

Kernel estimation of returns of retirement funds of employers based on monetary earnings (subscriptions and compensation) via regression discontinuity in Iraq

Omar Abdulmohsin Ali¹, Mohammed Qusay Naji², Mustafa Muneer Ismaeel³

¹Department of Statistics, University of Baghdad

²Ministry of Labour and Social Affairs

³Department of Banking and Finance Sciences

ABSTRACT

Regression Discontinuity (RD) means a study that exposes a definite group to the effect of a treatment. The uniqueness of this design lies in classifying the study population into two groups based on a specific threshold limit or regression point, and this point is determined in advance according to the terms of the study and its requirements. Thus, thinking was focused on finding a solution to the issue of workers retirement and trying to propose a scenario to attract the idea of granting an end-of-service reward to fill the gap (discontinuity point) if it had not been granted. The regression discontinuity method has been used to study and to estimate the effect of the end -service reward on the cutoff of insured workers as well as the increase in revenues resulting from that. The research has showed that this reward has a clear effect on increasing revenues due to the regularity of workers in their work and their work continuity. It has also found that using Local Linear Smother (LLS) by using three models of bandwidth selection. Its results after the analysis in the Regression program have been as follows: The CCT (Calonico, Cattaneo & Titiunik) beamwidth gives the best performance followed by the local linear regression using the LK (Lembens and kalyanman) beamwidth. The real data has been used in sample size 71 represented in compensation as a variable of effectiveness (illustrative) X and the revenue as a result or an approved variable Y, while the results of the traditional OLS estimation method have not been good enough.

Keywords: Regression Discontinuity, Local Linear Smother, Bandwidth Selection, CCT, LK

Corresponding Author:

Mohammed Qusay Naji
Ministry of Labour and Social Affairs
Baghdad, Iraq
Email: mohammed.act1@gmail.com

1. Introduction

Regression Discontinuity (RD) design is defined as a semi -experimental method that can be used to assess the effects of a treatment or intervention as it works to study the effect of this treatment on the group eligible for this treatment or intervention. The uniqueness about this design is that the study population is divided into two groups based on a specific threshold limit or the so-called discontinuity point, this point is determined in advance according to the terms of the study and its requirements [1-5].

The regression discontinuity's significance (RD) comes from the fact that the effect of treatment will result in a transferring or interruption in the regression function point of the relationship between Xi (explanatory variable) and the result Yi.

Simply it could be said that the regression discontinuity (RD) divides the study population into two groups are the bottom and the top of the discontinuity, and as in the randomized experiment, the design of the regression discontinuity (RD) assumes the equivalence of the two groups in the absence of the treatment effect.

The main attraction in this method is that it can be used to estimate the effect of treatment provided to those who need it or use it, provided that that need should be identified [6], [13]

In experimental designs, random assignment ensures that the treatment and comparison groups are initially equal. The difference can then be attributed to the treatments (the effect of the treatments), but it is clear that

we do not expect this equivalence found in the design of regression discontinuity (RD). Thus, instead of this condition we assume that the relationship between the task variable (X_i) and the result (Y_i) is equal for the two groups, the same as the continuous regression line that comprises the two groups. Thus, the interpretation of the regression discontinuity (RD) mostly depends on two factors:

1. There is no other alternative reason that can lead to discontinuity at the point of discontinuity.
2. We can model the previous treatment later [14].

1.1. Selection of the discontinuity point

The design of the regression discontinuity (RD) requires task variable (X_i) and the result variable (Y_i) be chosen so that they are of sufficient quality to justify the appropriate regression analysis and thus the discontinuity value could be chosen only based on available resources. For example, if there is a program applied for 25 people. However, only 70 people could be applied to treatment (program entitlement). The discontinuity point identified that only 25 people are in need of treatment. The discontinuity point can also be chosen for substantial and important reasons. For example, if the task variable X_i represents an indication of the severity of the disease measured on a scale of 1-7, experts may confirm that all those who have obtained a rate of 5 or more are sick enough to deserve treatment, so a justified discontinuity point of 5 can be used theoretically [2].

1.2. Treatment differences

When treatment decisions are absolute, the control group does not receive any real or unreal treatment. Whereas when treatment comparisons are relative, the comparison group receives alternative treatment, and it is often the current standard treatment that has been compared to the new treatment. One of the advantages of regression discontinuity design is that it allows for the customization of progressively more dangerous treatments for those who are urgently in need of them.

Suppose we have three treatment programs, a standard program, in addition to two more effective experimental programs. It is then possible to obtain two discontinuity points and allocate the most effective treatment to the needy patients and the least effective treatment (the standard) to the least needy, and the moderate impact-treatment for those who fall between the two periods. If there is no prior basis for making judgments about the effect, the alternative may use one term and designate at least a need for treatment during the assignment that is random.

Violating the task rule (choosing the most appropriate treatment) leads to misallocation and is often called wrong allocation, for example teachers or parents may try to identify students who have missed an educational program and give them a new compensation program based on other reasons than the reasons that led to be appointed at the beginning. Trochim (1984) [14].

2. Research method

2.1. Regression discontinuity estimation methods

In practical practices, there is a way to carry out regression discontinuity is to perform the regression analysis twice separately on each side of the discontinuity point in terms of sensitivity operations. It is appropriate to subtract the discontinuity from the variable i.e. converting X to $X-C$, and therefore the two regression junctions give the value of the regression function at the discontinuity point [1, 2, 3, 5].

The regression pattern on the left side of the discontinuity point ($X < C$) is:

$$y = a_L + m_L(x_i - c) + \varepsilon \dots\dots\dots(1)$$

While the regression pattern is on the right side of the discontinuity point ($X \geq C$)

$$y = a_r + m_r(x_i - c) + \varepsilon \dots\dots\dots(2)$$

Since m_L and m_r are the regression functions on both sides of the discontinuity, the treatment effect can be calculated by the difference between them, for example. The direct method is to estimate the effect of treatment using collective regression on both sides of the discontinuity.

$$y = a_L + Tw + m(x - c) + \varepsilon \dots\dots(3)$$

$$T = a_r - a_L \dots\dots\dots(4)$$

$$m(x - c) = w[m_r(x - c) - m_L(x - c)] \dots\dots\dots(5)$$

One advantage of this method is that it leads directly to standard estimates and errors for the effect of T therapy. However, in the regression function obtained from the difference between the two functions on the sides of the discontinuity by including the term interaction between X and w for example the following linear case:

$$m_L(x - c) = B_L(x - c) \dots\dots\dots(6)$$

$$m_r(x - c) = B_r(x - c) \dots\dots\dots (7)$$

And the aggregate regression can be as follows:

$$Y = a_L + Tw + B_L(x - c) + (B_r - B_L)w(x - c) + \varepsilon \dots\dots\dots(8)$$

