Investigate the Effect of Exchange Rate Volatility on the Demand for Life Insurance in Iran

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ABSTRACT

Numerous factors affect the insurance industry and its growth and development that comprehensive study and recognition about them and taking action to solve or control the negative effects of each one can in turn have a significant effect on the development of this potential market, particularly in the life insurances sector. One of the most important factors is the presence of some economic variables including exchange rate fluctuations in the economy of a country. Given the growing importance of variable exchange rate, especially in the current economic situation of Iran, the effect of exchange rate volatility on the demand for life insurance has been discussed in this study on a monthly basis during the period 1991-2012. Accordingly, the hybrid model of neural network and autoregressive conditional heteroscedasticity (ARCH) method for modeling and predicting the effect of exchange rate volatility on demand for life insurance have been used. The results showed that hybrid model of neural network group method of data handling and ARCH (1, 1), based on the criteria of root mean squared prediction error, significantly able to explain changes of exchange rate volatility on the demand for life insurance.

Keywords: Exchange Rate, Demand for Life Insurance, Instability (Volatility), Neural Network Group Method of Data Handling, Autoregressive Conditional Heteroscedasticity
JEL Classifications: G22, F41, C22, C45, C53, C63, C87

1. INTRODUCTION

With the increasing development of international trade in the fields of production of goods and services, the importance of the exchange rate is considered as one of the most important macroeconomic variables of the countries and its instability causes a reaction in the other macro variables such as production, exports, imports, employment, the level of prices and etc. in the economy (Snowden and Wayne, 2005). Life insurance is one of the important and known branches in the insurance industry and its growth and development can contribute to growth and excellence in insurance companies as well as economic development and growth. The importance of life insurances is to the extent that it was raised as a valid index in international survey measuring the level of development of countries (Abrishami, 2010). This type of insurance is known as the most effective and the most acceptable means in many countries of the world that gives people confidence in the future to have a better life. Therefore, it is very effective both in material well-being and mental and spiritual comfort.

Despite the all-round development of the insurance industry in developed countries and even many developing countries, life insurance products which is dire need of today life has not gained a confident position in the consumption basket of Iranian families.

In 2012, insurance premium per capita in the world was 656 $ which its 374 $ was related to life insurance and the remaining 282 $ related to non-life insurance. In other words, about 57% of insurance activity was in life insurance and 43% was in non-life insurance. While the insurance premium per capita in our country is about 140 dollars, which only 7.8% is related to the life insurance; that is, less than 8% of country's insurance activity is in life insurance. This simply reflects the backwardness of demand for life insurance in the country, so that it is 34 times less than the average demand for life insurance in the world (Statistical Yearbook of Central Insurance of the Islamic Republic, 2012).

Exchange rate volatility, as one of the obstacles to the development of life insurance which causes the paid up capital of life insurance

in contract expire of real value is much less than the starting day of the contract. On the other hand, the instability of exchange rate can have a tremendous effect on expectations of the people in accelerating inflation, so that the inflation intensified due to the currency devaluation is visible. Exchange rate volatility exacerbates the expected inflation, and this in turn will lead to an increase in actual inflation. The result is that people's purchasing power decreases and it causes the departure of some goods from the household basket that life insurance can be one of these goods.

Accordingly, the present study seeks to raise a kind of impacting exchange rate on demand for life insurance which involves exchange rate fluctuations by providing theories used regarding the relationship between exchange rate and demand for life insurance in various studies conducted inside and outside the country. In better words, the present study aims to propose a subject that has received little attention in previous studies, because these studies were mainly included only part of the issue and these fluctuations have been mentioned without examining.

Then in the second part, a review of previous studies in terms of theoretical principles is presented in detail. In the third section, literature review is explained and analyzed. Part IV includes research methodology, Part V presents results of the research, and Part VI including conclusions and recommendations will end the article.

