The Empirical Analysis of Relationship between Exchange Rate Volatility and Stock Prices Volatility, the Combination of Garch and Ardl Models

Majid Maddah[1] --- Mehrnaz Mahrou[2]

[1]*Associate Professor, Economic Department, Faculty of Economic, Management and Administrative Sciences, Semnan University*
[2]*MA in Economics, Semnan University*

(Corresponding Author)

ABSTRACT

Exchange rate is one of the effective factors on stock prices. In this paper has been investigated the effect of informal exchange rate volatility on stock prices volatility based on the daily data from 2007 to 2011 using the General Autoregressive Conditional Heteroscedasticity (GARCH) and Auto Regressive Distributed Lag Model (ARDL) in the Iranian economy empirically. The results from estimated models indicate that the informal exchange rate volatility has a negative and significant effect on stock prices volatility with coefficient (-0.411). Also the error correction coefficient in estimated Error Correction Model (ECM) is (-0.88) that shows is adjusted 84 percent of imposed shock by the informal exchange rate on stock prices in the short term.

Citation | Majid Maddah; Mehrnaz Mahrou (2016). The Empirical Analysis of Relationship between Exchange Rate Volatility and Stock Prices Volatility, the Combination of Garch and Ardl Models. International Journal of Economics, Business and Management Studies, 3(3): 136-142.

1. INTRODUCTION

The stock market has an important role in the allocation of internal and external resources. The boom of stock lead to more savings and as a result, more real investment in the various sectors. The changes of stock prices influence the investor motivation in the stock market. The performance of stock market is affected by the different factors such as profitability, risk, profit sharing policies and companies managers operation which can increase demand for the special shares. In the other hand, because is provided the part of companies need through import, thus the changes of exchange rate effect on the cost of companies. It also, influences the cost of imported goods, cash flows and profit of companies. In this regard, there are several question. How the volatility of exchange rate effect on stock prices and inverse? This paper, studies the relationship between volatility of exchange rate and volatility of stock prices in the Iranian economy during 2007 to 2011 using the month data in the framework of General Autoregressive Conditional Heteroscedasticity (GARCH) and Auto Regressive Distributed Lag (ARDL) Models.

2. LITERATURE REVIEW

The changes of exchange rate affect stock prices through the export and import channels. We can investigate the relationship between exchange rate and stock prices through the following relation:

$$\text{Value of Share} = \frac{EPS}{K}$$

Where the EPS denotes earning per share, the K is expected earnings by shareholders (to percent). Based on this relation, a reduction of exchange rate lead to the decease of EPS and also, the value of share. In contrast, an increase in exchange rate can lead to the raise of value of share. In the other hand, the cost of raw material purchasing will raise the following an increasing exchange rate. However. Whatever companies are more dependence to outside and use more raw material, operating costs increase more. The sudden changes of exchange rate impose shocks to companies so that they require to more working capital. In this condition, companies need to more financial resources in order to the purchasing of raw material. Other views, the changes of exchange rate influence the intrinsic value of the company and according to this, will change stock prices. If is imported machineries in low exchange rate, an increasing exchange rate promote the value of intrinsic value of companies which raise demand for shares and also, stock prices. In several researches have been studied the relationship between exchange rate and stock index.

Wu (2000) used an error correction model to explore of the asymmetric effects of four different exchange rate on Singapore stock prices. The findings from this study confirmed the asymmetric effects of four different exchange rates on the Singapore stock prices that effects' sensitivity depend to economic instability. Wälti (2005) explored the macroeconomic determinants of stock market synchronization and showed that trade and financial integration contribute posi-tively to synchronization, while a fixed exchange rate regime increases comovements, in particular when the institutional mechanism requires mutual interventions. Phylaktis and Ravazzolo (2005) studied the long-run and short-run dynamics between stock prices and exchange rates and the channels through which exogenous shocks impact these markets. They found stock and foreign exchange markets are positively related and that the US stock market acts as a conduit for these links. Hau and Rey (2006) developed an equilibrium model in which exchange rates, stock prices, and capital flows are jointly determined. Their finding showed that the net equity flows into the foreign market are positively correlated with a foreign currency appreciation. Mehrara (2006) examined the causal relationship between stock prices and macroeconomic aggregates in the Iranian economy and suggested that there is a unidirectional long run causality from macroeconomic variables to stock market. Therefore, the stock prices are not a leading indicator for economic variables.

