Using Support Vector Regression Model to Study the Exchange Rate of the Iraqi Dinar

Alyaa KADHIM*a   Waleed DHHAN*b

a Al-Mussaib Technical Insitute,Al-Furat Al-Awsat Technical University, Babylon, Iraq.
b Babylon Municipalities, Ministry of Construction, Housing, Municipalities and Public Works, Babylon, Iraq.

Corresponding Author: Alyaa Kadhim   Waleed Dhhan

Abstract :   *Regression analysis aims to estimate the relationship between the response variable and explanatory variable. Most of the related studies used the ordinary least squares to achieve this goal. Unfortunately, the ordinary least squares is not suitable to address the unknown data distribution. Further, it is not efficient to evaluate the nonlinear relationship. In this article, we use the support vector regression to build the models of the exchange rate of Iraqi dinner. It is a non-parametric method which is no strict conditions about the data. The results refer to the superiority of the support vector regression method over the ordinary least squares method.*

Keywords: The exchange rate, nonlinear, non-parametric methods, Support vector regression,.

1..Introduction

in order to maintain the economic policy of the state, there is necessity to maintain the internal and external balance and stability through achieving a stable growth rate in addition to overcoming the problems of inflation, unemployment and achieving balance in payments balance in addition to preserving stability of prices. It is very important to keep the exchange rate stability because it is providing an environment conducive to attracting foreign investment in addition to its volatility is reflected in trade exchanges. Thus, the stability of the local currency is the basis for the stability of exchange rates. It should be noted that the value of the local currency can not be separated from its value abroad. The exchange rate is a major element in the economics of the oil countries because it is a dominated by oil exports compared to other exports. Furthermore, it determines the prices of domestic goods and services abroad as well as foreign goods and services.

The Central Bank of Iraq seeks to achieve as much as possible in the stability of the exchange rate of Iraqi dinar, but there are major challenges faced at the local and international level and this is due to the instability in the political, social and economic conditions. Therefore, this study aims to explore the impact of the money supply index in the stability of the exchange rate of the Iraqi dinar.

In real life application, most of the data have non-linear relashionships, which make the classical methods not suitable for modeling these type data. Cortes and Vapnik (1995), presented a new class of learning algorithms that named support vector machine (SVM). It is firstly used to solve the classification problems (SVC) before extended at the same year to address the regression proplems (SVR). The idea behind support vector regression model (SVR) is to employ the kernel function to transform the relationships among variables in the input space from nonlinear to a linear shape in a high-dimensional feature space. It is folowing the principle of structural risk minimization and the statistical learning theory (Dhhan et al., 2015). It is a universal technique for solving nonlinear, rank deficient and high-dimensional problems. Since then, it has attracted the attention of researchers because it has excellent performance to handle a variety of learning problems (Ceperic, 2014). There are some additional reasons stand behind the widely use of the SVM, such as theoretical guarantees of its performance, high flexibility to add extra dimensions to the input space, and lower sensitivity to local minima which prevents the increasing of the model complexity (Ceperic, 2014).

In this paper, we used the SVR method to build the model of the exchange rate of the Iraqi dinner compaired with the ordinary least square method (OLS). We show in this study that the SVR method achieves a higher efficiency than the OLS method.

This article is organized as follows: in Section 2 the concept of the money supply and the exchange rate are defined. In Section 3, we give a brief description of the SVM for regression. In Section 4, the real data is used to build the model of the exchange rate of the Iraqi dinner. Finally, concluding remarks are given in Section 5.

2. Theoretical side

2.1 The Money supply

Ricardo is the first to refer the effect of the amount of the money in determining the exchange rate when he explained that England had to reduce the sterling from its nominal value to face the increase in the amount of money traded. It caused the rise in the domestic prices and then the high cost of exports, which led to a shortage of its demand in

global markets and lack of its value and the occurrence of balance of payments deficit. on the other hand, the opposite occurs in the case of shortage of the amount of the money inside the country, as the cost of exported goods are few, which increasing the demand for them and increase their value. This leads to achive surplus in the balance of payments as well as rise the currency value.

The money supply is an important monetary factor that affect the exchange rate. in other words, any increase in this factor leads to large changes in the value of the currency and the exchange rate (Hudson 1979). Thus, the increase in the supply of money leads to higher domestic prices, which weakens the competitiveness of domestic goods in the international market. This increases the demand for imported goods and services that become cheaper than the domestic goods and services, which decreases the exchange rate of the local currency.