2. THEORETICAL FOUNDATIONS AND OVERVIEW ON PREVIOUS STUDIES

Coinciding with the progress and development of life insurance, much research has been done over the past few decades so that the nature of demand and supply of life insurance and factors affecting the demand and other issues and techniques related to this branch of insurance to be exactly identified. On the one hand, very few studies have been conducted in the field of exchange-rate volatility on the demand for life insurance with the development of studies regarding life insurance. At first, studies on the relationship between life insurance and inflation were mentioned and then studies on the relationship between inflation and exchange rate and research techniques will be provided.

2.1. Previous Studies
2.1.1. Studies of the relationship between inflation and life insurance
Houston (1960) could examine the effects of inflation on life insurance after World War II. This study theoretically showed that inflation generally has a special effect on life insurance position, because he believed that life insurance is a way of saving belonging to all people and remains as a long-term investment with constant dollar. On the other hand, investment has created a guarantee in life insurance which is in contrast with spiraling inflation. In this study, Houston referred to the relationship between savings and life insurance costs from 1919 to 1958 that savings has been defined as net increase in reserves of life insurance company. Using the consumer price index during 1946-1958, he concluded that the price increase was associated with a decrease in savings.

Hofflander and Duvall (1967) investigated the inflation and life insurance sales by using data from 19 major life insurance companies in the state of Texas that the sale has been done on the basis of year 1965. In this study, sale of life insurance was raised as two forms of periodic and permanent sales which both periodic sales and permanent sales have fallen by increasing the level of sales. Overall, two models to estimate the relationship between inflation and insurance sales have been applied in this study which confirmed an inverse relationship between them.

Neumanm (1969) examined inflation and savings through life insurance. The hypothesis tested in this study was based on the effect of inflation on savings through life insurance after World War II and the model used to test this hypothesis was a multivariate regression model that time series data for analysis has been used during the 1946-1964. In this analysis, dependent variables are the demand for life insurance, payments of the 1st year and renewed premiums on individual policies that variable expected price is main explanatory factor in the model. The effect of other explanatory factors such as personal disposable income, the number of marriages, births and urban households is considered fixed. This analysis emphasizes on the adverse effect of inflation on savings of life insurance and cancels policies based on savings.

Babbel (1979) theoretically estimated the effect of inflation on the costs of life insurance that his aim was to develop a model for measuring the costs of life insurance and using it to determine the effects of inflation on the costs of life insurance. In fact, this model has been expressed in a way that inflation forecasts are linked with high and actual costs of life insurance.

Babbel (1981) analyzed the inflation and supply of life insurance in Brazil with ranking of indicators. Using time series multivariate regression model, Babbel conducted the regression analysis before 1968 without ranking indicators and after 1968 by ranking indicators that the course beginning was since 1951. During these years, life insurance rate with anticipation of inflation has been very high and so there was an expectation for sales decline of life insurances in inflation periods.

The results indicate that the effect of inflation on contracts and sales of life insurances for both consumers and insurers is increasing and insurance industries of many countries were tested by using life insurance policies with rankings of indicators which nominal values have been associated with some of the price indexes. So inflation had a significant effect on the supply of life insurances.

Also Babbel (1985) examined price elasticity of demand for life insurance in which he has acquired the real price index for life insurance in America from 1953 to 1979. Accordingly, the demand for life insurance has a negative relationship with price index fluctuations that is consistent with economic theory. So, the life insurance industry had high price elasticity during this period.

Cameron (1987) analyzed inflation and participation policies on life insurance in Canada. Using the periods 1962-1971, 1972-1981, 1962-1981 examined the variables inflation, expected inflation, Canada's long-term bond yields, average return of

insurers' investment, average return of participating life insurance policies, lifetime and its benefits and costs. The results indicate that the participation policies of life insurance are effective on the household wealth and created efficiency in financial markets that reduces the inflation.