The problem with restricting regression linear to be the same on both sides of the discontinuity ($B_r = B_L$) is best illustrated by returning to the separate regressions, we have to constrain the regression on either side of discontinuity, then this is to use the data on the right side of the discontinuity to estimate a_L and vice versa. It is understood that in regression discontinuity design, the treatment effect is obtained by comparing the conditional results of Y when approaching the left:

$$a_L = \lim_{x \rightarrow c} E[Y_i/X_i = x] \dots\dots\dots(9)$$

from the right

$$a_r = \lim_{x \rightarrow c} E[Y_i/X_i = x] \dots\dots\dots(10)$$

Thus, the regression restriction itself will not be consistent with the idea of (RD), since the data from the right of the discontinuity will be used to estimate a_L , as is the case with the left of the discontinuity.

In practice, however, the regression function $m(x-c)$ is estimated to be the same on either side of the discontinuity point. One possible justification for doing this is that if the shape of the function is the same on both sides of the discontinuity, more effective estimates of the effect of T therapy will be obtained by assuming that it is an additional estimate and should not be considered the fundamental basis of the experimental method. There are two methods of estimation are: parameter method and non-parametric method as in the below.

2.2. Parametric and non-parametric regression

In the basic setup for the regression discontinuity (RD), researchers are concerned with the causal effect of treatment. Suppose we have a sample of n observations randomly drawn from a population of size N , whereas $Y_i(1)$ for each $N, \dots, 1 = i$ indicates the outcome of observation likely received treatment [4, 8, 11, 14].

$Y_i(0)$ indicates a possible outcome that did not receive treatment. This can be summarized according to the following:

$$y_i = \begin{cases} y_{i(0)} & \text{if } w_i = 0 \\ y_{i(1)} & \text{if } w_i = 1 \end{cases} \quad (11)$$

It is also noted that for each view a variable called the task variable or Forcing Variable is referred to as X_i

$$m(x_i) = E[y_i/x_i=x] \dots\dots\dots(12)$$

The conditional prediction of the result y_i when the task variable x_i is given. The basic idea in design of Sharp Regression Discontinuity (SRD) is that the w_i treatment is determined only by the value of x_i on both sides of the discontinuity point as in:

$$w_i = 1 \quad \text{if } x_i \geq c \dots\dots\dots(13)$$

The concentration of the sharp regression discontinuity (SRD) design focuses on the average processing effect of units with variable values equal to the discontinuity.

$$T_{RD} = E[y_{i(1)} - y_{i(0)} / x_i = c] \dots\dots\dots(14)$$

We now assume that the conditional distribution functions $F_y(0) / x (y/x)$ and $F_y(1) / x (y/x)$ are continuous at x per y and that the first conditional moment for each $E[y_i(1)/X = x]$

Is existed at $c=x$ and $E[y_i(0)/X = x]$

Then

$$T_{RD} = M_+ - M_- \dots\dots\dots(15)$$

Where M_+
 $M_+ = \lim_{x \downarrow c} m(x) \dots\dots\dots(16) \dots$

and M_-
 $M_- = \lim_{x \uparrow c} m(x) \dots\dots\dots(17)$

Thus, the estimate is the difference between the regression functions calculated at the discontinuity point and Figure 1 illustrates this. The methods for estimating T_RD will be illustrated by both the parameter and non-parametric regression.

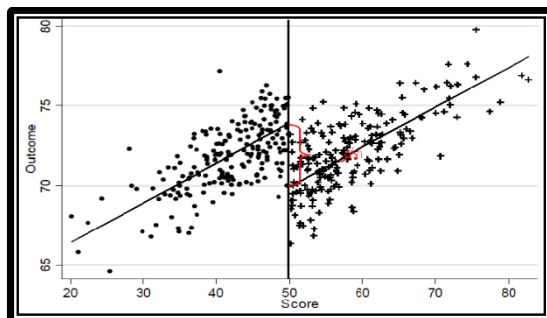


Figure 1. Effect of the treatment used before and after the discontinuity point

2.3. Estimation of the parametric regression discontinuity [4], [8], [14]

In general, there is a way to implement the regression discontinuity. It is employed to perform the regression analysis twice separately (separately) on each side of the discontinuity in terms of mathematical operations, where the analysis begins by subtracting the value of the regression from the task variable x_i means converting x to $x-c$ and thus the regression cross give the value of the regression function at a discontinuity point.

The expected value model of y_i can be given as follows:

$$E(y_i) = \beta_0 + \beta_1 w_i + \beta_2 \tilde{x}_i w_i + \beta_3 \tilde{x}_i^2 w_i + \dots + \beta_n \tilde{x}_i^s w_i + \varepsilon \dots\dots(18)$$

Where \tilde{x}_i : represents the value of the variable x minus the value of the discontinuity (c)

y_i : represents the measurement of treatment i

w_i : represents the giving of the treatment or not as

$$w_i = \begin{cases} 1 & \text{receiving treatment} \\ 0 & \text{not receiving treatment} \end{cases}$$

.....(19)

s : represents the degree of the polynomial for \tilde{x}

β_0 : represents Parametric group that did not receive treatment at the discontinuity point c

β_1 : represents parametric treatment effect

β_n : represents a parameter of multi-borders from the degree s

The OLS method is used to estimate the effects of treatment at the discontinuity point to test changes in averages and inclinations (regressions).

It is also required, as we explained above, to subtract the discontinuity value c from each degree of prior testing, as the term \tilde{x}_i indicates that the conversion was made for the values of the task variable x_i .

Any degree of polynomial degrees can be used in the model. There are certain limitations in determining the degree of polynomial that can be dependent on the true pre-relationship between x and y . It may be of the second or third degree, as there is no easy way to define a final and appropriate model.

Any statistical modeling and regression discontinuity (RD) require judgment, as well as multiple analyzes based on different assumptions about the true pre- relationship.

2.4. Estimation of the non-parametric regression discontinuity

There are many factors that push researchers to choose non-parametric methods. The most prominent of these factors is the lack of knowledge of the true form of the real function, and when the relationship is non-linear between the task variable x_i and the y_i variable. So, the researchers suggested many non-parametric methods to provide flexible estimates of the effect function and one of the most important of these methods is a local linear regression.

