Etikonomi
Volume 15 (2), October 2016
P-ISSN: 1412-8969; E-ISSN: 2461-0771
Page 111 - 124

INFLATION RATE MODELLING IN INDONESIA

Rezzy Eko Caraka, Wawan Sugiyarto
Universitas Diponegoro, Ministry of Finance Republic of Indonesia
rezzyekocaraka@gmail.com, wawan.sugiyarto@gmail.com

Abstract.

The purposes of this research were to analyse: (i) Modelling the inflation rate in Indonesia with parametric regression. (ii) Modelling the inflation rate in Indonesia using non-parametric regression spline multivariable (iii) Determining the best model the inflation rate in Indonesia (iv) Explaining the relationship inflation model parametric and non-parametric regression spline multivariable. Based on the analysis using the two methods mentioned the coefficient of determination (R^2) in parametric regression of 65.1% while non-parametric amounted to 99.39%. To begin with, the factor of money supply or money stock, crude oil prices and the rupiah exchange rate against the dollar is significant on the rate of inflation. The stability of inflation is essential to support sustainable economic development and improve people's welfare. In conclusion, unstable inflation will complicate business planning business activities, both in production and investment activities as well as in the pricing of goods and services produced.

Keywords: *nonparametric regression; parametric regression; inflation*

Abstrak.

Tujuan dari penelitian ini adalah untuk menganalisis: (i) Pemodelan tingkat inflasi di Indonesia dengan regresi parametrik. (ii) Pemodelan tingkat inflasi di Indonesia menggunakan non-parametrik spline regresi multivariabel. (iii) Menentukan model terbaik tingkat inflasi di Indonesia (iv) Menjelaskan parametrik model hubungan inflasi dan non-parametrik spline regresi multivariabel. Berdasarkan analisis dengan menggunakan dua metode yang disebutkan koefisien determinasi (R^2) dalam regresi parametrik dari 65,1% sedangkan non-parametrik sebesar 99,39% .Untuk memulai dengan, Faktor pasokan uang atau saham uang, harga minyak mentah dan rupiah nilai tukar terhadap dolar adalah signifikan pada tingkat inflasi. Stabilitas inflasi sangat penting untuk mendukung pembangunan ekonomi yang berkelanjutan dan meningkatkan kesejahteraan rakyat. Kesimpulannya, inflasi yang tidak stabil akan menyulitkan kegiatan bisnis perencanaan bisnis, baik dalam kegiatan produksi dan investasi serta dalam harga barang dan jasa yang dihasilkan.

Kata Kunci:*regresi nonparametrik;regresi parametrik;inflasi*

First Draft: May 18, 2016; Revised: August 20, 2016; Approved: September 13, 2016

DOI: 10.15408/etk.v15i2.3260

INTRODUCTION

The President of the Republic of Indonesia Joko Widodo targets inflation rate at 4.7% level and target economic growth of 5.5% in 2016. The targets contained in the Draft Budget macro assumptions revenue and State Spending 2016 read Jokowi in the State of the Union Speech about the draft Budget of income and Expenditure of the State Capitol in 2016 the MPR, Jakarta (CNN, 2016)

The Bank Indonesia (BI) is a regulator in the management of monetary policy in Indonesia. In carrying out these policies, given the various authorities of the BI in order to guarantee the independence, transparency and accountability of monetary policy are made. One of the main tasks of BI functions and indicators of success in managing its monetary policy is controlled by targeted inflation rate. A policy of inflation targeting has become best practice central banks in the world including in Indonesia in the last decade. In a simple inflation meansrising prices in General and continuous. Price increase of one or two items alone cannot be called unless the inflation hike that extends (or lead to price increases) in other articles. The opposite of inflation is called deflation. In addition to controlling the level of inflation, Bank Indonesia has the task of maintaining the stability of the value of the rupiah. The stability of the value of the rupiah has two aspects, namely the stability of the currency value against the goods and services, as well as the stability of the currency against the currencies of other countries. The first aspect is reflected in the development of the inflation rate while the second aspect is reflected in the development of the exchange rate of the rupiah currency against the currencies of other countries. Fluctuating inflation rates and tend to be uncontrolled may cause various upheavals and the negative impact to the national economy. In order to anticipate and mitigate it then necessary steps or policies conducive to keeping the inflation rate under control and corresponding target policy makers.