Chkili (2012) investigated the dynamic linkage between exchange rates and stock market returns for BRICS countries using a regime-switching VAR model and found stock markets have more influence on exchange rates during both calm and turbulent periods.

Zakaria and Shamsuddin (2012) investigated stock market volatility and macroeconomics volatility by applying GARCH model in Malaysia and showed money supply volatility is significantly related to stock market volatility. While the volatilities of macroeconomic variables as a group are also not significantly related to stock market volatility. Islami and Welfens (2013) focused financial market integration and studied stock markets and exchange rate dynamics in Eastern Europe. Their findings showed the integration of the stock markets in Eastern European countries seems to be rather week except for the Hungarian stock market. This means that only the Hungarian stock market is integrated. Lnci and Lee

(2014) re- examined the relation between stock returns and exchange rate changes in five major European counties by taking into dynamic and found that there is a Granger causality from exchange rate changes to stock returns, and also for the reverse direction.

2.1. The Specification of Model

The General Autoregressive Conditional Heteroscedasticity (GARCH) model, is used in order to explore of exchange rate and stock prices volatilities. The GARCH is a model conditional variance where the error process follows Autoregressive and Moving Average Process (ARMA). Define:

$$\varepsilon_t = v_t \sqrt{h_t}$$

Where ε_t denotes the error term of series, $\{v_t\}$ is the white noise. In this relation $E_{t-1}\varepsilon^2{}_t = h_t$ which

h_t shows conditional variance of ε_t. It follows the following pattern:

$$h_t = \alpha + \sum_{i=1}^{q} \alpha_i \varepsilon^2{}_{t-i} + \sum_{i=1}^{p} \beta_i h_{t-i}$$

In the next step, the Auto Regressive Distributed Lag (ARDL) has been applied in order to the study of casual relation between volatilities of variables. The ARDL model defines as follows:

$$Y_t = \alpha + \sum_{i=1}^{q} \alpha_i Y_{t-i} + \sum_{i=0}^{p} \beta_i X_{t-i} + e_t$$

Where dependent variable is a function of its lags, independent variable and the lags of independent variable. In the step of estimation of models, the daily data of informal exchange rate and the Tehran Exchange Price Index (TEPIX) as the natural logarithm during the beginning 2007 has been used. Table (1) demonstrates the descriptive statistics of variables.

Table-1. The Descriptive Statistics of Variables

Index	Informal Exchange Rate (Rial)	Stock Index
Mean	10250.17	14880
Maximum	20800	27281.2
Minimum	1035	7955.4
Standard Deviation	1821.14	6429.64
Observations	1580	1580

Source: Results of Research

2.2. Empirical Analysis

At first, the stationary of variables is tested by applying the Augmented Dickey – Fuller (ADF) that results showed the informal exchange rate logarithm and exchange price index logarithm are stationary in the first difference. Since variables are integrated of order one, in the next step, the hypothesis of existence of long – run relation between variables is tested by the Johansen Cointegration method that results confirmed the existence of at least one long – run relation. According to this, we can use the informal exchange rate logarithm and stock index logarithm data level in the step of models estimation. In the following, it is necessary that the volatility of variables is estimated that for this purpose, the behavior of

variables is modeled in the framework of autoregressive process. Tables (2) and (3) indicate the results from the estimation of autoregressive process. According to the Akaike and Schwarz criterions, the number of optimal lags are 2.

