Determining the urban economic resilience planning through ratio of original local government revenue

Titi Purwandari[a*], Sukono[b], Yuyun Hidayat[c] and Wan Muhamad Amir W Ahmad[d]

[a]*Doctoral Student at Department of Mathematics, Faculty of Mathematics and Natural Sciences, Universitas Padjadjaran, Sumedang, Jawa Barat 45363, Indonesia*
[b]*Departments of Mathematics, Universitas Padjadjaran, Sumedang, Jawa Barat 45363, Indonesia*
[c]*Departments of Statistics, Universities Padjadjaran, Sumedang, Jawa Barat 45363, Indonesia*
[d]*School of Dental Sciences, Universiti Sains Malaysia, 11800 Gelugor, Penang, Malaysia*

C H R O N I C L E	A B S T R A C T
	Today, the economic resilience in Indonesia measures using the index approach, but it does not consider the effect of the disturbance and causes meaningless. The index is essentially an average, and the average is not a model that captures the relationship between variables. This research differs significantly from earlier studies that used the index to measure economic resilience. The crucial step in assessing the economic resilience of a city is to determine the economic resilience decision variable itself. If a variable significantly correlates with the disturbance factors in each relationship pattern, it is considered suitable as an economic resilience variable. This study evaluates variable Z as an economic resilience variable with a significant relationship to its disturbance variable. The evaluation method is conducted in-depth by studying Indonesia's cities over five years (2015-2019). Z, the ratio of Original Local Government Revenue (PAD) to the number of poor people in a city as a cost centre, will be evaluated as a prospective decision variable for economic resilience. The statistical relationship between Z and 9 disturbance variables is examined using piecewise linear regression analysis. All 514 cities in Indonesia were observed extensively for identification during a five-year observation period. Rosenbrock pattern search estimation was used to estimate the model parameters. The following results were obtained by analysing the data with the STATISTICA software. As determined by parsimonious analysis, the price of Pertalite fuel and the US dollar foreign exchange are two disturbance factors that are crucial to the fall in the resilience variable Z. The joint effect of these two variables on the decline in the resilience measure Z is 73.63 percent. The study concludes that Z is a city-level economic resilience decision variable that applies to all 514 cities in Indonesia and is measured as the ratio of PAD to the number of poor people. This study's novel contribution to Indonesian policymakers is Z as a new economic resilience decision variable that can be used to assess cities' relative economic resilience.

1. Introduction

Economic resilience is a region's ability to recover successfully from its economic shocks (Hill et al., 2008). Regional resilience is an area's ability to anticipate, prepare for, respond to, and recover from disturbances (Foster, 2007). The new ways of establishing the basis for economic resilience and sustainability are essential dimensions of livable cities (Douglass, 2002). Currently, economic resilience in Indonesia is measured using the index approach. The index approach is currently used to assess Indonesia's economic resilience. The assessment of the National Resilience Index, including the economic resilience index, is still being socialised. According to the findings, economic resilience is generally in good condition

(Kusumastuti et al., 2014). Indonesia is not the only country that uses the index to measure economic resilience. Every year, the number of Indexes in use worldwide increases. The economic resilience index states that a higher index value implies that a city becomes more durable over time. The fundamental question is: what makes a city, region, or country resilient? What causes a city to degrade into an unwanted condition? The index is inadequate since it cannot determine which disturbance factors have a major impact on the city's economic resilience.

The index can also not predict the amount of disturbance at which a city may fall into undesirable conditions, causing it to be classified as economically unresilient (Hidayat et al., 2021). Bakhtiari & Sajjadieh (2018) researched the economic resilience index applied to developing countries, including Iran, involving dimensions of macroeconomic stability, market efficiency, governance, human development indicators, producing macroeconomic stability index, and efficiency market index, government index, index human development indicators. Pietroa et al. (2020) analysed the European Union's resilience based on regional vulnerability, resistance and recoverability using the resistance index, recovery index, and regression method. The analysis results show that the response area in receiving external disturbances varies widely. Foster (2011) transferred the concept of resilience into regionalisation science. He analysed regional resilience to economic shocks through the response of the regional economic system to the economic shock to maintain the continuous development of the region's economy.

