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Non-Parametric Model to Explain the Effect of Exchange Rate on The Egyptian Trade Balance

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Abstract— **Nonparametric regression is a type of regression analysis in which the predictor does not take a pre-determined form but is constructed according to information derived from the data. Kernel regression is a non-parametric technique, The objective of its is to find a non-linear relation between a pair of random variables X and Y.**

In this paper, explain the relation between exchange rate and trade balance in Egypt covering the period from 1985 to 2015. The determinant for the end of the period is a substantial change in exchange rates in Egypt due to the float of the Egyptian pound.

Index Terms— **non-parametric regression, kernel regression , Nadaria- Watson estimator**

I. INTRODUCTION

It is known that the exchange rate affects the trade balance because of the reciprocal relationship between them. The balance is achieved in both the trade balance and the exchange rate through the balance between exports and imports. This balance works to stabilize the exchange rate level.

The exchange rate is one of the economic and financial indicators that reflect the quality of the economic performance of any country, so governments seek to pursue policies aimed at ensuring the stability of the prices of their currencies.

The trade balance is the index that measures the total difference between the value of exports and the value of imports of goods and services in the country. The changes in the exchange rate affect the trade balance so that the high exchange rate of the Egyptian pound leads to a rise in the relative prices of domestic products, leading to higher export prices compared to the prices of imports of foreign goods.

The rise in the foreign exchange rate against the Egyptian pound also leads to a rise in the prices of imports of foreign goods in exchange for the drop in the prices of exports of local goods and this leads to the imbalance of terms of trade. With the revolution of January 2011 in Egypt, which negatively affected the movement of the Egyptian economy as a whole and led to a deficit in the balance of payments. In 2015, the trade balance deficit increased due to the decrease in commodity exports resulting from the decrease in world oil prices and the increase in the quantity offered.

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II. METHODOLOGY

Non-parametric regression models are used in cases where information is insufficiently available for the regression function. These models rely on information derived from the data and therefore require that the data size be large when compared to the models.

General shape of non-linear regression models:

$$y_i = m(x_i) + \varepsilon_i \qquad (1)$$

Where:

$m(x_i)$ Is an indication of the unknown regression and denotes the expected value of y at X = x

ε_i The value of random errors that follows the natural distribution is represented by an average of zero and a variation of σ^2

$$\varepsilon_i \sim N(0, \sigma^2)$$

Namely, non-parametric regression models aim to estimate the unknown regression function directly rather than estimating the coefficients

The assumptions of non-parametric regression models are as follow:

1- The mathematical shape of the regression function is unknown.

2- The probability distribution of random variables is not known.

3- The real regression function is a continuous and continuous function, ie, it has continuous derivatives to a certain degree and the required degree of derivation depends on the used "podium."

parametric models are more flexible in data analysis when compared to models because the data are not dependent on a particular distribution.

Hardle (1994) explained that the aim of the nonlinear regression analysis is to analyze the undetermined regression function by reducing error observations that allow for the interpretation of the average response of y / x and to make a curve approximation called the smooth.

The process of introduction in non-parametric regression models:

The initialization process of these models is done by estimating the average values of the dependent variable at each point x by using a number of observations that are near or near the point of estimation. After the estimation process at all points, these points are graphically represented and connected in a way to obtain Curve is close to the real curve, which expresses the shape of the relationship between the variables under study since the nature of the relationship between the variables under study is not known. Examples of non-parametric regression models are kernel regression models one of the most common and used non-linear regression models. The estimation of the mathematical form of the regression function is done using Nadarya-Watson smoother by the conditional expectation of the dependent variable Y, provided that the independent variables X

$$m(x) = E(Y|X = x) = \int y\, f(Y|x)\,dy$$

$$= \int y \frac{f(x,y)}{f(x)} dy \qquad (2)$$

Where:

$f(x)$ The function of the density of the joint probability of the vector of the independent variables.

$f(y/x)$ The conditional density function of the dependent variable y is defined by the independent variable

$f(x,y)$ The common probability density function for the dependent variable Y and the independent variables X.

Kernel regression in Nadarya-Watson format

In 1964, both Nadarya and Watson evaluated the mathematical shape of the regression function in the case of one independent variable using the kernel estimator method. That is, both f (x) and f (x, y) are estimated by attaching to the so-called regression model kernel "Nadaraya – Watson

$$m_h(x) = \frac{\sum_{i=1}^{n} k_h(x - x_i)\, y_i}{\sum_{i=1}^{n} k_h(x - x_i)} \qquad (3)$$

Where : X the value for which the regression function is estimated.