Sajadi and Gholami (2007) examined the impact of macroeconomic variables such as gross domestic product (GDP), inflation rate and interest rate on life insurance demand. Using the data analysis from econometric public methods, there is an inverse relationship between inflation rate and demand for life insurance that this shows that the increase in general level of prices reduces purchasing power of life insurance.

Mojtahed et al. (2012) examined the effects of exchange rate changes on macroeconomic variables by using satellite theoretical model derived from Professor Pesaran and then estimated the impact of macroeconomic variables on the production of premium and indirect effects of exchange rate on the production of premiums for the insurance industry through auto regressive distributed lags model. The obtained results indicate that the impact of exchange rate on production is negative. This means that production reduces by increasing the exchange rate and also direct impact of the whole country production on the production of premium is positive.

2.1.2. Studies related to exchange-rate volatility

Fidrmuk and Horvath (2008) examined the instability of exchange rate in the new selected member states Europe union including Czech Republic, Hungary, Poland, Romania and Slovakia using generalized auto regressive conditional heteroskedasticity (GARCH) and threshold generalized auto regressive conditional heteroskedasticity (TARCH) models which reviewed the dynamics of exchange rate in these countries on a daily basis during the years 1999-2006. Despite the inflation targeting system, these countries have tried to control the exchange rate. Using the GARCH model, volatility of exchange rate was estimated on a daily basis that this instability in all these countries has been quite stable. Modeling with TARCH models has shown systematic asymmetry in exchange rate volatility in these countries. This volatility is more obvious in periods of increasing the nominal value of money. On the other hand, sensitivity analysis during the years 2004-2006 has shown that Poland and Czech Republic have been the most experienced countries in inflation targeting which had the least experience in exchange-rate volatility. Despite continuing instability of exchange rate in these countries, inflation targeting policy seems an attractive option before the euro adapt for other European currencies.

Morana (2009) investigated the relationship of exchange rate instability and macroeconomics by using time series data on a monthly basis for the countries of America, Japan, the Eurozone, Britain and Canada which has been implemented by applying fractionally integrated factor vector auto regressive method during 1980-2006. Evidence has been found from considerable long-term relationship and replacement of exchange-rate volatility and macroeconomic instability in these countries which especially includes the instability of inflation and production and instability

of monetary growth. Finally, these relations effectively promoted the development of predicting long-term exchange rate volatility.

Mehrara et al. (2010) predicted the instability of oil prices between 1990 and 2010 by using neural networks on a daily basis. In this study, a model to predict oil price volatility is presented by using a neural network. In this analysis, four models, including econometric model GARCH (1, 1), two types of neural network-based model of group method of data handling (GMDH) and hybrid model of neural network GMDH and GARCH (1, 1) were studied. The results indicate that the hybrid model and neural networks based on the prediction criteria of root mean square error for both series have provided better prediction than the econometric model of GARCH (1, 1).

2.2. Explaining the Literature

Lewis (1989) examines the life insurance demand using theoretical structural development of Yaari's life insurance (1965) which this demand aimed to maximize the expected utility of its heirs. Most theoretical studies in the field of life insurance application, including Fischer (1972) and Pissarides (1980) have placed the study of Yaari as their starting point. As well as, books Basics of life insurances by Mahmoodi et al. (2011) and life insurance mathematics by Sharzei et al. (2008) have studied the theoretical concepts of life insurances. Yaari in the circulation model of life with uncertain lifetime shows that a person increases his expected desirability with purchasing life insurance and receiving annual pension.

Demand for life insurances has a positive relationship with the possibility of mortality of head of the family, current value of family consumption as well as the risk aversion of households and has a negative relationship with the family fortune and overhead cost (Lewis, 1989).

Demand function of life insurance generally has been formed within the framework of the life cycle that households maximize expected utility of consumption in their lifetime. Yaari (1965) and Hakansson (1969) and Abrishami et al. (2009) have assumed that households acquire uncertain revenue stream before the likelihood to die. Life insurance provides a mechanism to reduce volatility of household consumption (Li et al., 2007).