In addition to controlling inflation, Bank Indonesia has the task of maintaining stability in the rupiah. The stability of the rupiah contains two aspects, namely the stability of the currency's value against goods and services, as well as the stability of the currencies of other countries. The first aspect reflected in the

http://journal.uinjkt.ac.id/index.php/etikonomi
DOI: 10.15408/etk.v15i2.3260

inflation rate while the second aspect is reflected in the rupiah exchange rate against the currencies of other countries.

The inflation rate is volatile and tends to uncontrollable will cause a lot of turmoil and negative impacts on the national economy. In order to anticipate and mitigate these conditions, the necessary measures or policies that are conducive to keeping the inflation rate and corresponding targets policy makers. From the supply side, factors affecting inflation is negative supply shocks and rising costs of production or economic theory known as cost-push inflation. Negative supply shock happened due to natural disasters and disruption of distribution in domestic food commodities. Due to crop failure and the distribution of food commodities uneven cause domestic food commodity price increases. The increase in the cost of production represented by the price of fuel, salaries and wages associated with the exchange rate as the price of raw materials for production are imported from abroad.

Another problem is the world energy crisis marked by soaring oil prices into an energy crisis for Indonesia thus making the price of fuel oil (BBM) has increased. The fuel price hike which is one of the inputs in the production process and the increase in fuel prices will increase the cost of production and the impact will cause the producers to raise selling prices in the market. The rise in prices of products in the community tends to encourage inflate. The accuracy of estimates or predictions of global oil prices is expected by many parties, both from the public sector, businesses and investors so that all activities can be run according to plan. The amount of money in circulation becomes aspects to be taken into account in the inflation rate. The creation of money supply is the basis for their core money or money primary. Thus, the amount of money in circulation is greatly affected by the amount of money available core. According to Boediono, there are factors that affect the core money. The first is the state of the balance of payments (surplus or deficit); if the balance of payments had a surplus, it means that there is a foreign exchange into the country. This is an increase in the money supply. Vice versa, if the balance of payments deficit, meaning there is a reduction of the foreign exchange. It tells us there is a reduction in the money supply. The second factor is the state of the state budget (surplus or deficit); if the government had a deficit in

DOI: 10.15408/etk.v15i2.3260

the state budget, the government can print new money. This is an increase in the money supply and vice versa, if the country had a surplus state budget, then some of the money in circulation into the state treasury so that the money supply is getting smaller. The third factor is the direct credit Change Bank Indonesia; as monetary authorities, Bank Indonesia can not only give credit to commercial banks, but the central bank can also provide direct credit to government agencies other and state-owned enterprises (SOEs) others. Changes in the amount of credit will directly affect the size of the money supply. And the fourth factor is changes Bank Indonesia liquidity credits. As a banker's bank, the central bank can provide liquidity loans to commercial banks. For example, during the economic crisis since 1997, the central bank provides liquidity loans in order to overcome the liquidity crisis of commercial banks, numbering in the hundreds of trillions of rupiah. This resulted in a surge in the amount of money supply.

Various previous studies tend to only use one side of the approach in examining these three factors on the inflation rate in the context of the national economy while the inflation rate has a significant impact were great. Prahutama and Caraka (2015) conducted the modelling of inflation based on food prices explained by 93.94% in food prices contributed to inflation. In addition to the context in Indonesia and based on the literature of the economy, the inflation rate is influenced by several key factors, namely the increase in fuel prices, the money supply and the rupiah's exchange rate against the US dollar. If the inflation rate is able to predict more accurately and precision it will produce economic policy, especially in the field of monetary better targeted, Presence gap both in terms of academic studies and empirical these policies, encourage the authors to test how much influence these three factors by using approaches parametric and non-parametric the inflation rate in Indonesia.

METHOD

Gujarati (2006) defines the regression analysis as the study of the relationship of one variable is called a variable described by one or more variables that explain. Regression analysis is a statistical technique used widely in applied science. Regression analysis in practice there is three approaches to get the

http://journal.uinjkt.ac.id/index.php/etikonomi
DOI: 10.15408/etk.v15i2.3260

regression curve estimation, namely the approach of parametric regression, nonparametric regression, and semiparametric regression. Assuming the form of regression curve is known, it can be used parametric regression approach. However, if it is assumed that the shape of the regression curve is not known, then the approach can be used is nonparametric regression approach? In addition, if it is assumed partial regression curve shapes are known and some unknown, then used a semiparametric regression approach (Eubank, 1988).