This research differs significantly from earlier studies that used the index to measure economic resilience. A new approach is needed to assess the level of economic resilience of a city that considers the interrelation between three groups of decision variables: disturbance variable, control variable, and concern variable (Hidayat et al., 2021). This idea criticises the National Resilience Measurement Laboratory of Indonesia's National Resilience Institute and many other researchers for simply constructing an index to determine economic resilience. As a result, a mindset emerges in which economic resilience is viewed as a management model rather than an Index. The primary goal of this research is to figure out how the disturbance variable interacts with the economic resilience decision variable, which serves as a control variable. Without considering the severity of disturbance, the economic resilience model is unworkable. As a result, if a variable has a significant relation with the disturbance variable in each relationship pattern, it is declared suitable as an economic resilience decision variable. The discourse on economic resilience becomes useless and irrelevant if a variable declared as a variable of economic resilience is not changed by the disturbance variable. As a result, this research investigates a relationship model that may considerably explain the effect of disturbance variables on a variable assumed to be accepted as an economic resilience variable.

Meanwhile, certain disturbance variables that are expected to disturb the Z variable are proposed. Nine disturbance variables have been investigated., Specifically, G1: the price of Pertalite fuel oil, G2: Premium fuel price, G3: Gas price of 3 kg LPG, G4: Gas price of 12 kg LPG, G5: Basic electricity tariff of 900 VA Subsidies, G6: Basic Electricity Tariff 900 VA Non-Subsidized, G7: Exchange Rate of Indonesian Rupiah to US Dollar, G8: Bank Indonesia Reference Interest Rate, G9: Consumer Price Index (CPI). Throughout this research, 2570 units of observation are collected in 514 districts/cities across Indonesia for each variable G1, G2, ..., G9. To examine the model of the relationship between control variables Z and disturbance variables G, data on PAD, the number of poor people, the PDRB, and the population are collected.

Identifying economic resilience characteristics and their inherent disturbance are two strategic challenges that can be handled simultaneously in this study. As a result, the disturbance variables must be determined in addition to the resilience variables. This way of thinking arose from a series of fundamental issues concerning the concept of resilience. The subject of resilience demands to be answered: resilience to what? Of course, resilience to disturbances is important in this context. As a logical extension of this notion, managing resilience requires controlling and coping with disturbance variables. Hence it is obvious that the disturbance variable for the studied variable of economic resilience must be identified. Disturbance variables are independent variables that are elements rather than aggregates in this study. As the nature of the disturbance, this variable has its mechanism in influencing the economic resilience variable. The city government does not have access to decide the behaviour of this variable, so it is completely uncontrollable and unmanageable. As a result, it must be assured that this variable does not have collinearity or true independence during the analysis. By studying the model of the relationship among Z and multi disturbance variables, this study will discover the economic resilience variable at the city level that applies nationally to all 514 cities in Indonesia. This study is unique because it brings a new economic resilience decision variable that can be used to compare the relative economic resilience of cities in Indonesia.

2. Literature Review

2.1. Economic Resilience

Resilience means the ability to withstand shocks (Funke et al., 2016; Simmie & Martin, 2010), minimise potential losses due to disasters (Rose & Krausmann, 2013; Simmie & Martin, 2010), and recover from disturbances (Bastaminia et al., 2017; Martin 2012). Resilience is the ability to absorb the influence of external shocks (Rose & Krausmann, 2013). Define economic resilience as the ability of countries to reduce vulnerability, withstand shocks, and recover quickly (Funke et al., 2016). Define economic resilience as the ability of an area to anticipate, and recover from disturbances (Martin, 2012).

Economic resilience is defined as the ability of a region to recover successfully from economic shocks (Simmie & Martin, 2010). Besides that, Simmie & Martin (2010) added that regional resilience is the ability of an area to anticipate and recover from disturbances. Define economic resilience as a systematic approach to reducing economic vulnerability and loss and improving critical disaster situations. Developed an economic resilience index using microeconomic and macroeconomic variables (Bastaminia et al., 2017) results obtained a framework for obtaining an economic resilience index (Rose & Krausmann, 2013).