Many factors on the demand for life insurance are impressive. Burnett and Palmer (1984) have considered factors such as morality and religion influencing on life insurance, like education and income. Chen et al. (2001) provided evidence from the effect of gender on life insurance demand. Hammond et al. (1967) emphasized on occupational importance of family. Babbel (1985) and Babbel and Staking (1983) stated that inflation will have a negative effect on demand for life insurance. Fortune (1973) believed that life insurance is an alternative to financial assets such as bonds and shares. Headen and Lee (1974) stated that short-term demand for life insurance is affected by consumer sentiment, interest rates and savings.

Li et al. (2007) have estimated a different demand function from life insurance. He considered the demand function of life insurance as a function of inflation:

LFINS = f (INCOME, LIFXP, NBDEPT, EDUC, SSEXP,
      FINDEV, FMSHRE, INFLN, REALINT)   (1)

$$\text{Log (LFINS)} = \beta_0 + \beta_1 \log(\text{INCOME}) + \beta_2 \log(\text{LIFXP})$$
$$+ \beta_3 \log(\text{NBDEPT}) + \beta_4 \log(\text{EDUC})$$
$$+ \beta_5 \log(\text{SSEXP}) + \beta_6 \log(\text{FINDEV})$$
$$+ \beta_7 \log(\text{FMSHRE}) + \beta_8 \log(\text{FMSHRE})^2$$
$$+ \beta_9 \log(\text{INFLN}) + \beta_{10} \log(\text{REALINT}) + \varepsilon \quad (2)$$

In which, LFINS is demand for life insurance, INCOME is income (nominal GDP per capita), LIFEXP life expectancy, NBDEPT rate of dependents, EDUC level of education, SSEXP social security expenses, FINDER financial development (M2/GDP), FMSHRE foreign partners' market share, INFLN inflation anticipated and REALINT the real interest rate. The main feature of this model is linear logarithmic form which was used by Brown and Kim (1993) and Ma and Pope (2003). In this model, the demand for life insurance has a positive relationship with income, the dependent ratio, level of education and financial development and has a negative relationship with life expectancy and social security expenses and inflation, but its relationship with the market share of foreign partners and the real interest rate may be positive or negative.

Bonato (2007), in the report of International Monetary Fund, studied the factors affecting inflation in Iran. In his research, he has used the following regression model:

$$P_t = f(M_{1t}, \text{GDP}_t, R_t, e_t) \quad (3)$$

$$P_t = m_t + \alpha_1 y_t + \alpha_1 r_t - \alpha_1 e_t \quad (4)$$

Where, p_t is logarithm of the domestic price (index of consumer), m_t is logarithm of money supply (M_{1t}), y_t is logarithm of GDP at constant prices, r_t is return rate (annual interest rate) of bank deposits, and e_t is logarithm of the nominal exchange rate.

According to the proposed model of Bonato, we can examine the effect of exchange rate fluctuations on inflation in Iran. In the above equation, we can consider the difference between official and market exchange rate instead of the nominal exchange rate. Therefore, final model is as follows (Zobeiri and Elmi, 2009):

$$LP_t = f(LM_{1t}, \text{LGDP}_t, R_t, \text{LRERGAP}_t) + \varepsilon_t \quad (5)$$

$$\text{LRERGAP}_t = L(\text{NBMER} - \text{NOER}) \quad (6)$$

LP_t is logarithm of domestic prices (CPI, consumer price index), LM_{1t} is logarithm of the volume of money, LGDP_t is logarithm of GDP, R_t is bank deposit interest rate, LRERGAP_t is logarithm of gap between official and market exchange rates, NBMER is the market nominal exchange rate, NOER is nominal rate of official exchange and ε_t is error in this model.