2.5. Local linear regression (LLR)

This method is one of the most used methodologies to estimate the average effect of treatment when discontinuity in designing regression discontinuity being that instead of just calculating averages it reduces bias and the remaining bias can be considered as normal [4, 7, 8, 12].

It will be concentrated on estimating T_RD using local linear regression LLR on both sides of the discontinuity. This method is an important non-parametric method in estimation due to the need to consistently estimate the regression function at a specific point. Moreover, the local linear regression estimator is preferred over other non-parametric methods in the case of regression discontinuity since it has distinctive properties at the boundary. It has the best estimation rate [6]. More clearly, we are estimating the regression function $m(.)$ Which represents the estimation of the treatment effect of the following non-parametric regression model:

$$y_i = m(x) + e_i \quad i = 1, \dots, n \dots\dots\dots(20)$$

Whereas:

$$\hat{m}(x) = \begin{cases} \hat{a}_-(x) & \text{if } x < c \\ \hat{a}_+(x) & \text{if } x > c \end{cases} \quad (21)$$

Whereas:

$$\hat{a}_-(x), \hat{\beta}_-(x) = \text{argmin}_{\alpha, \beta} \sum_{i=1}^n 1 * x_i < x (y_i - \alpha - \beta(x_i - x))^2 * k(\frac{x_i - x}{h}) \dots\dots\dots(22)$$

$$\hat{a}_+(x), \hat{\beta}_+(x) = \text{argmin}_{\alpha, \beta} \sum_{i=1}^n 1 * x_i > x (y_i - \alpha - \beta(x_i - x))^2 * k(\frac{x_i - x}{h}) \dots\dots\dots(23)$$

k: represents the core function

h: represents the width of the beam

Accordingly, estimating the effect of treatment is as follows

$$\hat{T}_{RD} = \hat{M}_+ - \hat{M}_- \dots\dots\dots(24)$$

Whereas:

$$\hat{M}_- = \lim_{x \uparrow c} \hat{m}(x) = \hat{a}_-(c) \dots\dots\dots(25)$$

$$\hat{M}_+ = \lim_{x \downarrow c} \hat{m}(x) = \hat{a}_+(c) \dots\dots\dots(26)$$

2.6. Choosing bandwidth

The interest of the researchers in choosing the width of the package is the outcome of their effort. The top of them was by (Hardl, et al.) who emphasized that the most important part in the efficiency of non-parametric estimation? It is the optimal choice for the width of the package, since the fact that choosing a large package width leads to an increase in the bias. Choosing a small package width leads to a reduction in the bias but contrast increases, so researchers try to find an average bandwidth that reduces the average MSE to the lowest possible level to get the best non-parametric estimation [9, 10].

The methods that were used by the researcher will be covered in this research.

2.7. Package view

This method has been suggested by Lmbens & Kalyanaraman in 2009 [9], where they explained that the optimal bandwidth option is to replace the six unknown quantities shown in the equation below which will ultimately lead to consistency of capabilities:

$$hLK = \arg \min AMSE(h) = ck \left(\frac{\sigma_+^2(c) - \sigma_-^2(c)}{f(c) * (\hat{m}_+^2(c) - \hat{m}_-^2(c))^2} \right)^{1/5} * n^{-1/5} \dots\dots\dots(27)$$

Whereas, after estimating the six unknown quantities in equation (28), the optimum beam width estimation becomes according to the following:

$$\tilde{h}LK = \arg \min AMSE(h) = ck \left(\frac{\hat{\sigma}_+^2(c) - \hat{\sigma}_-^2(c)}{\hat{f}(c) * (\hat{m}_+^2(c) - \hat{m}_-^2(c))^2} \right)^{1/5} * n^{-1/5} \dots\dots\dots(28)$$

2.8. Package width

This method has been suggested by both Calonico and others as an optimized package width for a regression model [14]. We find the initial beam width (Vn, Cn) where an initial beam width is created to estimate (Asymptotic Variance) which is referred to as \hat{V} whereas:

$$\hat{V} = 2.58 * \omega * n^{-5} \dots\dots\dots(29)$$

Where:

$$\omega = \min \left\{ S_x, \frac{IQR_x}{1.349} \right\} \dots\dots\dots(30)$$

Here, S_x & IQR_x indicate the variance of the sample and the quadratic range $\{x_i; 1 \leq i \leq n\}$ then the width of the beam \hat{c}_n whereas:

$$\hat{c}_n = \left(\frac{1}{v,p,q} \right)^{1/2q+5} * n^{-1/2q+5} \dots\dots\dots(31)$$

We find the beam width \hat{b}_{cct} which is calculated according to the following formula:

$$\hat{b}_{cct} = \left(\frac{1}{0,1,2} \right)^{1/2q+5} * n^{-1/7} \dots\dots\dots(32)$$

We find the basic beam width \hat{h}_{cct} according to the following formula:

$$\hat{h}_{cct} = \left(\frac{1}{0,1,0} \right)^{1/5} * n^{-1/5} \dots\dots\dots(33)$$

$$\hat{c}_{0,1,0} = \frac{n * \hat{v}_n * \hat{v}_{0,1}}{4\beta_{0,1}^2 \{ (\hat{e}_2 * \hat{\beta}_{+,2}(\hat{b}_{cct}) - \hat{e}_2 * \hat{\beta}_{-,2}(\hat{b}_{cct}))^2 + 3\hat{v}_{2,2} * \hat{b}_{cct} \}} \dots\dots\dots(34)$$

2.9. Subscriptions

It is the amounts that the employer pays for the workers working in his company and are included in social security. That is, his company is registered with the Social Security Department; therefore, the payment of the subscription is monthly). It deducts it from their monthly salary to pay it to the Social Security Department and the total amount is 17% of the employee's salary that being divided by this 5% of the employee's salary and 12% of the company's owner within the framework of the employee's salary.

For example, the employee's salary is 500,000 five hundred thousand dinars, 17% of which must be paid monthly as a subscription to the department by the company's owner. Therefore, the monthly subscription for this worker is 85,000 eighty-five thousand dinars, of which the worker pays 5%, i.e. 25,000 twenty-five thousand dinars. The rest of the 12% is paid by the owner of the company, valued at 60,000, to be, after its merger, the total paid to the department, and as we said previously, 17%, means 85,000, eighty five thousand dinars.