According to Bakhtiari & Sajjadieh (2018), regional economic resilience refers to the idea of the ability of the local economic system to recover from an elastic shock. Analysed the regional economic resilience of province in China, explored the determinants of regional economic resilience using a spatial econometric model on panel data, and found out that the level of regional economic resilience in Liaoning was low and the urban economy was vulnerable to external shocks (Li et al., 2019). Develop a new measure of resilience using observed differences between expected and actual employment in a region following a shock (Ringwood et al., 2019). According to Palekiene (2015), economies have always been prone to different shocks, industry shocks, and currency crises (Palekiene et al., 2015). When applied structured, resilience principles provide a powerful tool to move urban resilience thinking from a metaphorical talk to meaningful solutions (Bahadur & Tanner, 2014). Resilient regions are regions that show high entry levels or even increase their entry levels after the shock (Xiao et al., 2018). The cities with higher resilience fared better during the recession concerning several economic productivity measures. However, in the absence of shocks, those with lower resilience exhibit superior economic performance. Analyse the effect of economic resilience on private investment in selected Malaysian economic sectors (Hassan & Othman, 2015). The results show that interest rates are statistically significant. Based on the above discussion, the stability of the economic system is explained by resistance to disturbance and speed to return to pre-existing equilibrium. The economy will be returned to its underlying trajectory via policy settings formulated by local institutions (Crouch & Farrell, 2004). Finally, a comprehensive assessment and synthesis of what makes some regions more resilient than others and what regional policymakers can do to increase the resilience of the regions to the future economic crises need to be conducted.

2.2. Disturbance Variables

This research suggests that economic resilience has meaning when disturbance exists significantly. This paradigm also characterises the uniqueness and originality of this research. Disagree with the existing theories that determine economic resilience-based only on the disturbance model (Miles, 2015). Economic resilience requires unwanted conditions and level of disturbance factors; the economic resilience model without considering the level of disruption and unwanted conditions is unrealistic. It is the main context of integrated research under our economic resilience research umbrella. This research has two strategic objectives that can be simultaneously achieved: identifying resilience variables and their inherent disturbance. In addition to the resilience variables, the disturbance variables must also be identified. A disturbance can generally be thought of as anything that disrupts a system. Disturbance variables are independent variables and must be elements not in the form of an aggregate. As the nature of the disturbance, this variable has its mechanism in influencing the modifier variable. The city government does not have access to control the behaviour of this variable, so it is completely uncontrollable. Therefore, in the analysis, it must be ensured that this variable is truly independent.

2.3. Control Variables as Economic Resilience Decision Variables

Economic resilience shows the ability of the government to return to the normal-set point level after economic shocks (withstand the effects of such shocks). It is acceptable if variables correlate with the concern variable and the local authority can regulate. When an external shock happens, this variable acts as a shock absorber. A control variable is another name for this variable. In this study, the control variable is a variable that will be scientifically demonstrated as an economic resilience decision variable. This study treats the control variable as a resilience variable because it acts as an antidote to economic instability, keeping the concern variable at the set point; specifically, the control variable is the resilience variable. Because the two variables are closely associated in a statistical model, the city authority merely monitors the control factors to manage the concern variables. Piecewise linear regression with breakpoint 126,255,066 can explain the pattern of relationships between Z and Income per Capita (Coondoo & Dinda, 2008). The control variable will distinguish the economic endurance of a city relative to other cities. Thus, the thing being compared is not a concern variable but a control variable as a variable that determines the resilience of a city.

The rationalisation of this line of thought is that a system's money reserves are a factor that determines the economic resilience of a city. The PAD's performance determines the level of financial reserves of a city. Thin financial reserves are reflected in the low ratio of PAD to the cost center. A low ratio indicates the position of a city's financial reserves that is vulnerable to economic shocks because the city's PAD is too burdened by the cost center (poverty subsidies, unemployment subsidies).In worse conditions, a PAD in a city even collapsed to finance the cost center. Cities with a low ratio indicate the city's position in life-saving mode. The opposite is true for cities with a high ratio; this city is growing because its PAD has a very little burden on the cost center, so it is possible to invest in various product development programs. This variable logically functions as a measure of a city's economic resilience because this variable will function as a protector for the