Edwards (1989) believed that fluctuations in exchange rates have a positive effect on domestic inflation. Arize et al. (2004) also emphasized on the Edwards' findings and provided a model that associated the standard deviation of inflation rate (dependent

variable) to the average inflation rate (independent variable) and examined a model to estimate changes in nominal exchange rate with real exchange rate as follows:

$$\sigma_{\text{inf},i} = a + b\,\mu_{\text{inf},i} + c\,\sigma_{\text{ex},i} \quad (7)$$

In which, $\sigma_{\text{inf},i}$ is inflation rate fluctuations of country i, $\mu_{\text{inf},i}$ is the average rate of inflation of country i and $c\,\sigma_{\text{ex},i}$ calculates the exchange rate fluctuations of country i (Arize et al., 2004).

Inflation rate fluctuations are defined as a percentage of standard deviation changes in the consumer price index. The average inflation rate is defined as mean percent change in the consumer price index and exchange rate fluctuations is referred to the percentage of standard deviation change in the real or nominal effective exchange rate (Arize et al., 2004).

Basically, measurement indices of exchange rate volatility are estimated by non-conditional standard deviation and standard deviation of moving average. It should be noted that there is no theoretical basis for preference of one index over the other. In this study, we tried to model and predict the effect of exchange rate volatility on the demand for life insurance based on the impact of reduced purchasing power of life insurance due to uncertainty of economic environment and increasing the general level of prices by using ARCH and neural network GMDH which is the distinction and innovation of the present study compared to previous studies.

3. RESEARCH METHODOLOGY

As trend of changes in the model variables is nonlinear, so we used nonlinear evolution algorithm GMDH within the structure of neural network that we will have a short review on the method in this section.

3.1. Neural Network Algorithm - Type GMDH
Neural networks are based on a general concept of pattern recognition and purifier of traditional technical methods. Neural networks which are highly flexible have been used as semi-parametric models in many practical fields, particularly behavioral and economic sciences[1].

Grouping method of numerical data is a statistical training technology to overcome the statistical weaknesses and neural networks. What presents the GMDH algorithm as a heuristic method[2] is to build models for complex-systems from regression-type with high degrees which has the advantage over the classical modeling. GMDH algorithm was initially introduced by a Ukrainian scientist Ivakhnenko (1968; 1995).

Generally, there are two basic views in introducing and understanding the neural networks. At first viewpoint, neural networks can be considered as a science which have different

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[1] For further study, see the paper: Abrishami et al. (2009), Economic Research; also: Abrishami et al. (2009), Journal of Commerce.

[2] Heuristic algorithm is a criterion, method or principle for deciding between several policies, so that the most effective one to achieve the desired objectives is selected.

variety of network structure and enjoy a high ability to identify and modeling. The basis for this view is the training of neural networks. In the second view, neural networks are considered as a scientific tool for implementing and understanding the algorithms; i.e. in this perspective, neural networks are a flowchart for complex mathematical algorithms. About GMDH neural networks, the case should be seen with the second view. In general, GMDH algorithm could be discussed and examined from two different views; we can introduce this algorithm in the first part based on its mathematical basis and in the second part based on theory and analysis of the system modeling.

Based on a mathematical, algorithm GMDH was established based on Volterra functions series analysis to second grade bivariate polynomials.

$$G\ (x_i,\ x_j) = a_0 + a_1x_i + a_2x_j + a_3x_i^2 + a_4x_j^2 + a_5x_ixj \tag{8}$$

In this analysis, Volterra series becomes to a set of recursive chain equations, so that the Volterra series is established again with algebraic insertion of recursive relations in each other. Algorithm GMDH in the second part is based on the theory and system modeling analysis; the modeling is built based on two general rules.
1. Complex systems, including m input variable and one output can be analyzed to $C_m^2 = [m\ (m-1)]/2$ simple partial system that has two inputs and one output. Of course, the output of all partial systems is same and is considered similar to the output of main system.
2. To combine two partial systems in the form of a single system and creation of another new partial system which encompasses the variables of both previous systems, it is enough we again model the output or estimated values of both models obtained for n input sample. Applying these two principles on the agenda, algorithm GMDH performs the modeling. The goal which is always considered in the process of combining the models created is to achieve the models in which almost all variables of system are visible in it and play a role; another purpose is to achieve a model in which the error of its output compared to other calculated models in the previous step is less.