2.10. Compensation

It includes both the end-of-service and retirement bonus, as the end-of-service remuneration is the cash equivalent that a worker takes a year after the date he left the work from the guaranteed company that the worker is working in. It is considered compensation for any amounts disbursed from the fund and thus negatively affects the fund's revenue from contributions as the worker here has lost his contribution. For instance, his monthly payment has been lost), as well as giving him end-of-service payment (amount deducted from the Social Security Fund), meaning that this negatively affects the fund and is calculated by a special formula according to the service and salary.

Here, we must make it clear that the end of service reward is the one. It represents the discontinuity point, that is, the point that we must give the worker an incentive in order to continue the work and thus his continuation means his continuation of paying the contribution and the incentive considered as a discontinuity point is a five million dinar equivalent for someone who has passed 15 years of his career. That is, the employee's period of work in the company) provided that the worker pledges to continue paying until the retirement age.

2.11. Classification of data

The research 's data were collected using the data of the Ministry of Labor and Social Affairs, the Social Security Department in Baghdad, as we have been provided with annual rates of contributions for the period (2014-2019). As for the explanatory variable (compensation) data have been taken for the same years.

2.12. Explanatory variables

The message model included an explanatory variable x one, which is compensation, because the study model is the regression discontinuity model (RD).

2.13. Adopted variable (subscriptions):

According to the study, the contributions are greatly affected by the amount of compensation, especially after reducing workers' deductions, which results in the regression discontinuity model. It is worth noting that the practical application was applied using the programming language R (3.1.2).

3. Results of the analysis

The data gathered by the researcher that represents the effect of the variable x that represents (compensation) in the variable y that represents (revenue) will be analyzed here.

Table 1 depicts some statistical indicators of the data as a whole. It becomes clear that the value of the mean of the dependent variable y was $(1.64E + 04)$ with a standard deviation of $(3.86E + 03)$ and that the lowest value was $(5.21E + 03)$ and the highest value was $(2.50E + 04)$, in addition to this it is clear by drawing the values of the dependent variable y below that there is an increase in its value and this rise is due to the change in the values of the independent variable x .

Table 2 represents some statistical indicators of the data before the discontinuity point of $(5,000,000)$, as it becomes clear that the value of the mean of the dependent variable y before the discontinuity point reached $(1.40E + 04)$ with a standard deviation of $(2.83E + 03)$ and that the lowest value reached $(5.21E + 03)$ and the highest value reached $(1.70E + 04)$. In addition, it is clear by drawing the values of the dependent variable y below that there is an increase in its value and this rise is due to the change in the values of the independent variable x .

Table 3 represents some statistical indicators of the data after the point of discontinuity of $(5e + 06)$. It represents the effect of the used treatment represented by paying an amount of five million dinars $(5,000,000)$. It becomes clear that the value of the mean of the dependent variable y after the discontinuity point reached $(1.95E + 04)$ with a standard deviation of $(2.56E + 03)$ and the lowest value of $(1.50E + 04)$ and the highest value of $(2.50E + 04)$. In addition to this, it is clear by drawing the values of the dependent variable y in the below that there is an increase in its value and this the height is caused by the values of the independent variable x .

Table 1. Some statistical indicators for the data as a whole

Variable	Mathematic mean	Standard deviation	Difference coefficient	Lowest value	Highest value
X	6.32E+03	5.33E+03	.84	5.71E+02	1.79E+04
Y	1.64E+04	3.86E+03	.23	5.21E+03	2.50E+04

Table 2. Some statistical indicators for the data before the discontinuity point

Variable	Mathematic mean	Standard deviation	Difference coefficient	Lowest value	Highest value
X	2.51E+03	9.57E+02	.38	5.71E+02	4.21E+03
Y	1.40E+04	2.83E+03	.20	5.21E+03	

Table No. (3) shows some statistical indicators for the data after the discontinuity point

Variable	Mathematic mean	Standard deviation	Difference coefficient	Lowest value	Highest value
X	1.12E+04	4.56E+03	.41	5.50E+03	0.44
Y	1.95E+04	2.56E+03	.13	1.50E+04	

Through the two tables above that represent the statistical indicators before and after the discontinuity point, we notice that the value of the arithmetic mean of the variables x and y has increased after the discontinuity point compared to before the discontinuity point. In addition, the standard deviation of the variable x has increased after the discontinuity point compared to the previous discontinuity point. The standard deviation of the variable y has decreased its value after the discontinuity point compared to before the discontinuity point.

Figure 2 shows the values of the arithmetic mean and the standard deviations before and after the discontinuity point:

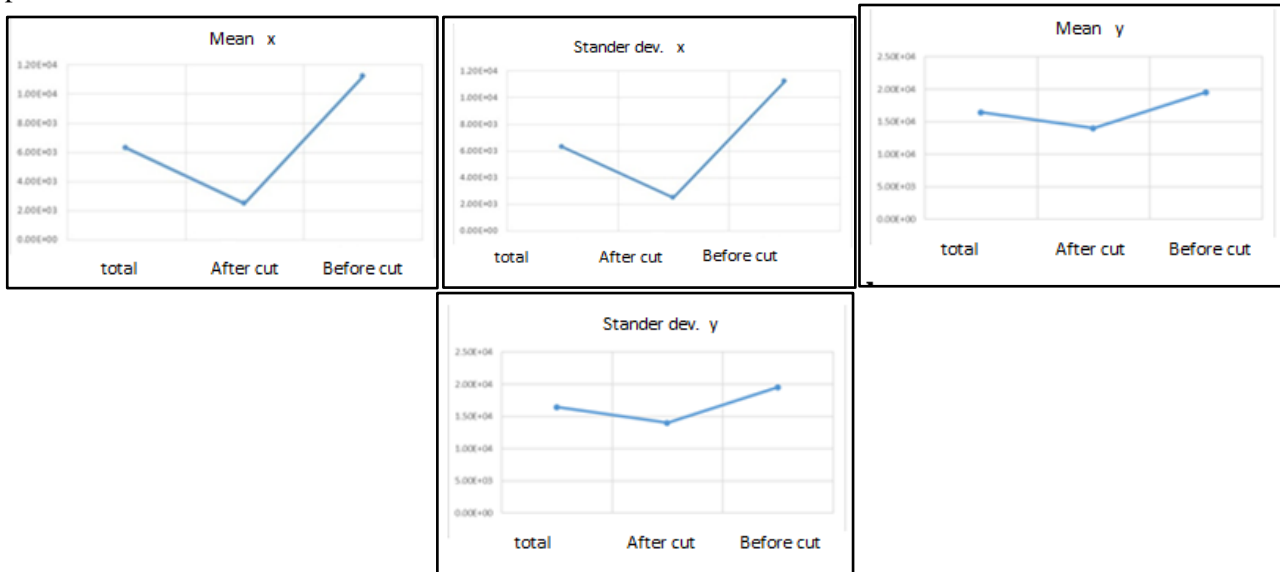


Figure 2. The values of the mean and standard deviations before and after the discontinuity point