economic conditions that a city wants to defend from the economic shocks. It is reasonable to construct economic resilience decision variable by including PAD as the basic element. Based on the rationale presented above, this study considers Z, the ratio of PAD to the number of poor and unemployed persons in a city, as a decision variable of economic resilience, which is stated as follows:

$$Z = PAD/m + N \qquad (1)$$
$$Z = PAD/m \qquad (2)$$
$$Z = PAD/N \qquad (3)$$

The control variable, which is subsequently stated as a resilience decision variable and having a strong relationship with a concern variable, must also have a strong relationship with a disturbance variable because economic resilience has meaning when disturbance exists significantly. If there is no significant relationship between resilience variables and disturbance variables, then there is a fundamental mistake regarding determining the resilience variable or the disturbance variable studied. Central Bureau of Statistics (BPS) defined Regional original income (PAD) as revenue derived from regional income sources consisting of local taxes and others. Local Own Income is used to measure the degree of fiscal decentralisation of a city (Tajuddin & Ilyas, 2020). The amount of regional income can reflect the regional government's independence (Mankiw, 2000). The local revenue has a positive but not significant effect on economic growth; the general allocation funds have a significant positive effect on economic growth (Lin & Liu 2000). Local taxes and user charges dominate locally generated revenues (Rahmad et al., 2019.

3. Methodology

The data used and analysed in this research are historical data of yearly variables. This study used data on the disturbance variables group and Control variables groups from the Central Bureau of Statistics Indonesia website. These data covered all 514 cities in Indonesia and were observed for 5 years from 2014 to 2018. The resilience variable studied is Z, the ratio between PAD and the number of poor people. There are 9 disturbance variables studied, namely G1: the price of Pertalite fuel oil, G2: Premium fuel price, G3: The gas price of 3 kg LPG, G4: The gas price of 12 kg LPG, G5: Basic electricity tariff of 900 VA Subsidies, G6: Basic Electricity Tariff 900 VA Non-Subsidized, G7: Exchange Rate of Indonesian Rupiah to US Dollar, G8: Bank Indonesia Reference Interest Rate, G9: Consumer Price Index (CPI). 2570 observation units on each variable G1, G2, …, G9, PAD, number of poor people, PDRB, and population are collected to analyse the model of the relationship between modifier variables Z and disturbance variables G. The methods employed in this research are Piecewise Linear Regression and Non-Linear Estimation, Simple Linear regressions. The data were analysed using STATISTICA and SPSS software.

3.1 Piecewise Regression

Some studies examined the independent variable consisting of several segments based on certain values called X-knots denoted by X* and piecewise linear regression analysis (Wand & Ormerod, 2008). Piecewise linear regression analysis includes various linear regression models that match the data for each X interval (Li et al., 2015). Piecewise linear regression from the Nonlinear Estimation Startup Panel - Quick tab, STATISTICA (Pan & Zhang, 2020) estimates, using least squares, the model:

$$y = (b_{01} + b_{11}x_1 + ... + b_{m1}x_m)(y \leq b_n) + (b_{02} + b_{12}x_1 + ... + b_{m2}x_m)(y > b_n) \qquad (4)$$

We estimate two linear regression equations; one for the y values that are less than or equal to the breakpoint (b_0) and one for the y values greater than the breakpoint (Pan & Zhang, 2020). Nonlinear Estimation uses one very efficient general algorithm (quasi-Newton) that approximates the second-order derivatives of the loss function to guide the search for the minimum (i.e., for the best parameter estimates, given the respective loss function). For nonlinear least-squares regression, i.e., nonlinear regression functions and the least-squares loss function), Nonlinear Estimation includes a dedicated algorithm that is very efficient and robust and is the recommended estimation method when analysing large data sets and using the least-squares loss function (Shi et al., 2017; Marquardt, 1963)—developed a maximum neighbourhood method that performs an optimum interpolation between the Taylor Series method and the gradient method (Verwer et al., 1999). Piecewise linear models are broken-stick models, where two or more lines joined at unknown points, called breakpoint(s), represent the threshold(s). Breakpoints are the value of x where the slope of the linear function starts to change. The regression function may be defined as discontinuous, but it can be written in a continuous form (Lee & Card, 2008). One of the regression models that are less considered is piecewise regression. In piecewise regression, independent variables are divided at intervals, and for each interval, a separate piece regression line is fitted and bound between parts called breakpoint or node. This model is very useful when there are many fluctuations in the data (Galí & Rabanal, 2004).

