

Estimating Gross Regional Domestic Product (GRDP) District/City in East Nusa Tenggara with Spatial Dynamic Panel Data

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Abstract

East Nusa Tenggara Province has the lowest Gross Regional Domestic Product (GRDP) value in Indonesia. The local governments try to increase the value of GRDP by provide capital for productive businesses, increase human resources and manage the economic sector in each district/city. The GRDP value is influenced by economic factors that are dynamic. In functional region GRDP value in a region are correlations with neighboring regions. Regions that have homogeneous characteristics will tend have the same economic condition, therefore indicate there are spatial dependence. Therefore, to know the pattern of GRDP value should be do periode observed use panel data. Model panel data that can accommodate the effect each factor on GRDP value has dynamic and dependence spatial, the model can be more useful to capture them. This studies will apply the model to the cast of GRDP value in the district/city of East Nusa Tenggara Province with economic factors affect GRDP value is labor (L), population (P), investment (Inv) and local generated revenue (LGR).The results of variabel estimated the found that significance affect the GRDP value are investment (Inv) and local generated revenue (LGR), furthermore GRDP value affect by GRDP value in the previous period and GRDP value by neighbor regions.

Keywords: gross regional domestic product, spatial panel dynamic, spatially corrected blundell-bond GMM

INTRODUCTION

East Nusa Tenggara Province has economic conditions left behind from other provinces in Indonesia, this is seen on the GRDP value in each district/city is on the lowest group. The Problem of low GRDP value make goverments take agenda for created policy on economic sectors with give capital for productive businesses, increase human resources and manage the economic sector in each district/city.

During the period observed the trend GRDP values districts/city in East Nusa Tenggara has a fluctuatif trend. Variation of GRDP value because in each district/city has difference characteristics. Based on Weber's theory, the region that are homogeneous in terms of topography, climate and population tend to have the same economic activity and are static.

Based on the formal region of the district/city in NTT has different physical, natural and cultural criteria, but each district/city is interconnected based on the functional region. The functional region is an area governed by several centers of

economic activities that are interrelate and are characterized by the existence of relationship or interaction between each region and its neighbor regions.

Based on the functional region economic activity forms a unified relationship and dependency patterns which are usually controll from a central point called the nodal region. The functional region is dynamic because it is characterized by movement to and from the the center of economic activity. The relationship between the nodal region is generally characterized by the flow of transportation and communication that supports economic growth, development in each region. So that functionally the GRDP value district/city in NTT has a relationship and interrelate, this is can be identifies spatial dependency.

The relationship of economic factors that affect GRDP value does not only occur in the current period but also influence by economic factors in the previous period. This explains that economic activity is a process that goes on and on and is not an economic picture in one period of time (one shoot).

To taking economic policy in each district/ city requires periode observed to determine the trend of GRDP value, therefore observed is not

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enough to only use time series or cross-region data, but need a combination data from time series and cross section which is panel data [1]. To find out the relationship between the GRDP value and the factors that influence GRDP value each district/city in East Nusa Tenggara, a model is needed that can accommodate spatial dependency and dynamic effect. Model that can capture the presence of spatial dependency and dynamic effect of GRDP value in each district/city is spatial dynamic panel model.

Some studies has been analysis GRDP value in ditrict/city in East Nusa Tenggara Province but, previous studies only focus on model static that didn't involve the dynamic model and spatial dependence. This matter lacking to explain the relationship of economic factors that affect GRDP value because GRDP value are not only static but also dynamic. Furthermore, GRDP value is also affect by economic factors in neighboring regions [3]. So, that in studies it is necessary to involve dynamic and spatial dependence in modeling GRDP value in district/city in East Nusa Tenggara Province.

The model that accomodat dynamic and dependence panel spatial data is a spatial panel dynamic model. The results of this estimated parameters model's are expected to contribute to knowledge and give information to government for create policy increasing of the GRDP value in district/city of East Nusa Tenggara Timur Province. Analysis with dynamic model has endogeneity problem, wich results in estimated parameterss with Ordinary Least Squares (OLS) and Generalized Least Square (GLS) model results in bias and inconsistent parameters. Resolve this problem can be used estimator method of the Spatially Corrected Blundell-Bond Generalized Method of Moment (SCBB-GMM) [4].