Based on Figure 3, it shows the location of the breakpoint within the spread of the values of the independent variable x:

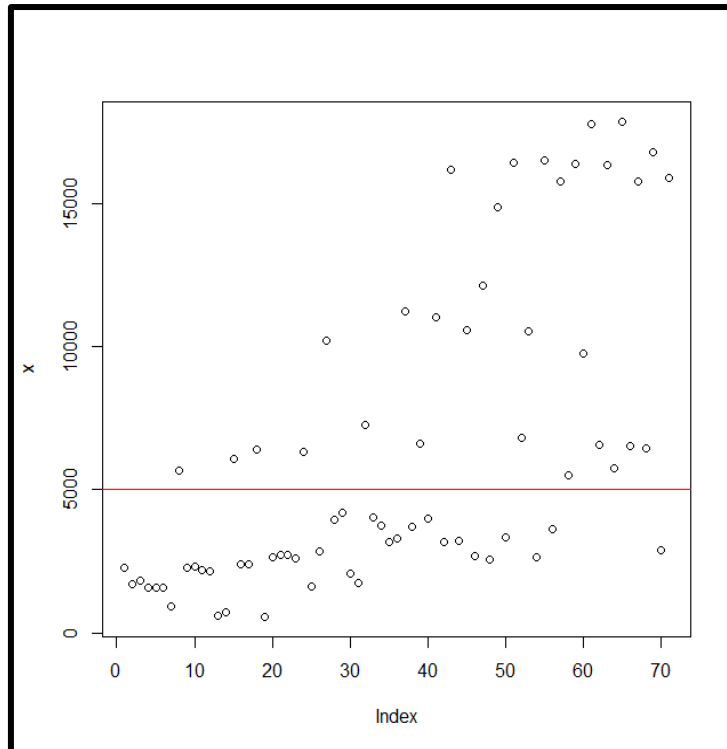


Figure 3. The effect of the discontinuity y point on determining the direction of the studied data

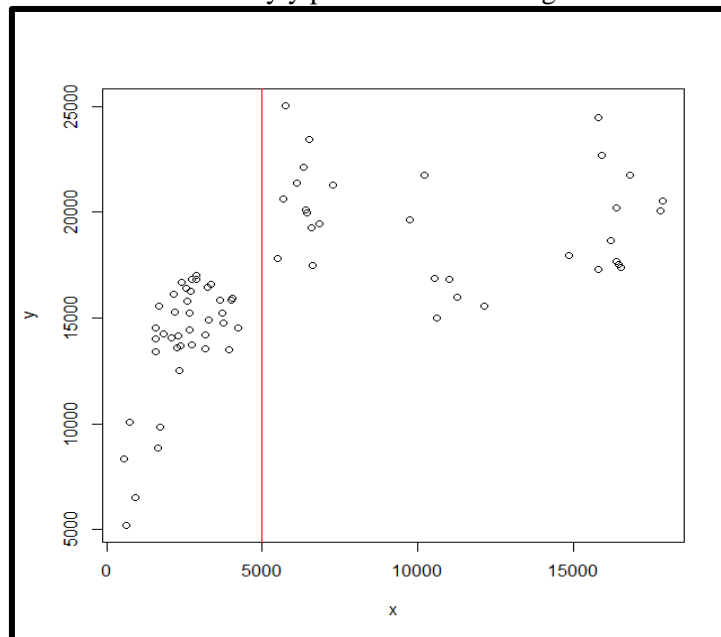


Figure 4. The pattern of data spread after the point of discontinuity than it was before the point of discontinuity

In addition, for the purpose of giving a clearer picture about the effect of the discontinuity point in determining the direction of the studied data, the researcher drew the shape of the spread of the variable values x against the values of the dependent variable y and determining the value of the discontinuity point as in Figure 4.

It is clear from Figure 4 that the pattern of data spread has differed after the discontinuity point from what it was before the discontinuity point.

3.1. Linear regression

The research data has been analyzed based on simple linear regression for the purpose of giving an initial look at the nature of the data and the relationship between the variable x and the variable y if this traditional method

is used so that these results are paved for the application of the regression discontinuity design (RDD). Table 4 includes the values of the estimates using the OLS method.

Table 4. Analysis of variance for the simple linear regression model

Variable	Parametric estimated value	Standard value	T-test value	Sig.
Consistency	1.371e+04	5.781e+02	23.708	0.000
Variable X	4.307e-01	7.016e-02	6.139	0.000
Determination coefficient	0.35			
Root Squares Standard Errors / RMSE	3127			

Table 5. The capabilities of the linear regression using the LK beamwidth

Variable	Estimated parametric value	Standard error value	T- test value	Sig.
Variable x (LATE)	6462.98	1982.3	3.26	0.002
Determination coefficient	0.716			
Root Squares Standard Errors / RMSE	330.1			

The above results show that the regression line was 01- 4.307e, that the model was significant, that the value was significant (Sig = 0.000) which is less than 0.05 and a parameter of 0.35, and this indicates the weakness of the model, given that the value of RMSE has reached 3127.

Figure 5 shows the graph of the spread of the variable x values against the y values in addition to the regression line.