3.2. Rosenbrock Pattern Search

This method rotates the parameter space and aligns one axis with a ridge (also called the method of rotating coordinates); all other axes remain orthogonal to this axis. Suppose the loss function is unimodal and has detectable ridges pointing toward the minimum of the function. In that case, this method will proceed with sure-footed accuracy toward the minimum of the function. However, note that this search algorithm may terminate when several constraint boundaries (resulting in the penalty value; see above) intersect, leading to a discontinuity in the ridges. Explained Rosen rock pattern search method as follows:

We start with a diagonal method

$$k_i^n = hf\left(y^n + \sum_{j=1}^{i-1}\alpha_{ij}k_j^n + \alpha_{ii}k_i\right), i = 1, 2, \ldots s$$

$$y^{n+1} = y^n + \sum_{j=1}^{s}b_j k_j$$

$$((5))$$

Applied to the autonomous differential equation

$$y' = f(y),$$

Linearizing the first formula yields

$$k_1^n = hf\left(y^n + \sum_{j=1}^{i-1}\alpha_{ij}k_j^n\right) + hf'\left(y^n + \sum_{j=1}^{n}\alpha_{ij}k_j^n\right)\alpha_{ii}k_i^n, i = 1, 2, \ldots, s,$$

$$((6))$$

Replacing the Jacobians with the computational cost

$$k_i^n = hf\left(y^n + \sum_{j=1}^{i-1}\alpha_{ij}k_j^n\right) + hJ\alpha_{ii}k_i^n, i = 1, 2, \ldots, s,$$

$$((7))$$

and introducing additional linear combinations of terms to gain further freedom:

$$k_i^n = hf\left(y^n + \sum_{j=1}^{i-1}\alpha_{ij}k_j^n\right) + hJ\alpha_{ii}k_i^n, i = 1, 2, \ldots, s.$$

$$((8))$$

Definition:

The formulas give an s-stage Rosenbrock method:

$$k_i^n = hf\left(y^n + \sum_{j=1}^{i-1}\alpha_{ij}k_j^n\right) + hJ\gamma_{ij}k_j^n, i = 1, 2, \ldots, s$$

$$y^{n+1} = y^n + \sum_{j=1}^{s}b_j k_j,$$

$$((9))$$

where α_{ij}, γ_{ij} are the determining coefficients and $= f'(y)$ J $= f^1(y)$.

The Equation $y^1 = f(x, y)$ can be converted to autonomous form by adding $x^1 = 1$, so the s-stage Rosenbrock method for the non-autonomous case could be written as

$$k_i^n = hf\left(x^n + \alpha_i h, y^n + \sum_{j=1}^{i-1}\alpha_{ij}k_j^n\right) + \gamma_i h^2 \frac{\partial f}{\partial x}(x^n, y^n) + h\frac{\partial f}{\partial y}(x^n, y^n)\sum_{j=1}^{i}\gamma_{ij}k_j^n$$

$$y^{n+1} = y^n + \sum_{j=1}^{s}b_j k_j,$$

$$((10))$$

where the additional coefficients are given by $\alpha_i \sum_{j=1}^{i-1}\alpha_{ij}, \gamma_i = \sum_{j=1}^{i}\gamma_{ij}$

Implicit differential equation: $y_i \sum_{j=1}^{i}y_{ij}$

Suppose the problem is of the form $M_y' = f(x, y)$ where M is a constant, nonsingular matrix. Applying an s-stage Rosenbrock method, we can get.