Spatial model analysis requires a spatial weight matrix to measure the effect of close observed neighborhood location. One way determine the spatial weight matrix is theoretically, where the spatial weight matrix is determined based on the theory developed from the understand and phenomena that occur [4]. Based on the growth pole theory, explain that ecomic growth in an area doesn't occur in all regions but certain locations which are the pole of economic growth. East Nusa Tengga Province is an archipelago that doesn't contiguity but economic activite continue to run and interconnected by sea and air transportation. So that, this studies used a weight matrix spatial based on distanvce information this is K-Nearest

Neighbor (K-NN) matrix. The spatial weight matrix K-NN can provide the optimum weight based on the spatial autocorellation value on error terms of the dynamic panel regression model [5].

MATERIAL AND METHOD

A. Study Area

The observed location is East Nusa Tenggara Province by district/city, which consist of 20 district and 1 city with a land area of 47.349,9 km² and sea area of 20000 km² which is between 80⁰-12⁰ Latitude and 118⁰-125⁰ Longitude[6].

B. Data Collection

The studies data is secondary data observed by "BPS" (Central Statistics Biro) East Nusa Tenggara Province. Data observed in this studies is GRDP value and factors affect GRDP value in each district/city start in 2012 up to 2017, the unit spatial ($i=1,2,...,21$) and time ($t=1,2,...,6$)

The GRDP value is variable dependent. Labor (**L**), population (**P**), investment (**Inv**) and local generated revenue (**LGR**) is variable independent affect GRDP value. The emprical GRDP value model, using spatial panel dynamic setting, is defined such that GRDP value of location i at time t (Y_{it}) is function of the following independent variabels:

1. The neighborhood present GRDP value ($Y_{jt}, j \in \text{neighborhood of } i$)
2. The local previous period GRDP value ($Y_{i,t-1}$)
3. The neighborhood previous period GRDP value ($Y_{jt-1}, j \in \text{neighborhood of } i$)
4. The local labor (X_{1it}), population (X_{2it}), investment (X_{3it}), and local generated revenue (X_{4it}).

C. Theory of Gross Regional Domestic Product

Gross regional domestic product (GRDP) is amount of add value by all economic activities in a region during period of time. The Increasing of GRDP value will provide a great opportunity for the government to meet the basic needs of society. In the process of economic development there are dynamic, where a situation changes over time. Based on the Neo-Classical economic growth theory and Solow-Swan stated that economic growth depends on the increase in the provision of economc factors; labor, population, capita accumulation and the level technology progress.

The population affect the GRDP value because if population growth increase then labor

used can increase production. Furthermore, with increase of population it can encourage economic development. Labor is one of the factors the affect GRDP value in a region because if happened increase absorption of labor then can increase in productivity and encourage economic development. Investments is spending capital that will increase of income regions [7].

D. Spatial Weight Matrix

The concept “neighborhood” in model spatial can be defined based on the relative distance between locations or spatial arrangement of every location. The spatial arrangement will be presented the from spatial weight matrix (\mathbf{W}) with demention $n \times n$. The element w_{ij} of the matrix for $i = 1, 2, \dots, n$ and $j = 1, 2, \dots, n$ and zeros diagonal element. Formal definition for each element (w_{ij}), according to K-NN concept is :

$$w_{ij} = \frac{d_{ij}}{d_i}, d_{ij} = \begin{cases} 1, & j \in N_k(i) \\ 0, & \text{otherwise} \end{cases}$$

$$d_i = \sum_{j=1}^n d_{ij}$$

This studies use spatial weight matrix based on K Nearest Neighbor concept. Neighbor values based on $K = 1, 2, \dots, n-1$. The K number of neighborhood based optimum autocorrelation value [8]. Spatial weight matrix is a standardization on lines. First step on spatial modeling is testing spatial autocorrelation with statistic Moran’s I on residuals dynamic panel regression [9]. If the autocorrelation spatial value is positive then each district/city has similar characteristic. Otherwise, if the autocorrelation spatial value negative then each district/city no has same characteristics [10].

E. Dynamic Spatial Panel Model

Dynamic spatial panel model is extends of the static spatial panel model. Where the spatial dynamic model involves of lag dependent variable. This explain that the GRDP in the current period is affect by the previous period.