Neural network GMDH is a manifestation of GMDH algorithm that have been proposed to the form and structure of a network[3].

Neural network GMDH is a self-organizing and unilateral network which has several layers and each layer is also composed of many neurons, all neurons have a similar structure. Weights (w) are placed within each neuron based on methods of singular value decomposition and solving normal equation as certain and fixed values. The main feature which is observed in this type of networks indicates that neurons in previous step or previous layer (m) are the cause or producer of new neurons to a number of C_m^2. Among the neurons produced, a number of them should necessarily be removed thereby the divergence of network to be avoided. These neurons are so called dead neurons.

One of the important issues that arises in multi-layered artificial neural network is a network structure design. In this design, the number of layers as well as the internal structure such as the number of weights and their original values and the excitation function of each neuron should be properly chosen so that an appropriate and ideal mapping between input and output data is established. One of the purposes of GMDH neural networks is to prevent the growth of network divergence and linking the form and structure of the network to one or more numerical parameters in a way that the network structure will also be changed by changing this parameter[4].

Evolutionary methods such as genetic algorithm are widely used in various stages of designing neural networks because of its unique capabilities to find the optimum values and the possibility of searching unpredictable spaces. In the present study, genetic algorithm has been used to design the neural network form and determine its coefficients.

Numerous works in the field of economics have been carried out in Iran by using GMDH algorithm which part of them is as Table 1.

4. RESEARCH FINDINGS

According to theoretical and information limits about the research subject, choosing a research methodology based on Mehrara et al. (2010) in predicting instability, based on combination of ARCH models and neural network, is to model and predict the effect of exchange rate volatility on the demand for life insurance that we have used the conditional variance resulting from the implementation of ARCH model (1, 1) as input of neural network GMDH.

The data used is from the site of the Central Bank and the Central Insurance on a monthly basis during the period 1991-2012.

Figures 1 and 2 indicate time diagram of growth related to the unofficial exchange rate and demand for life insurance in the period under study.

4.1. Estimating the Econometric Models of Instability
In this section, we estimate the econometric model of instability to provide inputs of hybrid model. For this purpose, we estimate the model of ARCH (1, 1). Econometric modeling and estimates were done by using EViews 5 software.

Test statistic presented the existence ARCH (ARCH-LM test) effects with regard to two interruption in residual (Chi-square distribution) in Appendix. Predictably, the test results imply the existence of ARCH effects. Coefficients associated with instability equation are provided in the same Appendix. In these estimates, we have assumed the distribution of disrupting statement as normal (Gaussian).

4.2. Results of Prediction
At this stage, we provided the results of instability prediction in Table 2. It should be noted that the neural network predictions are

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3   For further study, see the paper: Abrishami et al. (2009), Economic Research; also: Abrishami et al. (2009), Journal of Commerce.

4   For further study, see the paper: Abrishami et al. (2009), Economic Research; also: Abrishami et al. (2009), Journal of Commerce.