$$Mk_i^n = hf(y^n + \sum_{j=1}^{i-1} \alpha_{ij} k_j^n) + hJ \sum_{j=1}^{i} \gamma_{ij} k_j^n, i = 1, 2, \ldots s$$

$$y^{n+1} = y^n + \sum_{j=1}^{s} b_j k_j, \tag{11}$$

3.3. Disturbance Identification Method

In identifying the disturbance, Z and G data sets are processed. The resulting Z variable is then processed by changing Z to ΔZ. This is done because we want to study disturbance while disturbance is a change. ΔZ as the observed disturbance and entered as input in the modelling of the disturbance model is the negative sign cell; the positive and zero marked cells in the ΔZ matrix are deleted because it is not the nature of the disturbance.

$$\Delta Z = [(Z_{i+1} - Z_i) / Z_i].100 \tag{12}$$

Because we want to study the effect of the disturbance G on the ΔZ disturbance, the data on all the disturbance variables are processed into ΔG. Zero, and negative values of ΔG are omitted from the observational data set because zero indicates no change and the absence of change indicates no disturbance phenomenon. Meanwhile, negative cells clearly show that they are not a disturbing phenomenon because it reflects the decline, and the decline is not of a disturbing nature (reduction in fuel prices, foreign exchange, interest rates, inflation). Therefore, in observing the disturbance factor, the model is obtained by eliminating rows containing zero values on the disturbance variable. A reduction in variable disturbance (foreign exchange, inflation) is not a natural disturbance. It must be noted that the elimination of zero rows and negative cells must be carried out by combining matrix data pairs 2, 3,4,5,6,7,8 and 9

$$\Delta G = [(G_{i+1} - G_i) / G_i].100 \tag{13}$$

The identified model also has a peculiarity; the nature of the disturbance guides the researcher to obtain a model with all coefficients being negative. Logically, the disturbance must have a negative effect on the disturbance because the variable that has a positive effect is certainly not a disturbance.

4. Results

In this section, we discuss the result and analysis that includes changing Z to ΔZ data, and the data on all the disturbance variables are processed into the change data from year to year to ΔG.

4.1. ΔZ data and the data on all the disturbance variables from year to year, ΔG

Eq. (12) and Eq. (13) estimate the Piecewise Linear Regression model parameters. The disturbance data based on nine variables and disturbance variables ΔZ are processed by change transformation. The descriptive statistics of ΔZ and ΔG transformation are given in Table 1.

Table 1
Descriptive statistics of nine disturbance and economic resilience variables

	N	Range	Minimum	Maximum	Mean
Z	652	0.94	-0.94	0.00	-0.2511
G1	652	1.19	-0.90	0.29	-0.0773
G2	652	0.27	-0.18	0.09	-0.0025
G3	652	1.57	-0.29	1.29	0.1546
G4	652	0.83	-0.16	0.67	0.0393
G5	652	0.55	-0.24	0.31	0.0441
G6	652	0.10	-0.06	0.03	-0.0101
G7	652	0.16	-0.02	0.14	0.0595
G8	652	0.37	-0.22	0.15	0.0302
G9	652	0.27	-0.27	0.00	-0.0806
Valid N (listwise)	652				

Source: All data processed are from the Central Bureau of Statistics (BPS).

4.2. Estimating Parameters

Parameter estimation on Equation (4) is done by Rosenbrock pattern search estimation. In Equation (11), this method rotates the parameter space and aligns one axis with a ridge (also called the method of rotating coordinates); all other axes remain orthogonal to this axis. Suppose the loss function is unimodal and has detectable ridges pointing towards the minimum of the function. In that case, this method will proceed with sure-footed accuracy toward the minimum of the function. STATISTICA 10.0 software makes calculations easier to obtain coefficient parameters, and variance estimators are presented in Table 2.