Table-2. Estimation of Exchange Rate Autoregressive Process

The Significance Level	T Statistics	Coefficient	Variables
0.000	6.5	0.81	Intercept
0.000	20.37	0.46	LEXCH(-1)
0.000	19.65	0.44	LEXCH(-2)
	R-Squared=0.74	F-statistic=2247.9(0.00)	

Source: Results of Research

Table-3. Estimation of Stock Index Autoregressive Process

Variables	Coefficient	T Statistic	The Significance Level
Intercept	0.001	0.31	0.740
LTEPIX(-1)	1.31	54.36	0.000
LTEPIX(-2)	-0.31	12.87	0.000
R-Squared=0.99		F-statistic=2538261. (0.00)	

Source: Results of Research

In the next step, the ARCH – LM test was employed in order to the recognition of heteroscedasticity that Tables (4) and (5) indicate the results from test. According to the test statistic results, null hypotheses are rejected at the 5% level of significance which confirm the existence of Heteroscedasticity.

Table-4. Conditional Heteroscedasticity Test – Informal Exchange Rate

Statistics	Computational Statistics	The Significance Level
F-statistic	126.52	0.000
Obs*R-squared	218.31	0.000

Source: Results of Research

Table-5. Conditional Heteroscedasticity Test – Stock Index

Statistics	Computational Statistics	The Significance Level
F-statistic	12.97	0.000
Obs*R-squared	25.60	0.000

Source: Results of Research

The confirmation of variables conditional heteroscedasticity provide the possibility of modeling the informal exchange rate and stock index volatility using the GARCH patterns. After the determination of optimal lags, GARCH (1, 1) as the optimal model were selected which introduce the behavior of the informal exchange rate logarithm and stock index logarithm. Tables (1) and (2) show the results from estimation of models.

Table-6. Estimation of GARCH (1, 1) – Informal Exchange Rate

Average Equation			
Variables	Coefficient	Z Statistic	The Significance Level
Intercept	0.814	1.872	0.061
LEXCH(-1)	0.462	2.465	0.013
LEXCH(-2)	0.449	2.336	0.019
	Variance Equation		
Variables			The Significance Level
Intercept	0.003	2.812	0.004
$RESID(-1)^2$	0.449	2.563	0.000
GARCH(-1)	0.599	4.212	0.000
Durbin – Watson: 2.26 $R^2 = 0.74,$			

Source: Results of Research

Table 7. Estimation of GARCH (1, 1) – Stock Index

Average Equation			
Variables	Coefficient	Z Statistic	The Significance Level
Intercept	-0.0004	-0.096	0.923
LEXCH(-1)	1.427	50.25	0.000
LEXCH(-2)	-0.0427	-15.084	0.000
	Variance Equation		
Variables			The Significance Level
Intercept	0.000	20.570	0.000
$RESID(-1)^2$	0.057	50.255	0.000
GARCH(-1)	0.788	82.344	0.000
Durbin – Watson: 2.26 $R^2 = 0.99,$			

Source: Results of Research

The fit measures of models confirm fit goodness statistically. The related equations as follows:

$$h_t = 0.003 + 0.44\varepsilon^2{}_{t-1} + 0.59h_{t-1}$$

$$h_t = 0.000 + 0.057\varepsilon^2{}_{t-1} + 0.788h_{t-1}$$

In this equations, there is the convergence condition in conditional variants and as a result, is used the estimated models residuals as the indicators of informal exchange rate volatility and stock prices volatility. In order to the study of effect of informal exchange rate volatility on stock prices volatility, were employed the Granger causality tests that table (8) presents the results from causality test. The obtained results confirm a two- way causality between stock prices volatility and the informal exchange rate volatility. Since is not considered the dynamic response in causality, we use the Auto Regressive Distributed Lag (ARDL) model. This model investigates the long run relationship between variables. After necessary statistical tests, was estimated the ARDL model that table (9) indicate the results from it.