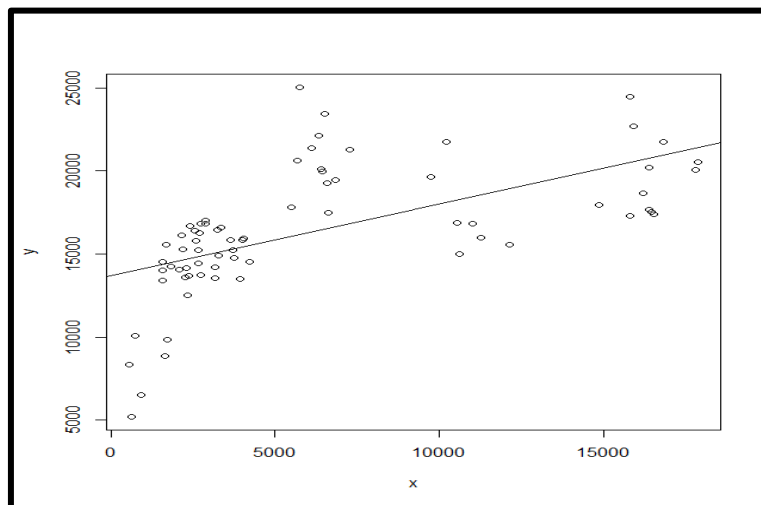


Figure 5. The spread of variable values x against y values in addition to the regression line

Based on these figures, it shows the drawing of the estimated values of the variable y against the error values, the QQ-plot drawing of the standard errors, drawing the estimated values of the variable y against the root of the standard errors and finally the drawing of the values raised against the values of the standard errors to determine which of the values of the dependent variable that had the greatest impact on the regression.

Through Figure 6, the depiction becomes more clear about existence of some values that are close to each other, while others move away to meet in another place.

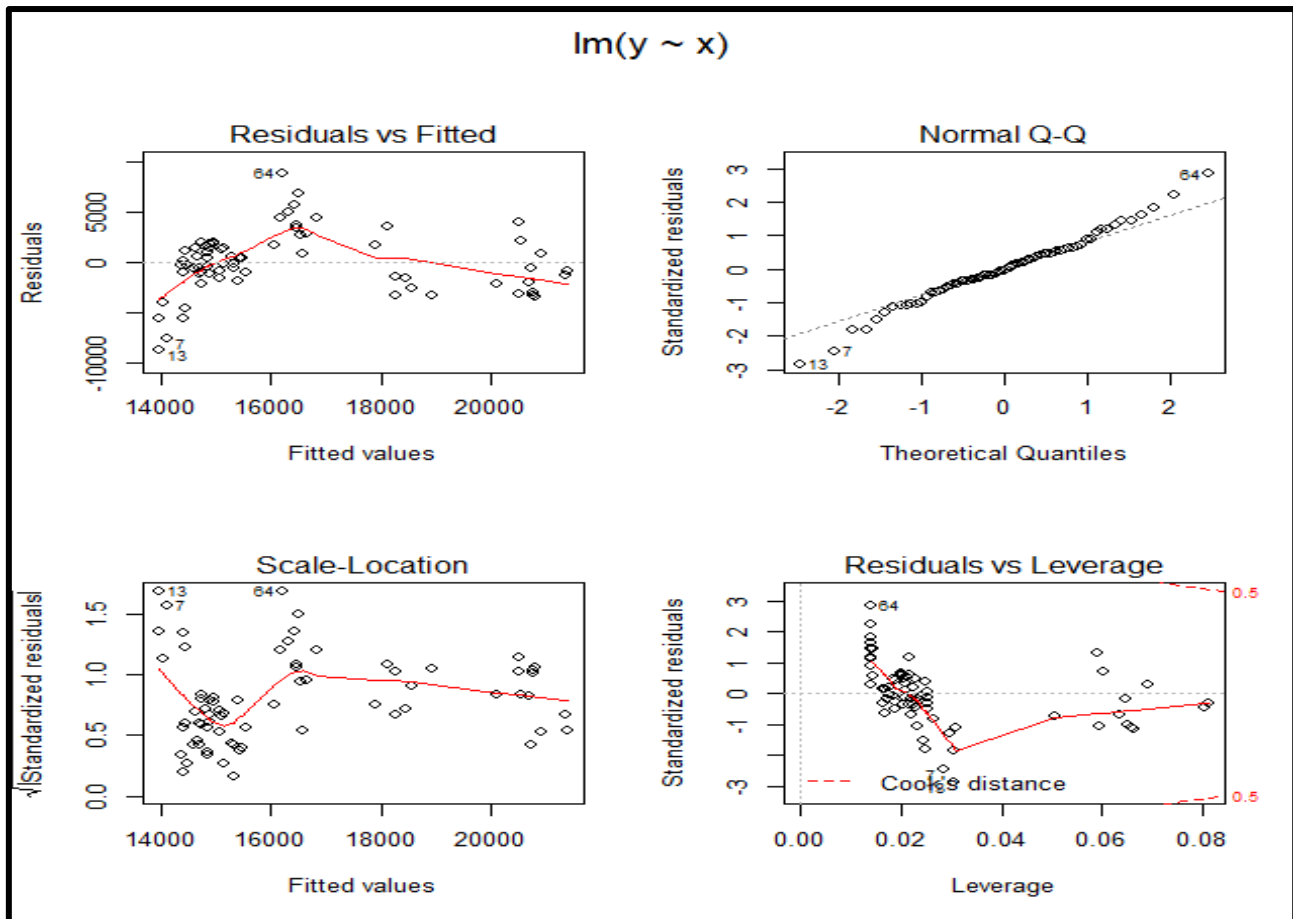


Figure 6. The values against the standard errors and the values of the variable y against the root of the standard errors in addition to the values raised against the values of standard errors.

3.2. Regression discontinuity design

Complementing what was presented on the theoretical side, Regression Discontinuity Design (RDD) design method will be applied to the data in question. The local linear regression method was used in the case of sharp RDD design to estimate the regression function on both sides of the discontinuity point. The most important part in accuracy estimation by this method mainly depends on the width of the package or what is also called the preamble parameter. Therefore, the researcher has relied on three methods to calculate the width of the package, relying on previous studies and the results obtained from those studies as a result of employing types of package width and employing those that gave the best results in light of the regression discontinuity application that are:

The first: The proposed package presentation by researchers Imbens & Kalyanaraman [9] in 2012 which was briefly named LK and explained in detail in [9].

Second: The proposed package presentation by researchers Calonico & Cattaneo & Titiunik [1] in 2014 which was named CCT and explained in detail in [10].

3.3. LK bandwidth

The LK bandwidth was used with the previously mentioned discontinuity point. The value of the LK bandwidth was calculated based on the equations shown in the theoretical side [9], where its value was $LK = 2432.081$ and the following table shows the local linear regression capabilities in addition to the root of the mean standard error and its statistic t test and its significance as it is clear from Table 5.