In this paper, two types of the money supply are studied as explanatory variables. Firstly, the money supply in the narrow sense (M_1) which is difined as the sum of the means of payment that actually used in circulation and held by individuals, projects and general administrations as cash balances. Secondly, the money supply in the broad sense (M_2) which is defined as the sum of the means of payment (M_1) plus time deposits and special savings deposits in private banks.

2.2 The exchange rate

The exchange rate can be defined as the number of units to be paid from a particular currency to obtain a unit from another currency or it is the number of units of foreign currency needed to obtain a unit of the local currency of the country (Singh 2002). There are also other concepts of the exchange rate such as the number of units of a particular currency that can be bought or exchanged in one unit of the other currencies (Sutherland, and Canwell 2004). It can also be considered as the link between the price of the item in the domestic economy and its price in the global market. It can be said that the exchange rate is the mirror that reflects the situation of the trade with the outside world through the relationship between exports and imports. In other words, there is need to the foreign exchange when importing different goods to pay its price and thus, the local currency will be converted to foreign currency.

2.3 The relationship between money supply and exchange rate

The Money supply is one of the most important factors that affecting the value of the exchange rate, as the increases the value of the money supply leads to major changes in the exchange rate through changes in the general level of prices and through the change in the mechanism of supply and demand. In other words, any change in the money supply would change the foreign exchange rate as the first (the money supply) is an independent variable and the second (exchange rate) is a dependent variable (Moore 2006). Thus, the increase in demand of the foreign currency unit will lead to a higher exchange rate and vice versa if the money supply is reduced. It is clear that the exchange rate is linked with the money supply in a positive relationship.

3. The SVR model

The support vector machine (SVM) is following the statistical learning theory and the principle of structural risk minimization (SRM) (Cortes and Vapnik 1995). It is a universal technique used to solve classification (SVC) and regression (SVR) problems. In the SVR model the relationship among variables is learned directly from the data, without the need to any assumptions about the underlying probability distribution (Tezcan and Cheng 2012). Consequently, it has some vital advantages such as the good generalization ability, being globally optimal, being resistant to the over-fitting problem, and having a small sample size (Chan et al 2001). Furthermore, it is suitable to address the non-linear relationships.

The SVR function can be written as follows:

$$f(x) = \sum_{i=1}^{n}(\alpha_i - \alpha_i^*)k(x_i . x) + b \qquad (1)$$

where α_i and α_i^* are the Lagrange multipliers, $k(x_i . x)$ is the kernel function and b is the bias term of the SVR model.

4. Modeling of the Real data

In this section, we explore the relationship between the exchang rate of the Iraqi dinnar and the money supply. The data is collected from the central bank of Iraq based on the annual rate. Then, we compare the ordinary least square error (OLS) with the support vector regression model (SVR). We build two models when the exchang rate is the dependent variable, the fist model when the predicted varaiable (X_1) is the money supply in the narrow sense (M_1) that written in the following equation.

$$X_1 = M_1 = C + D \qquad (2)$$

2

where the C is the circulated currency and D is the deposits with the banks.

The other model is explained in equation (3) when the predicted varaiable (X_2) is the money supply in the broad sense (M_2).

$$X_2 = M_2 = M_1 + T \qquad\qquad (3)$$

where the T is the saving deposits at the commercial banks.

It should be noted that the parameters of the SVR model set by using the grid search procedure. The data come from the Iraqi central Bank for years (2003-2015). The data are scaled to be distributed with zero mean and variance equal one. **The kernel function that used in this example is the Radial Basis Function (RBF)**. All calculations were implemented by R software.

The results of applying the compared two methods are put in the Table1. It can be seen that the SVR achieved the less values of MSE and VAR for both models (M1 and M2). Furthermore, the results of two models (M1 and M2) almost converged. This is due to the fact that M1 is the part of the M2, therefore, the similarity in both models to a great degree is normal. This similarity is clearly can be shown in Figure1 and 2.