Table 1: Part of studies conducted on economics using GMDH algorithm in Iran

Row	Subject	Authors
1	Modeling and forecasting of economic growth in Iran	Abrishami et al. (2009)
2	Modeling and forecasting of the effects of globalization on Iran's non-oil exports	Abrishami et al. (2009)
3	Modeling and forecasting price index and cash return of Tehran stock exchange	Mehrara et al. (2009)
4	Modeling and forecasting inflation in Iran	Mehrara et al. (2009)
5	Various effects of economic globalization on the total demand of labor force and also demand of skilled and unskilled labor force in Iran	Abrishami et al. (2010)
6	Iran's population growth projections due to socio-economic factors and based on an interdisciplinary approach	Mahmoudi et al. (2011)

GMDH: Group method of data handling

completely under the influence of inputs. In hybrid neural network model and ARCH (1, 1), we added the corresponding values of $\alpha_1 \varepsilon_{t-1}^2$ and $\beta_1 h_{t-1}$ as network input. In hybrid patterns, it is assumed that the series obtained from estimating the econometric model can help to improve the learning process of network.

And the percentage of prediction error is calculated by the following equation:

$$\frac{\sqrt{MSE}}{Mean\ Price}*100 = \frac{RMSE}{Mean\ Price}*100 \qquad (9)$$

As the accuracy of model predictions is more than 92% in the period of 12 month and is more than 97% in the period of 8 months, it can be said that this model is significantly able to explain the instability of exchange rate changes on demand for life insurance. As well as, it is observed that the less the range of predictions, the prediction accuracy increases. Comparison between predicted and actual values is shown in the Figure 3.

5. CONCLUSIONS AND SUGGESTIONS

Despite the importance and development of life insurance in most countries, both developed and developing countries, this type of insurance has not still obtained a safe place in the consumption basket of Iranian families. Unfortunately despite the passing nearly 80 years of insurance life in Iran, life insurance demand is much lower than the other types of insurance. One of the most important factors affecting demand for life insurance is to decrease or increase the value of the domestic currency in Iran and exchange rate fluctuations during the years 1991-2012 that this in turn exacerbates the expected inflation and increases the purchasing power of people. In these conditions, products as life insurance have no a place in the Iranian household consumption basket and are not accounted among essential commodities in the consumption basket. In this study, we tried to review and analyze some of the reasons for low demand life insurance demand from the perspective of the impact of unofficial exchange rate volatility.

According to theoretical and information limits on the research subject, choosing a research methodology in predicting instability, based on combination of ARCH models and neural network, is to model and predict the effect of exchange rate volatility on the demand for life insurance that we have used the conditional variance resulting from the implementation of ARCH model (1, 1) as input of neural network GMDH. Research findings based on modeling and predicting the effects of unofficial
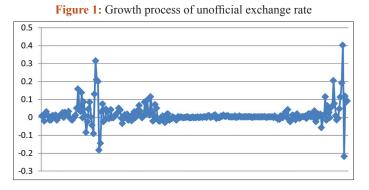

Figure 1: Growth process of unofficial exchange rate

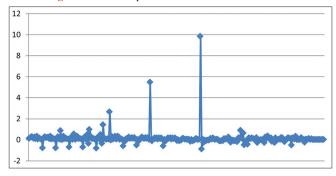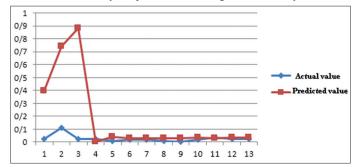**Figure 2:** Growth process of life insurance demand

Figure 3: The actual and predicted values of demand for life insurance affected by the pattern of exchange-rate volatility

exchange rate volatility on the demand for life insurance using the aforementioned hybrid model during the years 1991-2012 indicated the significant impact of exchange-rate volatility on demand for life insurance, in addition to confirming non-linear effects and ARCH in behavior of the model variables which can be as one of the evidence for reducing the willingness of people to buy life insurance in uncertain situations of economic environment, including instability atmosphere with currency change and the central bank's policies in future studies.

