Kihangire, D. (2005). The Effects of Exchange Rate Variability on Exports: Evidence From Uganda (1988-2001). *International Trade*, ESRC workshop No: 0505013.

[19] Kroner, K., & Lastrapes, W. (1993). The Impact of Exchange Rate Volatility on International Trade: Reduced Form Estimates from a GARCH-in-Mean Model. *Journal of International Money and Finance*, 12, 298–318.

[20] Melitz, M. J. & Ottaviano, G. (2008). "Market Size, Trade, and Productivity, *Review of Economic Studies*, 75, 295-316.

[21] Onafowora, O. A., & Owaye, O. (2008). Exchage Rate Volatility and Export Growth in Nigeria. *Applied Economics*.

[22] Ozturk, I. & Acaravci, A. (2002). The Effects of Exchange Rate Volatility on the Turkish Export: An Empirical Investigation. Review of Social, *Economic and Business Studies*, 2, 197-206.

[23] Qian, Y., & Varangis, P. (1994). Does Exchange-Rate Volatility Hinder Export Growth ? Additional Evidence. *Empirical Economics*, 138-148.

[24] Saatcioglu, C. & Karaca, O. (2004). The Impact of Exchange Rate Uncertainty on Exports: The Case of Turkey. *Dogus University Journal*, 5(2), 183-195.

[25] Sever, E. (2009). Uncertainty of Real Exchange Rate Effects on Trade Performance: The Case of Turkey. *Journal of Entrepreneurshıp and Development*, 2, 105-134.

[26] Vergil, H. (2002). Exchange Rate Volatility In Turkey And Its Effect on Trade Flows. *Journal of Economic and Social Research*, 4(1), 83-99.