Table 2
The result of nine disturbance variables effect on economic resilience variable Z using Piecewise Linear Regression

	Model: Piecewise linear regression with breakpoint Dependent variable: PADBM (Z) Loss: Least squares Final loss: 9.879608402 R= .84336 Variance explained: 71.126%									
N=652	Const.B0	BBMPRE (G1)	BBMPER (G2)	LPG3KG (G3)	LPG12KG (G4)	TDLNS (G5)	TDLS (G6)	VA (G7)	IHK (G8)	SBABI (G9)
Estimate	-0.469868	-0.023873	-0.956490	0.094905	-0.134021	-0.25277	0.274863	-0.12264	0.567065	0.878246
Const.B0	BBMPRE	BBMPER	LPG3KG	LPG12KG	TDLNS	TDLS	VA	IHK	SBABI	Breakpt.
0.093693	-0.003781	-0.980526	0.010981	0.068903	-0.024321	1.101936	-1.40936	-1.40949	0.90634	-0.30451

Table 3
The result of five disturbance variables affect economic resilience variable Z using Piecewise linear regression

	Model is: Piecewise linear regression with breakpoint Dependent variable: PADBM Loss: Least squares Final loss:10.501062433 R= .83253 Variance explained: 69.310%					
N=652	Const.B0	BBMPRE	BBMPER	LPG12KG	TDLNS	VA
Estimate	-0.583361	-0.098465	-0.441212	-0.067519	-0.074081	-0.036207
Const.B0	BBMPRE	BBMPER	LPG12KG	TDLNS	VA	Breakpt.
-0.042460	0.163058	-0.250568	0.314506	-0.011858	-1.06437	-0.367171

Table 2 shows the coefficients on the LPG3KG, TDLS, CPI, and SBABI variables are positive. The four variables must be eliminated in the disturbance analysis because a positive sign indicates that the four variables are not a disturbance for the Z resilience variable. It must be emphasised that the disturbance variable must be signed negative. The negative sign shows the logical consequence in the form of a decrease in the effect of the resilience variable Z. Then recalculate the coefficients for the disturbance variables BBMPRE, BBMPER, LPG12KG, TDLNS, and VA. The results obtained with the help of STATISTICA are presented in Table 3. In Table 3, there are still positive disturbance variables, namely the BBMPRE and LPG12KG variables. The two variables are omitted; the recalculation is presented in Table 4.

Table 4
The result of three disturbance variables affects economic resilience variable Z using Piecewise linear regression

	Model: Piecewise linear regression with breakpoint Dependent variable: PADBM Loss: Least squares Final loss: 8.909808218 R= .86000 Variance explained: 73.961%							
N=652	Conts Bo	BBMPER	TDLNS	VA	Conts Bo	BBMPER	TDLNS	VA	Breakpt
Estimate	-0.577279	-0.322426	-0.035541	-0.005773	-0.113318	-0.047028	-0.012893	-0.291199	-0.356696

The parsimonious analysis produces redundancy in the TDLNS variable; the recalculation without this variable shows no significant decrease in the variance explained. Table 5 is the end of the disturbance variable coefficients calculation iteration.

Table 5
The result of two disturbance variables affects economic resilience variable Z Piecewise linear regression

	Model: Piecewise linear regression with breakpoint Dependent variable: PADBM Loss: Least squares Final loss: 9.021719731 R= .85810 Variance explained: 73.634%						
N=652	Conts Bo	BBMPER	VA	Conts Bo	BBMPER	VA	Breakpt.
Estimate	-0.567180	-0.164253	-0.296262	-0.129311	-0.040632	-0.105255	-0.367244

Table 5 displays all coefficients are negatives; it is a success in getting a model of the relationship between disturbance and economic resilience variables. A positive sign on the coefficient of the model in Table 5 indicates a failure to identify the resilience variable and its disturbance. It means the model shows that BBMPER and VA have characteristics as disturbance variables for Z as a variable of economic resilience. Based on the information in Table 5, BBMPER (The price of Pertalite fuel variable) and VA (the US dollar foreign exchange rate) are 2 disturbance variables that are significant to the decrease in the resilience variable Z. The price of Pertalite fuel variable and the US dollar foreign exchange rate together are suitable predictors that have the effect of 73.63% on the decline in the resistance variable Z. VA has the greatest influence to disturb the Z value leading to a significant decrease. In certain conditions, the decrease in the Z value must be evaluated so that it does not fall into the unwanted condition, and the city is declared to have no economic resilience.