Estimation of the regression curve shape is used to describe the relationship between the dependent variable and independent variables. Estimation approach most commonly used is a parametric approach. The underlying assumption of parametric regression approach is that the form of regression curves can be described by a set of specific parameters or in terms of other words it can be described in a specific pattern (Hardle, 1990).

DISCUSSION

The data used in this journal in the form of secondary data. The data rate of inflation and the rupiah exchange rate against the dollar is taken from www.bi.go.id. The data on the money supply is taken from www.bps.go.id and fuel prices of crude oil taken from www.opec.org. the study variables are in the form of time series data but can be modified to be variable based on a formula basis time series that explains that the data is now affected by data ago , so it can be in the multivariable regression with a spline . As research roadmap for modelling the inflation data is as shown in figure 1. Before performing regression modelling will be performed descriptive analysis on the data. This analysis aims to look at the characteristics of the data such as trends in the data centre in addition to the need to know their dispersion or variation data, which value can be expressed in terms of standard deviation as the root of the variance. Data analysis was done for inflation, crude oil prices, the money supply and the rupiah exchange rate against the dollar. Descriptive analysis of data can be seen in Table.1

DOI: 10.15408/etk.v15i2.3260

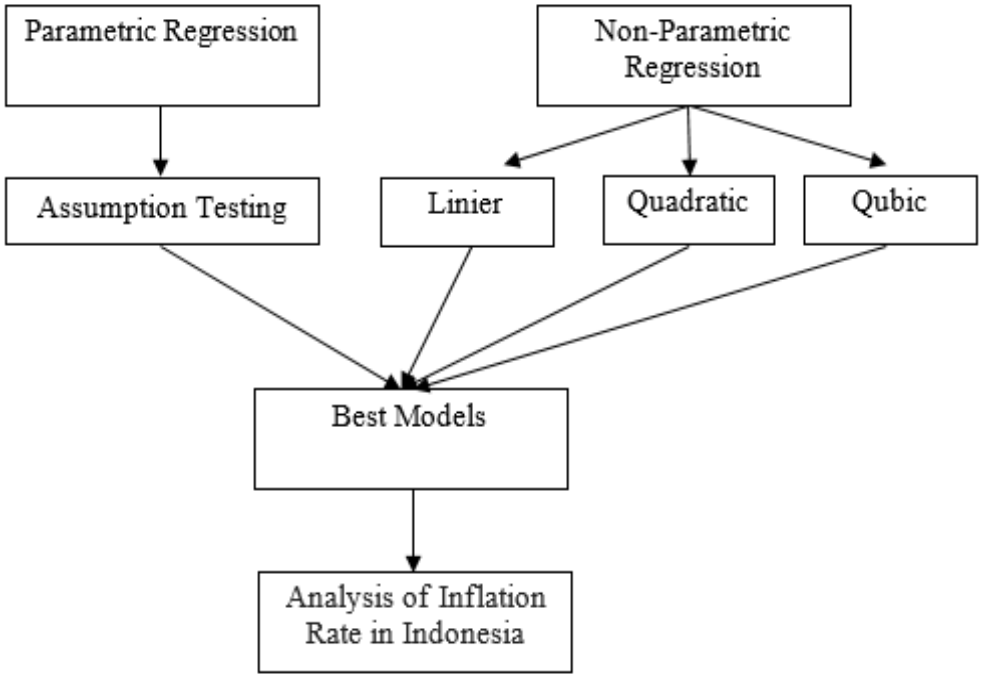

Figure 1. Roadmap

Descriptive analysis testing is used to look at the data center and view information on the data. The data used consists of a variable inflation, Indonesian crude price (in the US $ / BBL) the money supply / M2 year and the rupiah exchange rate against the dollar can be seen in Table 1.