The local average treatment effect indicates that there is an effect of the treatment. It was made by granting an amount of five million dinars. This treatment led to a rise in the value of the dependent variable y where the rise of the value of the independent variable x by one unit leads to the value of the variable y increased by 6462.9 Iraqi dinars. The following figure shows a drawing of the estimated values before and after the discontinuity value in addition to the estimated regression line drawing using the non-parametric regression method using the

Local Linear Smother (LLS) method to show the difference between them. The RMSE = 330.1 error with a coefficient of 0.716 was lower than that obtained using the OLS linear regression.

Figure 7 shows that the treatment used led to a change in the value of the adopted variable, as the difference between the shape of the data before and after the discontinuity, point becomes clear.

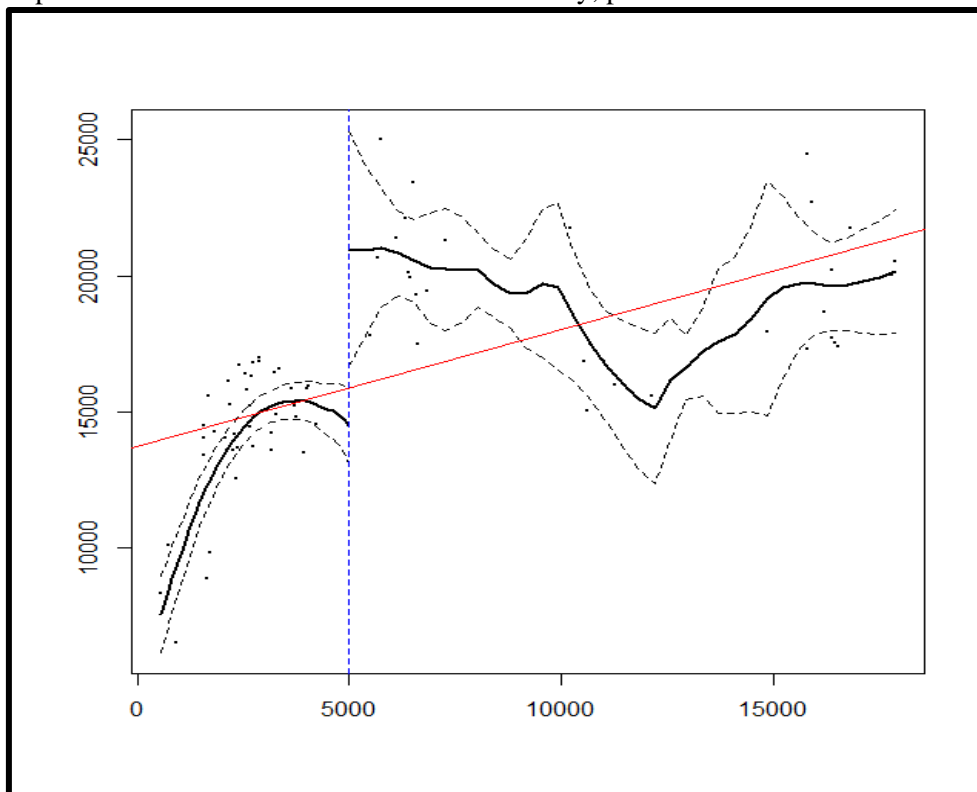


Figure 7. The effect of the treatment used on changing the value of the approved variable before and after discontinuity using the width of the LK beam

3.4. CCT bandwidth

The CCT beamwidth was used with the previously mentioned discontinuity point. The value of the CCT bandwidth was calculated based on the equations shown in the theoretical side where its value was CCT = 2625.665. Table 6 shows the capabilities of local linear regression, in addition to the mean standard error and the t-test statistic and its significance.

Table 6. The capabilities of local linear regression using the CCT beamwidth.

Variable	Estimated parametric value	Standard error value	T-test value	Sig.
Variable x (LATE)	6501	1782.17	3.648	0.000
Determination coefficient	0.721			
Root Squares Standard Errors / RMSE	306.2			

The value of the local average treatment effect indicates that there is an effect of the treatment that was carried out by granting an amount of five million dinars. This treatment led to a rise in the value of the dependent variable y where the rise of the value of the independent variable x by one unit leads to Increase the value of the variable y by 6501 Iraqi dinars.

Figure 8 shows drawing the estimated values before and after the discontinuity value, in addition to drawing the estimated regression line using the OLS method to show the difference between them. The error value RMSE = 306.2 with a coefficient of 0.721 was lower than that obtained using IK beamwidth.

The graph below shows that the treatment followed resulted in a change in the value of the adopted variable, as the difference between the shape of the data before and after the discontinuity point becomes clear.

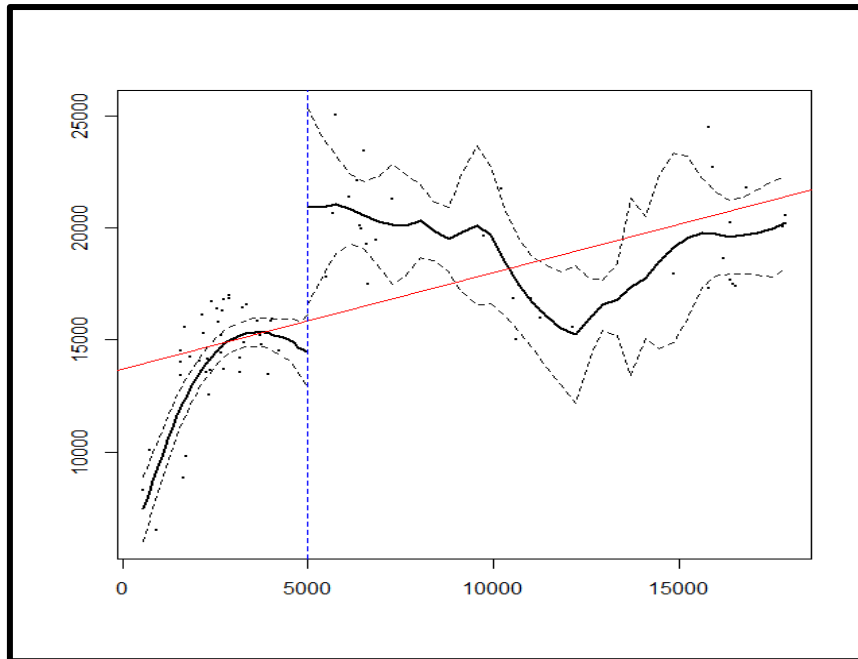


Figure 8. The effect of the treatment used on changing the value of the approved variable before and after cutting using the CCT beamwidth