Table-8. Granger Causality Test between Exchange Rate Fluctuations and Stock Prices Volatility

Null Hypothesis	F Statistic	Observations	The Significance Level
Exchange rate volatility does not Granger causes stock prices fluctuations	3.7959	1559	0.022
Stock prices volatility does not Granger causes exchange rate fluctuations	24.053	1559	0.000

Source: Results of Research

Table-9. Estimation of Long Run Pattern of Stock Prices Volatility on Informal Exchange Rate Volatility

Explained variables	coefficient	T statistic	The Significance Level
Informal exchange rate fluctuations	-0.4111	-3.472	0.004
intercept	0.484	4.522	0.000

Source: Results of Research

Table-10. Estimation of Long Run Pattern of Informal Exchange Rate Volatility on Stock Prices Volatility

Explained variables	coefficient	T statistic	The Significance Level
Stock index fluctuations	-1.27	-.091	0.927
Intercept	0.004	0.981	0.327

Source: Results of Research

Based on table (9) the informal exchange rate volatility has a negative and significant effect on stock prices volatility by the coefficient of (-0.4111) which shows increasing the informal exchange rate volatility reduces stock prices volatility. In fact, the informal exchange rate volatility influence the manufacturing programs of companies and also their profit. It imposes restrictions in the ground of raw materials purchase and make that raise cost of companies. In these conditions, stock market faces uncertain situation which has a negative effect on the intensive of stock demand and can diminish upward volatility of stock. The existence of long run relationship from the informal exchange rate volatility to stock prices volatility provides the possibility of error correction model (ECM) estimation which express how to variables adjustment toward the long run equilibrium relationship. Table (11) specifies the results from ECM model.

Table-11. Estimation of Error Correction Model of Stock Index Volatility on Informal Exchange Rate Volatility

Explained variables	Coefficient	T statistic	The Significance Level
The first difference of Informal exchange rate volatility	0.355	0.005	0.996
dC	0.41	4.482	0.000
Ecm(-1)	-0.847	-33.822	0.000

Source: Results of Research

The coefficient of error correction model stock prices volatility on the informal exchange rate volatility is estimated as (-0.84) that is significant statistically. According to this, in the short run is compensated 84 % of stock prices deviation from its equilibrium value.

5. CONCLUSION

Due to the fact that is funded sector of foreign require of companies through service and commodity import, the informal exchange rate volatility effect on the import cost. The cost changes of companies

influence the profit and shares demand. In this paper, is studied the effect of informal exchange rate volatility on stock prices volatility using the daily data from 2007 to 2011 in the formwork of General Autoregressive Conditional Heteroscedasticity (GARCH) and Auto Regressive Distributed Lag Model (ARDL) in the Iranian economy empirically. The results from estimation models show that the informal exchange rate volatility has a negative and significant effect on stock prices volatility by (-0.411). Increasing the informal exchange rate affect the profitability of companies which influences demand for shares. In this conditions, the upward swing in the stock index volatility is reduced.

REFRENCES

Chkili, W., 2012. The dynamic relationship between exchange rates and stock returns in emerging countries: Volatility spillover and portfolio management. International Journal of Management Science and Engineering Management, 7(4): 253- 262.

Hau, H. and H. Rey, 2006. Exchange rates, equity prices, and capital flows. Review of Financial Studies, 19(1): 273-317.

Islami, M. and P.J.J. Welfens, 2013. Financial market integration, stock markets and exchange rate dynamics in Eastern Europe. International Economics and Economy Policy, 10(1): 47-79.

Lnci, A.C. and B.S. Lee, 2014. Dynamic relation between stock returns and exchange rate changes. European Financial Management, 20(1): 71- 106.

Mehrara, M., 2006. The relationship between stock market and macroeconomic variables: A case study for Iran. Iranian Economic Review, 10(17): 137-148.

Phylaktis, K. and F. Ravazzolo, 2005. Stock prices and exchange rates dynamics. Journal of International Money and Finance, 24(7): 1031-1053.

Wälti, S., 2005. The macroeconomic determinants of stock market synchronization. Journal of International Banking Law, 11(10): 436-441.

Wu, Y., 2000. Stock prices and exchange rates in VEC model—The case of Singapore in the 1990s. Journal of Economics and Finance, 24(3): 260-274.

Zakaria, Z. and S. Shamsuddin, 2012. Empirical evidence on the relationship between stock market volatility and macroeconomics volatility in Malaysia. Journal of Business Studies Quarterly, 4(2): 61-71.