The spatial dynamic panel model of GRDP value can be defined as:

$$GRDP_{it} = \lambda GRDP_{it-1} + \tau WGRDP_{it} + \eta WGRDP_{it-1} + \beta_1 L_{it} + \beta_2 P_{it} + \beta_3 LGR_{it} + \beta_4 Inv_{it} + \varepsilon_{it}$$

The model consider a panel with spatial units - location ($i=1, 2, \dots, n$) and time periode ($t=1, 2, \dots, T$). GDRP is dependent variable of each spatial units. The independent variable; $GRDP_{i,t-1}$ is the local previous period GRDP value, $WGRDP_{i,t}$ is the

neighborhood presenent of GRDP value, $WGRDP_{i,t-1}$ is the neighborhood previous period GRDP value, L is the local present of labor, P is the local present of population, Inv is the local present of investment, LGR is the local present of local generated revenue

ε_{it} is error term of i.i.d distribunce terms, with zeros mean and infinite variande σ^2 . \mathbf{W} is spatial weight matrix is an $n \times n$. $\tau, \lambda, \eta, \beta_1, \beta_2, \beta_3, \beta_4$ is coefficient parameters regressor variable.

F. Spatially Corrected Blundell-Bond GMM (SCBB-GMM) Estimator

To estimate coefficient parameters of dynamic model there are endogeneity problem that needed SCBB-GMM estimator. The first stage of model was first difference model in equation (2).

The modification, model (2) becomes:

$$\Delta GRDP_{it} = \lambda \Delta GRDP_{it-1} + \tau \Delta WGRDP_{it} + \eta \Delta WGRDP_{it-1} + \beta_1 \Delta L_{it} + \beta_2 \Delta P_{it} + \beta_3 \Delta LGR_{it} + \beta_4 \Delta Inv_{it} + \Delta \varepsilon_{it}$$

In the first difference model the time lag and spatial lag or dependent variable are endogeneity problem. SCBB-GMM estimation is possible if there are instrument variable that are correlation with spatially, time lagged and dependent variable and are uncorrelated with the errors. Estimator SCBB-GMM has discussed the estimation method and the hypothesis testing of the parameterss [11], [12],[13], [14].

RESULT AND DISCUSSION

The GRDP value each district/city in East Nusa Tenggara has fluktuatif trend. Kupang City has consisten highest GDP value while Sabu Raijua district consistent has lowest GRDP value. This condition can be seen in the figure 1:

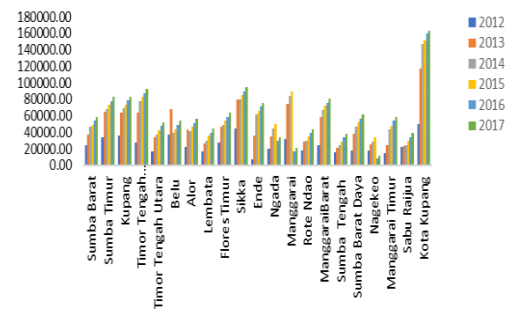


Figure 1. The Proportion of GRDP value each district/city in East Nusa Tenggara, 2012-2017

Results test autocorrelation in residuals GRDP value dynamic panel model regression with K-NN weight spatial matrix, the number neighborhood that optimum is 15 neighborhood with result spatial autocorrelation is 5,812 and positive autocorrelation value. It explained that GRDP value and factors economic affect GRDP value has same characteristics.

The SCBB-GMM of dynamic spatial panel model parameters and significance are present in Table 1.

Table 1. The Estimate model Coefficient and their significance

No	Variabel	Coefficient	P value of the t-test
1	GRDP _{t-1}	0,6558	0,000(**)
2	WGRDP _t	-0,6189	0.000(**)
3	WGRDP _{t-1}	0,7722	0.000(**)
4	L _t	0.2464	0.947
5	P _t	0.9226	0.663
6	LGR _t	9.3494	0.033(*)
7	Inv _t	72.8220	0.004(**)

(*): Significant at = 5% α

(**): Significant at any level of α

The results of estimation coefficients in Table 1. is the short term results for each of the variable that affect the value of GDP in each district/city in the East Nusa Tenggara.

The independent variable that affect GRDP value is neighborhood present GRDP value, neighborhood previous period GRDP value, neighborhood previous period GRDP value, local present of investment, local present of local generated revenue.

The equations obtained for the model of the factors that affect the GDRP with estimator SCBB-GMM is as follows:

$$GRDP_{it} = 0.655 GRDP_{it-1} - 0.618 WGRDP_{it} + 0.772 WGRDP_{it-1} + 0.246 L_{it} + 0.922 P_{it} + 9.349 LGR_{it} + 72.822 Inv_{it} + \varepsilon_{it}$$

The estimate model coefficient in Table 1. Is the short run effect of each variable on the proportion of GRDP value. The GRDP value in the each district/city current period is affected by the GRDP value previous period.