4. Conclusions

Inferences will be clarified according to the results of the third chapter, which can be drawn as follows:

1. It is evident from Table 3, the effect of treatment, which is the end-of-service remuneration of (5,000,000) on the amount of revenue. We note the increase in the impact of the end-of-service gratuity, which led to the survival or continuation of the largest possible number of workers in the service, which led to an increase in revenues its value ranged between $(1.50E + 04)$ and $(2.50E + 04)$.
2. Likewise, we notice an increase in the value of compensation after the mentioned reward, which indicates an increase in the number of workers who are not out of work, and this is what the compensation value showed in Table 3.
3. We note that the pattern of data spread has varied after the discontinuity point and for all the mentioned methods. We notice a decrease in the value of the coefficient of difference after the discontinuity point, which gives a more uniform pattern of data due to the regularity of workers at work and the lack of randomness in staying or leaving work.
4. The prototype using the linear regression was significant and with a determination factor of (35%), meaning that the compensation explains (35%) of the change in the amount of revenue.
5. There is an effect of the treatment that was proposed by granting five million dinars for the uninterrupted year as a reward for the end of service, where the value called (Local Average Treatment Effect) and its abbreviation (LATE) of (6463), meaning that any increase in the values of Compensation by one unit leads to an increase in revenues by (6463).
6. We note that the RMSE value for the non-parametric regression of the local Linear Smoother (LLS) method is the lowest of the RMSE of the least-squares OLS method for the regression, and the reason for this is that the parameter regression did not fit the nature of the data as much as it fits with the non-parametric regression.
7. The best beamwidth method used is the (Calonico, Cattaneo & Titanic) (CCT) method and the LK beamwidth by comparing the RMSE value.
8. High value of the determination factor when using the non-parametric method, namely the LLS method, where its value reached 0.72, got higher than its value in the parametric method, which amounted to

0.35, which indicates a high improvement in the interpretation of the model through the non-parametric method.

9. The best explanation for the model when the used beam width is the CCT method where the determination coefficient was 0.72 0.719 and then the beam width Lembens and kalyanman (LK) 0.716 by comparison with the value of the determination coefficient.

We recommend the Ministry of Labor and Social Security to work on legislation for the end-of-service remuneration law for workers who are not out of work for an amount of no less than five million dinars. This is because of its positive impact in the long term on both the regularity of workers at work and their non-interruption. It leads to easy determination of their salaries and increase the income of the guarantee fund on the other hand through contributions paid and its continuation by workers and companies affiliated with it.

It is possible to conduct other studies similar to the directorates affiliated with the Ministry by suggesting specific incentives and studying their long-term impact on the returns of workers and employees in the Ministry's projects. Adoption of the non-parametric regression method can be used, namely the local linear smother (LLS) in estimating the regression function in addition to using the best beam width methods in this study.

Here is some future research:

1. Employing other methods of non- parametric regression, such as the Spline method, the Cubic spline method, and other methods of non- parametric regression in estimating the discontinuity regression function.
2. Using a package presentation other than mentioned in the research, based on recent studies and research.
3. Experimenting more than one discontinuity point, that is, more than one treatment, which is called multi- discontinuity regression.
4. Using multiple discontinuity regression, that is, for more than one explanatory variable, as this leads to the use of more than one discontinuity point.
5. Use Fuzzy Discontinuity Regression and FDR to estimate the effect of treatments when there is not enough information about the choice of discontinuity point.

References

- [1] S. Calonic, M. D. Cattaneo, and, R. Titinik, Robust Nonparametric Confidence Intervals for Regression-Discontinuity Designs *Econometrical*, Vol. 82, No. 6, 2295–2326, 2014.
- [2] J. C. Cappelleri and W. M. Trochim, Regression Discontinuity Design. *International Encyclopedia of the Social & Behavioral Sciences*, 2nd edition, Vol. 20, pp.152-159, 2015.
- [3] M. D. Cattaneo, R. Titinik., and V. G. Bare, "The Regression Discontinuity Designs" Arxiv: 1906.04242v1 [econ. EM] 10-Jun, 2019.
- [4] M. D. Cattaneo, R. Titiunik, and G. Vazquez-Bare, "Comparing Inference Approaches for RD Designs: A Reexamination of The Effect of Head Start on Child Mortality", *Journal of Policy Analysis and Management*, Vol. 36, No. 3, pp.643–681, 2017.
- [5] L. Davezies, and L.T. Barbanchon, "Regression Discontinuity Designs with Continuous Measurement Error in the Running Variable", institute of Labor Economics, Bonn, Germany. No. 10801, 2017.
- [6] J. Porter, "Estimation in the Regression Discontinuity Model" Harvard University of Economic, 2003.
- [7] X. Gong and J. Gao, " Nonparametric Kernel Estimation of the Impact of Tax Policy on the Demand for Private Health Insurance in Australia" Working Paper 06/15, Department of Econometrics and Business Statistics, MONASH university, Australia, 2015.
- [8] D. S. Lee, and T. Lemieux, "Regression Discontinuity Designs in Economics" *Journal of Economic Literature*, Vol. 48, pp.281-355, 2010.
- [9] G. Lmbens and K. Kalyanaraman, "Optimal Bandwidth Choice for the Regression Discontinuity Estimator", *Review of Economic Studies*, Vol. 79, pp.933–959, 2009.
- [10] G. Lmbens and T. Lemieux, " Regression discontinuity designs: A guide to practice", *Journal of Econometrics*, Vol.142, pp.615–635, 2008.

- [11] H. J. Ryoo, C. P. Pullen, " Regression Discontinuity Designs for Longitudinal data, Cross-Sectional data, and Intervention Research", University of Virginia, 2017.
- [12] Y. Sun, "Adaptive Estimation of the Regression Discontinuity Model" University of California, San Diego Department of Economics, 2005
- [13] L. Donald, and T. Campbell, "Regression- Discontinuity Analysis: An Alternative to the Ex-Post Facto Experiment" *Observational Studies*, Vol. 2, No.2016, pp.119-128, 1960.
- [14] K.M. Trochim and J. D. Campbell, "Research Design for Program Evaluation the Regression Discontinuity approach" Volume 6 – Sage Publications Beverly Hills London New Delhi, 1984.
- [15] A. H. Yousef and O. A. Ali, " Proposing Robust LAD-Atan Penalty of Regression Model Estimation for High Dimensional Data", *Baghdad Science Journal*, Vol. 17, No. 2, pp.550-555, 2020.