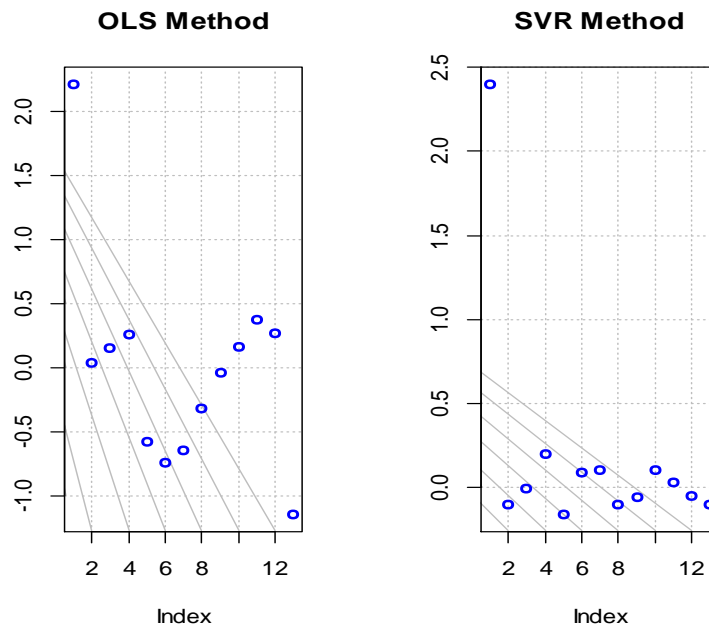| Methods	MSE1	VAR1	MSE2	VAR2
OLS	0.613	0.664	0.614	0.665
SVR	0.426	0.455	0.422	0.467

Table1: The results of applying OLS and SVR methods

Fig.1: The residuals of OLS and SVR with independent variable M1

The Figures 1and 2 explain the superiority of the SVR over OLS based on the residuals of the models. The SVR has low residuals and more flat than OLS mehod. On the other hand, the residuals of the two models of OLS and the two models of the SVR looks similar. In reality, this happened because the independent variable in the first comparison M1 is part of the independent variable in the second comparison M2.
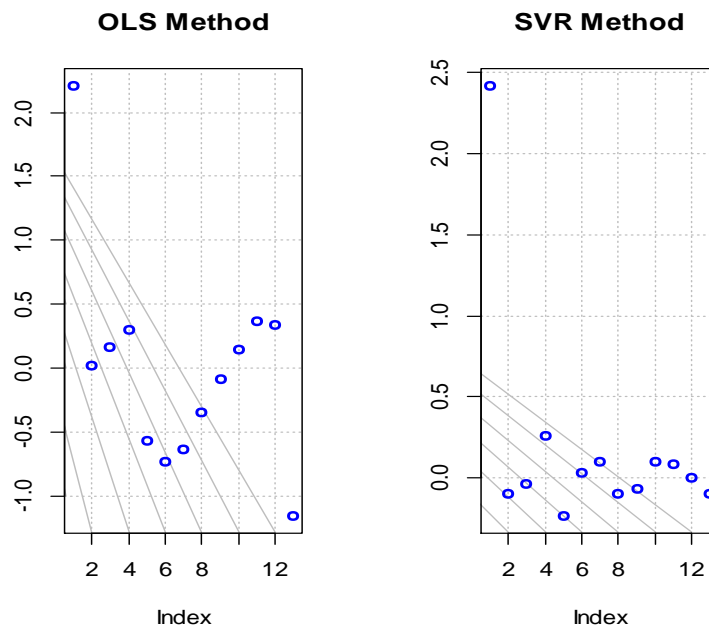

Fig.2: The residuals of OLS and SVR with independent variable M2

4

5. Conclusion

In this paper, the SVR technique is used to build the models of the exchange rate of Iraqi dinner compared with the OLS method. The fist model is when ($Y \sim M_1$) and, the second model is when ($Y \sim M_2$). In order to generalize the results, two criteria are used to compare the two methods. The comparison results are demonstrated, the superiority of the SVR over OLS for the two models. Thus, we can predict the exchange rate of the Iraqi dinnar more accurately by using the SVR model. Finally, the SVR technique is recomended to study and predict the exchange rate of the Iraqi dinner.

References:

[1] V. Ceperic, G. Gielen, , and A. Baric. Sparse\ varepsilon-tube support vector regression by active learning. *Soft Computing,* 2014.

[2] W. Chan, C. Chan, K. Cheung, and C. Harris. On the modelling of nonlinear dynamic systems using support vector neural networks. Engineering Applications of Artificial Intelligence, 2001.

[3] C. Cortes and V. Vapnik. Support-vector networks. *Machine Learning,* 1995.

[4] W. Dhhan, S. Rana, and H. Midi, Non-sparse ε-insensitive support vector regression for outlier detection, Journal of Applied Statistics, (2015.

[5] N. Hudson. Money and Exchange Dealing in International Banking. Springer, 1979.

[6] B. Moore. Shaking the Invisible Hand. Springer Nature, 2006.

[7] T. Singh. India's trade balance: the role of income and exchange rates. Journal of Policy Modeling, 2002

[8] J. Sutherland,and D. Canwell. Key Concepts in International Business. Springer, 2004.

[9] J. Tezcan, & Q. Cheng. Support vector regression for estimating earthquake response spectra. Bulletin of Earthquake Engineering, 2012.