Here is also presented the inflation data plot against time to - i (Figure 2). It can be seen that the inflation rate moves up and down fluctuating. The sharp rise occurred in December 2014. The significant increase is considered as a result of the enactment of the fuel price hike policy in June 2013. Based on these realities, it would be a useful thing to know how long the high inflation impact of the fuel price hike will be felt and how the rate of inflation in 2016. The inflation data examined has a minimum value of 3% occurred in December 2015 while the value of 8:36 maximum % occurred in December 2014. Thus, this data has a value range wide enough for data inflation which are equal to 5 % with an average of 5% and a standard deviation 1 %.

http://journal.uinjkt.ac.id/index.php/etikonomi
DOI: 10.15408/etk.v15i2.3260

Table 1. Descriptive Statistics

	Min.	Max.	Mean	Std. Deviation
Inflation	3%	8.36%	5%	1%
Crude Oil Prices	$25.12	$29.60	$28.57	1.27
Money Supply	747028	4173327	1953054	1125419
Exchange Rate	Rp13.400	Rp13.826	Rp13.583	126

Parametric Regression

Parametric regression model development is done on the inflation data on crude oil prices, the money supply and the rupiah exchange rate against the dollar. Based on the analysis of the model obtained as follows:

$$\hat{Y} = 0.928+0.00206x1+0.000000x2-0.000096x3+\varepsilon$$

Based on the model found that the value of crude oil prices, the money supply has a positive correlation to inflation while the rupiah exchange rate against the dollar has a negative correlation to the inflation data. Before using the model to measure the rate of inflation is necessary to test the significant model (F), the significance test parameter (t), and test the classical assumption of normality, heteroscedasticity, multicollinearity, and autocorrelation.

Table 2. Test Assumption

Test	Statistics Value	Result
F (Significance Model)	Prob (F-Statistics) = 0.007	✓
t (Significance Parameter)	sig (X_1)=0.008	✓
	sig(X_2)=0.048	✓
	sig(X_3) =0.001	✓
Normality	sig=0.141	✓
Heteroscedasticity	sig = 0.364947	X
Multicollinearity	sig = 0.6849	X
Autocorrelation	Durbin Watson (d) = 1.88138	X

Significance level α 5%

Based on the analysis we found the coefficient of determination R^2 = 0.651, meaning that 65.1 % of inflation rate is influenced by crude oil prices , the money supply and the rupiah exchange rate against the dollar year. While 34.9 % in influenced by other factors beyond the variables used in this journal.

DOI: 10.15408/etk.v15i2.3260

Non Parametric Regression

In this research, the analysis performed by nonparametric regression approach. Although the study variables are in the form of time series data but can be modified to be variable based on a formula basis time series, so it can be analyzed by spline multivariable. Scatterplot conducted in Indonesia as inflation data (Y) of the Indonesian crude price (in the US $ / BBL) as (X_1), the money supply as (X_2), and the rupiah exchange rate against the dollar as (X_3). Scatterplot is used to see the pattern of the relationship between these variables