X_i viewed number i of variable x.

K (.): The Kernel function is assumed to be a symmetric density function.

h: Parameter "Smoothing Parameter" is also called the Bandwidth

In order to estimate the regression function at x, the observations that occur in a small period around the x look are x (h, x + h).

Table (1) shows the different types of Kernel functions

Kernel	Kernel Function	Relative Efficiency
Epanechnikov	$\frac{3}{4}(1-u^2)\quad(\lvert u\rvert \le 1)$	1.0
Quartic	$\frac{15}{16}(1-u^2)^2\quad \lvert u\rvert \le 1)$	1.0602
Uniform	$\frac{1}{2}\quad(\lvert u\rvert \le 1)$	1.0602
Triangle	$(1-\lvert u\rvert)\quad(\lvert u\rvert \le 1)$	1.0114
Triweight	$\frac{35}{32}(1-u^2)^3\quad(\lvert u\rvert \le 1)$	1.0114
Gaussian	$\frac{1}{\sqrt{2\pi}}\exp(-\frac{1}{2}u^2)$	1.0108

source :Kayri and Zirhlioglu (2009)

The estimation of the dependent variable is based on the use of the Kernel estimator for the marginal and common density units and the application of the "Nadarya -Watson" formula to estimate its expected value. We use the following formula:

Y	Estimate
Mean y	-7.093238
Effect x	1.387786

$$\hat{m}_{NW}(x) = \frac{\sum_{i=1}^{n} k_h(x - x_i)\, y_i}{\sum_{i=1}^{n} k_h(x - x_i)} \qquad (4)$$

Where: $\hat{m}_{NW}(x)$ is the unknown Kernel function that we want to estimate using the Nadarya- Watson method

This estimate can be written in another way:

$$\hat{m}_{NW}(x) = \sum_{i=1}^{n} w_{n,i}(x) y_i$$

Where: $w_{n,i}(x)$ is the function of weight and is equal to $w_{n,i}(x_1, \dots, x_n) = w_{n,i}(x)$

Usually, these weights are not negative and the total is equal to the correct one and gives the observations very close to the point x greater weights than the distant views and can be written as follows:

$$w_{n,i}(x) = \frac{k\left(\frac{x - x_i}{h}\right)}{\sum_{i=1}^{n} k\left(\frac{x - x_i}{h}\right)} \qquad (4)$$

The common density function can be written as follows:

$$\hat{f}(x,y) = n^{-1}h^{-1}\sum_{i=1}^{n} k\frac{(x - x_i)}{h}\, k\frac{(y - y_i)}{h} \qquad (5)$$

$$\hat{f}(x) = n^{-1}\, h^{-1}\sum_{i=1}^{n} k\left(\frac{x - x_i}{h}\right)$$

APPLIED STUDY

in this section**,** the applied study of Egypt economy about the Exchange rate and Trade Balance for the period from 1985 to 2015 annual data , the source of data is World Bank Database World Bank Database

http://data.albankaldawli.org/indicator/...

Nonparametric kernel regression

Bandwidth

	Mean	Effect
Mean x	1.386976	1.681258

Local-linear regression

number of obs =29

kernel : epanechnikov

E(Kernel obs) =29

bandwidth: cross validation

R-squared = 0.6723

$$\hat{y} = \frac{\left\{\sum_{i=1}^{29} \frac{3}{4}\left[1 - \left(\frac{x - x_i}{1.386976}\right)^2\right]\right\} * y_i}{\sum_{i=1}^{29} \frac{3}{4}\left[1 - \left(\frac{x - x_i}{1.386976}\right)^2\right]}$$

Using the equation to predict the values of the variable for the next two time periods and to compare the values in the real values, found that the values shown are very close to the real values which indicates the quality of the model used.

			Kernel regression
Year	y	x	$m(x)$
2014	-8.54465	**7.0776**	**-7.0795205**
2015	-8.44102	**7.6913**	**-8.8016284**
		MSE	**1.53384**

III. CONCLUSION

The Kernel regression model is a new addition to regression methods that can be used to predict variables that give good values. The state should increase international reserves of foreign exchange and reduce the trade balance deficit and Lack of continuity in the system of reduction in the exchange rate because it leads to imbalance in the balance of trade, also must maintain the values of exports to be equal or exceed the values of imports in order to prevent a deficit in the balance of trade.

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