Table 2: Investigating the prediction accuracy of hybrid model due to effect of exchange rate volatility on the demand for life insurance

Time frame	RMSE	Prediction error (%)	Prediction accuracy (%)
12 months	0.2528	7.5	92.5
8 months	0.03	2.15	97.85
2 months later	0.01	-	-
3 months later	0.012	-	-
4 months later	0.017	-	-
5 months later	0.018	-	-
8 months later	0.018	-	-

RMSE: Root mean square error

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APPENDIX

The unofficial exchange rate effects

Heteroskedasticity test: ARCH				
F-statistic	2255.884	Prob F (1,261)		0
Obs*R^2	235.7270	Prob Chi-square (1)		0

Test equation:
Dependent variable: WGT_RESID^2
Method: Least squares
Date: 12/09/13
Time: 18:14
Sample (adjusted):
1370M02
1391M12
Included observations: 263 after adjustments

Variable	Coefficient	S.E.	t-statistic	Prob
C	0.050671	0.020114	2.519176	0.0124
WGT_RESID^2(−1)	0.943746	0.019870	47.49615	0.0000
R^2	0.896300	Mean dependent variable		0.881283
Adjusted R^2	0.895903	S.D. dependent variable		0.499465
S.E. of regression	0.161148	Akaike info criterion		−0.805416
Sum squared residual	6.777793	Schwarz criterion		−0.778252
Log likelihood	107.9122	Hannan-Quinn criter		−0.794499
F-statistic	2255.884	Durbin-Watson stat		2.594002
Prob (F-statistic)	0.000000			

Data output: ARCH (1, 1). ARCH: Autoregressive conditional heteroscedasticity, S.E.: Standard error, S.D.: Standard deviation, GARCH: Generalized auto regressive conditional heteroskedasticity

Dependent variable: EX				

Method: ML - ARCH (Marquardt) - normal distribution
Date: 12/09/13
Time: 18:13
Sample:
1370M01
1391M12
Included observations: 264
Failure to improve likelihood after 5 iterations
Pre sample variance: Back cast (parameter=0.7)
GARCH=C(1)+C(2)*RESID(−1) ^{2}+C(3)*GARCH(−1)

Variable	Coefficient variance equation	S.E.	z-statistic	Prob
C	37679328	21327062	1.766738	0.0773
RESID(−1)^2	0.520864	0.404501	1.287671	0.0197
GARCH(−1)	−0.201046	0.510139	−0.394100	0.0693
R^2	−4.214674	Mean dependent variable		6844.840
Adjusted R^2	−4.194921	S.D. dependent variable		3340.453
S.E. of regression	7613.685	Akaike info criterion		20.52286
Sum squared residual	1.53E+10	Schwarz criterion		20.56350
Log likelihood	−2706.018	Hannan-Quinn criter		20.53919
Durbin-Watson stat	0.019424			

Data output: ARCH (1, 0). ARCH: Autoregressive conditional heteroscedasticity, S.E.: Standard error, S.D.: Standard deviation, GARCH: Generalized auto regressive conditional heteroskedasticity

Dependent variable: EX

Method: ML - ARCH (Marquardt) - Normal distribution

Date: 12/09/13

Time: 18:20

Sample:

1370M01

1391M12

Included observations: 264

Convergence achieved after 21 iterations

Pre sample variance: Back cast (parameter = 0.7)

$GARCH = C(1)+C(2)*RESID(-1)^2$

Variable	Coefficient variance equation	S.E.	z-statistic	Prob
C	38093387	11414586	3.337255	0.0008
$RESID(-1)^2$	0.479115	0.534889	0.895728	0.0370
R^2	4.214674	Mean dependent variable		6844.840
Adjusted R^2	4.194921	S.D. dependent variable		3340.453
S.E. of regression	7613.695	Akaike info criterion		20.55889
Sum squared residual	1.53E + 10	Schwarz criterion		20.58598
Log likelihood	2711.773	Hannan-Quinn criter		20.56978
Durbin-Watson stat	0.019424			

Output ARCH (1, 0). ARCH: Autoregressive conditional heteroscedasticity, S.E.: Standard error, S.D.: Standard deviation, GARCH: Generalized auto regressive conditional heteroskedasticity