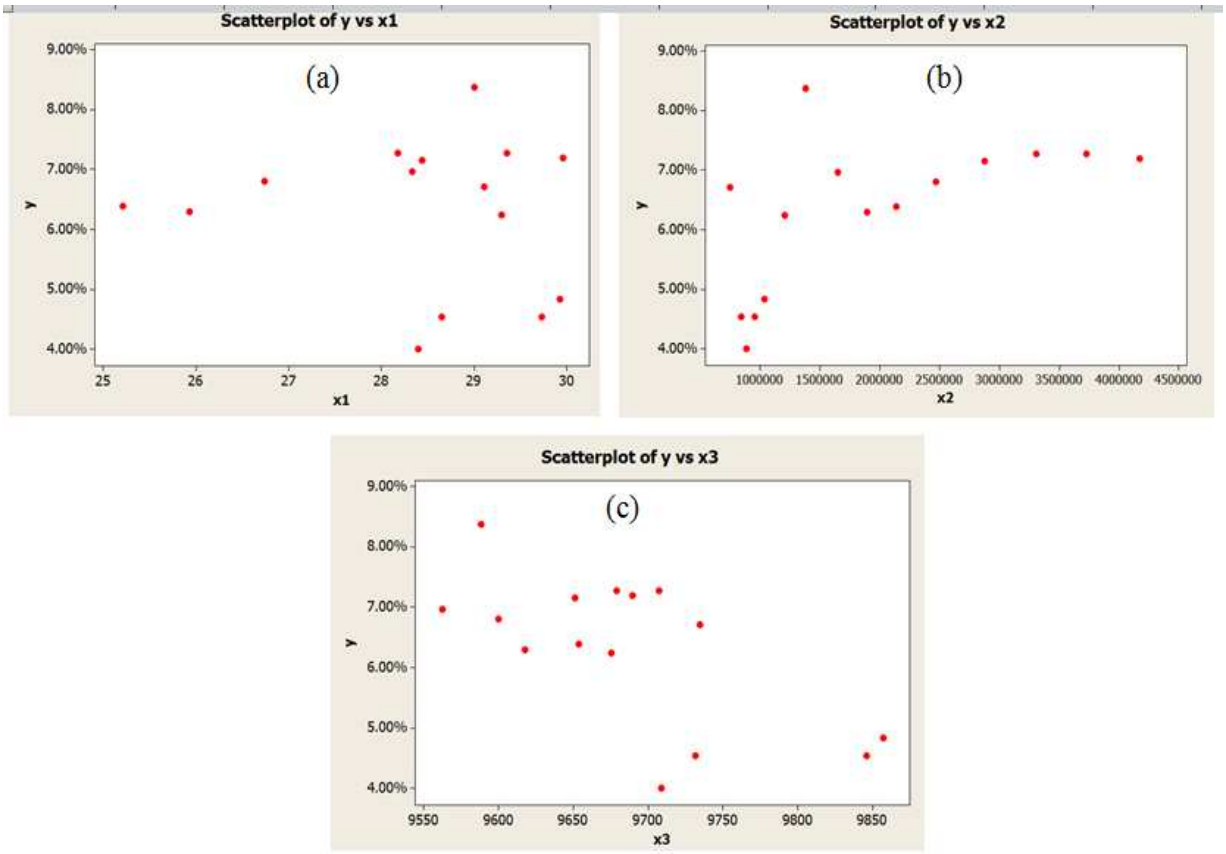

Figure 2(a,b,c). Scatterplot of Inflation vs Exchange Rate, Money Supply, and Crude Oil Prices

Based on Figure 2 (a) can be described a pattern of relationships inflation (Y) to the price of crude oil (X_1) there is a trend of positive correlation, meaning that if the value of the oil price rise, inflation will also rise. If the

http://journal.uinjkt.ac.id/index.php/etikonomi
DOI: 10.15408/etk.v15i2.3260

price of crude oil can be controlled inflation can also be controlled, but other than that there are other factors that also affect. Based on Figure 2(b) can be described a pattern of relationships inflation (Y) on the money supply / M2 (X_2) there is a tendency that the non-linear relationship between inflation and the money supply (M2). In addition, there are other factors that also have an effect. Based on Figure 2(c) can be described a pattern of relationships inflation (Y) against the rupiah exchange rate against the dollar (X_3) have a tendency relationship between the two variables. The third variable in the regression is able to obtain the best estimation using nonparametric methods are spline regression multivariable approach some knots to get the optimal estimation. Knot very important role in determining the spline functions are formed. To obtain optimal spline model of the necessary election knots optimal layout. Generalized Cross Validation (GCV) is one method that can be used to determine the optimal knots that can be used to get the best predictor. Estimated actual data regression curves using spline regression is done by determining the lot and location of knots and approached in order spline.

The approach starts from a single point of knots with the smallest order, i.e. the order of 2. The addition of point knots and order made to produce a more optimal estimation. When the model spline with knots point, more or order a greater yield greater GCV, the additional point of order knots or discontinued. It shows that the addition of point knots or order, it provides estimates that inefficient that need to be made a good combination between the point knots and order to create a model for the optimal spline. To perform data analysis and then performed standardization in mean and variance. After obtaining the spline multivariable models using linear and quadratic forms with point different knots, then the next stage is to choose the model best multivariable spline based MSE smallest and largest R^2.