If the current GRDP value each district/city increases by IDR 1 million, the next year the local GRDP value will in crease by IDR. 655,200 million. If the current GRDP value increases by IDR 1 million, then on neighborhood will experiences a decrease GRDP value by 618.900 million. If the current neighborhood increases GRDP value by IDR 1 million, the next year, the

local proportion of GRDP area will increases by IDR 772.200 million. If investment increases by of IDR 1 million, then happening increase GRDP value by to IDR. 9.349.400. This is in accordance with the theory of production if investment increases then the GRDP will also be increases, this is because the higher procurement investments in sectors economy in the district/city in the form of capital goods so production capacity increased.

Investment is an expenditure aggregate, if investment increases then aggregate demand also increases. In addition, investment are usually follow by technological developments, so that will increase the productivity and income of the community. The increases of the local generated revenue (LGR) as much IDR 1 million, then the GRDP value increases by Rp. 72.822.000. The better the Governments manages economic sectors and tax areas then increases.

CONCLUSION

The dynamic spatial panel model of Gross regional value succed in captring the of GRDP value use their dynamic in fringe district/city of East Nusa Tenggara. The model indicates the domination of positive GRDP value. According to spatial autocorrelation testing by K-NN spatial weight matrix, there were 15 neighborhood spatial units

According to spatial autocorrelation testing by K-NN spatial weight matrix, there were 15 neighborhood spatial units creating an optimum autocorrelation value. GRDP values of district/cities in East Nusa Tenggara were affect by GRDP value during the previous period and by GRDP at the neighborhood unit spatial during the previous period.

There was a functional relationship between GRDP values of observation area and that of neighboring locations, where GRDP value in observed district/city were affect by GRDP value at their neighborhood locations. Based on parameters significance test, variable affect GRDP value of district/city in East Nusa Tenggara were investment (Inv) local generated revenue (LGR). To make economic policy to increase GRDP values in East Nusa Tenggara, the government may manage economic sectors particularly in investment and LGR.

REFERENCES

- [1]. Gujarati, D. N. 2004. Basic Econometrics. 3th edition. McGraw-Hill. New York.

- [2]. Boediono. 1999. Teori Pertumbuhan Ekonomi. Seri Sinopsis, Edisi Pertama, Cetakan Pertama, BPFE, Yogyakarta.
- [3]. Mankiw, N.G. 2006. Teori Makro Ekonomi. Edisi Keenam. Alih Bahasa Imam Nurmawan dan Lita F. Penerbit Erlangga. Jakarta.
- [4]. Jacobs, J. P. A. M., Ligthart, J. E., and Vrijburg, H. 2009. Dynamic Panel Data Models Featuring Endogenous Interaction and Spatially Correlated Errors. SSRN Electronic Journal.
- [5]. Getis, A. 2009. Spatial weights matrices. *Geographical Analysis*. 41: 404-410.
- [6]. BPS NTT. 2018. Nusa Tenggara Timur Dalam Angka 2018. BPS Provisni Nusa Tenggara Timur. Kupang.
- [7]. Mankiw, N.G. 2006. Teori Makro Ekonomi. Edisi Keenam. Translated by Imam Nurmawan and Lita F. Penerbit Erlangga. Jakarta.
- [8]. Smith, TE. 2014. Areal data analysis. *Spatial data analysis. Journal of econometric* 130: 99-133. Greene, W. H. 2003. *Econometrics Analysis*. 5th edition. Prentice Hall. New Jersey.
- [9]. Lee, Jay and Wong, S. W. 2001. *Statistical Analysis with Arcview GIS*. John Willey & Sons, INC: United States of America.
- [10]. Cizek, P. Jacobs, J. L. J. dan Vrijburg. 2011. GMM estimation of fixed effects dynamic panel data models with spatial lag and spatial errors. *Journal of econometric* 150: 97-134.
- [11]. Jacobs, J. P. A. M., Ligthart, J. E., dan Vrijburg, H. 2009. Dynamic Panel Data Models Featuring Endogenous Interaction and Spatially Correlated Errors. SSRN Electronic Journal.
- [12]. Elhorst, J. P. 2010. Dynamic panel with endogenous interaction effects when T is small. *Regional Science and Urban Economics*, 40, 2010, 272-282