The smallest MSE and R^2 contained in the multivariable regression model three-point spline knots to order 3. With the regression model

$$\hat{y}=-2.232367+3.148126\,X_1+2.254421\,(X_1-0.1_+)+0.3615655\,(X_1-0_+)+1.923692\,(X_1-0_+)$$
$$+\,0.4345845\,X_2-4.369765(X_2-0.1_+)-3.853199\,(X_2-0_+)-1.671454(X_2-0.1_+)-5.656733\,X_3$$
$$+4.176947(X_3-0.1_+)+2.180059(X_3-0_+)$$

DOI: 10.15408/etk.v15i2.3260

Based on the analysis will be the comparison between parametric and non - parametric regression. Based on Table 5 it can be seen that the modeling regression non-parametric have an accuracy greater than Regression parametric by proved that the mean square error in the regression of non-parametric has a smaller value than the regression parametric besides the coefficient of determination (R^2) in regression models of non-parametric greater than parametric regression. Based on the analysis, that the inflation rate is also affected by factors that are surprises like rate and crude oil prices, the inflation targeting requires the cooperation and coordination between the government and the central bank through well-integrated macroeconomic policies of fiscal, monetary and sectoral. Furthermore, the characteristics of inflation in Indonesia is quite vulnerable to shocks (shocks) on the supply side requires specific policies for these problems. Bank Indonesia has the objective to achieve and maintain rupiah stability.

Tabel 4. Multivariable Spline Model Comparison

Number of Knot	MSE	R^2
1 knot for orde 1	0.2560	0.6792
1 knot for orde 2	0.2455	0.6887
3 knot for orde 2	0.08271	0.89415
1 knot for orde 3	0.25080	0.6790
2 knot for orde 2	0.2122	0.7244
2 knot for orde 3	0.08271	0.8931
3 knot for orde 3	0.00474	0.9939

The stability of the rupiah includes the stability of prices of goods and services reflected in inflation. The stability of inflation is essential to support sustainable economic development and improve people's welfare. Bank Indonesia monetary policy is intended to manage price pressures derived from aggregate demand side (demand management) relative to the supply side. Monetary policy is not intended to respond to the rise in inflation caused by factors that are surprises temporary (temp) which will disappear by itself over time. Controlled inflation and low to support the preservation of purchasing power,

http://journal.uinjkt.ac.id/index.php/etikonomi
DOI: 10.15408/etk.v15i2.3260

meanwhile, unstable inflation will complicate business planning business activities, both in production and investment activities as well as in the pricing of goods and services produced.

Tabel 5. Comparison Models

	MSE	**R^2**
Parametric Regression	0.00838	0.651
Non-Parametric Regression	0.00474	0.9939

Abadi and Muhsin (2005) do the inflation modelling using Fuzzy system with exchange rate and national income. Faizah & Setiawan (2013) said that there is a similar inflation pattern in Semarang, Yogyakarta, and Surakarta because there is a causality relationship between the cities. Widasari and Wahyuningsih (2012) said that the inflation rate is influenced by the inflation in previous period. Suparti, et.al (2014) analyse the inflation rate in Indonesia with local polynomial regression model, which is applied on data before the increase of the electricity basic tariff and the fuel prices in 2013. Nuhad (2014) found that the non-linear SETAR model can be used to inflation modelling in Indonesia, but the regime-2 SETAR model can't be used for the inflation modelling in Indonesia. Santoso (2011) using GARCH model to explain the behaviour of food inflation in Indonesia, which is the ARCH/GARCH will produce a better estimate to doing forecasting the volatility of food inflation in Indonesia.

CONCLUSION

The stability of inflation is reflected in the price of crude oil, the money supply and the rupiah exchange rate against the dollar. The achievement of low inflation is a prerequisite for achieving other macroeconomic objectives, such as job creation. The role of fuel is very important for the transport of inter-regional trade. If fuel prices soared, the price of basic commodities tends to rise so that will impact the principal inflate. BI as the central bank in Indonesia main thing is creating monetary stability, which made the so-called inflation target framework (ITF).

DOI: 10.15408/etk.v15i2.3260

ITF is a monetary policy framework that is characterized by the existence of a public announcement about the target (or target range) rate of inflation which is authorized for one or more during the period of time, and with the assertion explicit that inflation is stable and low is the primary objective of monetary policy long term. From modelling the inflation rate in Indonesia by using regression parametric and non-parametric spline multi variable, can be used as study materials in considering policies that will be taken by Bank Indonesia as well as account for the rate of inflation so that Bank Indonesia can prepare them selves before going on excessive inflation in achieving low inflation, collaboration and strong commitment of all economic players. The role of research actors is especially needed at Bank Indonesia, where these actors can contribute ideas to overcome the problems that arise, such as inflation. Factors such as the exchange rate against the exchange rate, money supply, and the price of fuel oil, had to be considered in overseeing the inflation rate in Indonesia.

REFERENCES

Abadi, A.M. & A. Muhson. (2005). Pemodelan Tingkat Inflasi di Indonesia dengan Menggunakan Sistem Fuzzy.*Jurnal Ekonomi dan Pendidikan.* Vol. 2 (2): 113-121.

Badan Pusat Statistik. (2005). *Metode Pengukuran Inflasi di Indonesia*. Direktorat Statistik Keuangan dan Harga. Jakarta: Badan Pusat Statistik

Boediono. (1985). *Ekonomi Moneter* Edisi 3. Yogyakarta: BPFE.

Budiantara, I.N. (1999). Estimator Spline Terbobot dalam Regresi Semi-parametrik. *Majalah Ilmu Pengetahuan dan Teknologi*. Vol 10: 103-109.

Darmawan,E. et.al. (2014). Pemilihan Model Regresi Polinomial Lokal dan Spline Untuk Analisis Data Inflasi Di Jawa Tengah.*Jurnal Gaussian.* Vol. 3 (2): 223-231.

http://journal.uinjkt.ac.id/index.php/etikonomi
DOI: 10.15408/etk.v15i2.3260

Devi, A.R. et.al. (2014). Analisis Inflasi Kota Semarang Menggunakan Metode Regresi Non Parametrik B-Spline. *Jurnal Gaussian*. Vol. 3 (2) : 193-202.

Draper, N.R. &H. Smith. (1992). *Applied Regressioon*. New York: John Wiley and Sons.

Eubank, R. L. (1988). *Spline Smoothing and Non parametric Regression*. Texas: Departement of Statistics Southern Methodist Dallas University.

Faizah, L.A. & Setiawan. (2013). Pemodelan Inflasi di Kota Semarang, Yogyakarta, dan Surakarta dengan Pendekatan GSTAR. *Jurnal Sains dan Seni Pomits.* Vol. 2 (2): D317-D322.

Ghozali, I. (2005). *Aplikasi Analisis Multivariat dengan Program SPSS*. Semarang: Badan Penerbit Universitas Diponegoro.

Gujarati, D. (2006). *Dasar-Dasar Ekonometrika*. Jakarta:Erlangga.

Hardle, W. (1990). *Applied Nonparametric Regression*. Cambridge: Cambridge University Press.

Kurnia, A. M. & Didit. (2009). Fluktuasi Kurs Rupiah Terhadap Dollar Amerika Serikat pada. *Jurnal Ekonomi Pembangunan*. Vol 10. No 2: 234-249.

Nuhad, F. (2014). Penerapan Model Non-Linier Self-Exciting Tresshold Autoregressive (SETAR) Untuk Pemodelan Data Inflasi di Indonesia. *Jurnal Mahasiswa Statistik.* Vol. 2 (4): 289-292.

Prahutama, A.et.al. (2014). Pemodelan Inflasi Berdasarkan Harga-Harga Pangan Menggunakan Spline Multivariabel. *Jurnal Media Statistika*. Vol. 7 (2): 89-94.

Purwanti, D. (2011). *Dampak Guncangan Harga Minyak Dunia Terhadap Infasi dan Pertumbuhan Ekonomi di Negara-Negara ASEAN+3.* [Unpublished Thesis]. Bogor: Institut Pertanian Bogor.

Ruppert, D.et.al. (2003). *Cambridge Series in Statistical and Probabilistic Mathematics: Semiparametric Regression*. Cambridge: Cambridge University Press.

DOI: 10.15408/etk.v15i2.3260

Santoso, T. (2011). Aplikasi Model GARCH Pada Data Inflasi Bahan Makanan Indonesia. *Aset.* Vol. 13 (1): 65-76.

Suparti, et.al. (2014). Analisis Data Inflasi di Indonesia Menggunakan Model Regresi Polinomial Lokal. Vol. 2 (1): 65-78.

Widasari, L. P. & N. Wahyuningsih. (2012). Aplikasi Model ARCH-GARCH dalam Peramalan Tingkat Inflasi. *Jurnal Sains dan Seni Pomits.* Vol. 1 (1): 1-5.

DOI: 10.15408/etk.v15i2.3260