4.3. Discussion

This research suggests that economic resilience has meaning when disturbance exists significantly. The economic resilience model that ignores disturbances is unrealistic, because resilience logically requires the ability to stay acceptable when confronted with some disturbances.This viewpoint is backed up by previous economic resilience research that took three different approaches: Approach based on engineering, ecology, and adaptation. The engineering concept of resilience is to assess the ability of the region to "go back" to its original state before the crisis; the economic resilience of the region is quantified according to the level of recovery of the selected indicator (Modica & Reggiani, 2015). This approach is used in studies of British economists (Martin et al., 2016). The ecological concept of the resilient region can absorb the deviation from equilibrium by changing its internal structure (Walker & Cooper, 2011). The adaptive approach highlights the ability of the system to undergo, either in a preventive way or in response to a sudden change; the modification of its function is to minimise the impact of destabilising change.

The region as an adaptive system can never be in balance and, therefore, the economic resilience of the region turn into the continuous ability to adjust to stress, and the analysis of resilience becomes the study of how economics adjusts to varying stages in economic cycles (Pendall et al., 2010). Based on that thinking, this research challenges the work of earlier researchers with the approach that determines economic resilience-based only on the index. For measuring regional economic resilience, economic resilience indices have been developed on reff (Cheng & Zhang, 2020; Briguglio et al., 2009; Guillaumont, 2009). Researched insight capacity index, local government capacity index, knowledge and innovation capacity index, learning capacity index, and infrastructure capacity index (Bruneckiene et al., 2018). Research to measure the economic resilience index is based on four aspects: macroeconomic stability, microeconomic market efficiency, governance, and social development using the simple average also developed (Bakhtiari & Sajjadieh, 2018). Research to highlight several aspects that underlie regional resilience and analysis in building a territorial composite index for five factors, namely public relations factors, human structure in urban areas, labour market, economic innovation performance, science, and research using principal component analysis was also carried out (Stanickova & Melecký, 2018), the results of which state that the measurement of regional resilience is based on making an index. These factors can explain 81.748% of the total variability of the indicator.

Research on economic resilience was also carried out (Oliva & Lazzeretti, 2018), discussing regional economic resilience in natural disasters by establishing a resistance and recovery index for Japan, which was hit by a major earthquake. The factors studied were regional demographics, economic aspects, labour, innovation and social, using the resistance and sensitivity indices. The result is that the resistance index is greater than 1, indicating that regions in Japan have relatively high resistance to shocks. On the other hand, if the resistance index is less than 1, this region has relatively low resistance against shocks. The Republic of Indonesia's National Resilience Measurement Laboratory (Lemhannas) has researched to measure the national resilience index based on eight factors, namely economy, geography, natural resources, socio-culture, politics, ideology, defence, and security, using weighted average methods. The ranking of national resilience is done by index conversion, resulting in vulnerable, less resilient, quite tough, tough and very tough categories. Propose an index for gauging the adequacy of policy in twenty broad areas (Prieto et al., 2019).

Logically, a strategic step in assessing the economic resilience of a city is to determine the economic resilience decision variable itself. As a result, a variable is recognized suitable as an economic resilience variable if it has a significant correlation with the disturbance variable in each relationship pattern. When a variable is classified as an economic resilience variable but isn't influenced by the disturbance factors, the economic resilience discourse becomes meaningless and irrelevant. As a result, this research investigates a statistical relationships model that can explain significantly the relationship between Z, a measure expected to be a variable of economic resilience, and some disturbance variables. In this scenario, Z, the ratio of PAD to the number of poor people in a city as a cost center, will be investigated as a candidate variable for economic resilience. By recognising that the price of Pertalite fuel and the US dollar foreign exchange are two two disturbance variables relevant to the lowering in the resilience variable Z, this research has proved Z as a variable of economic resilience. These two variables together have an effect of 73.63% on the decline in the economic resilience variable Z. It can be concluded that Z, the ratio of Original Income of Region (PAD) to the number of poor people in a city, is a city-level economic resilience variable that applies nationally in Indonesia. Z gives a strong indication to be a variable of economic resilience having the following right reasons. Z is a control variable that functions as an absorber or antidote to various economic shocks so that the concern variable remains within the set point. The rationalisation of this reasoning is that the money reserve of a system is a factor that determines the economic resilience of a city. Low reserves are reflected in the low Z as the ratio of PAD to the cost center.

A city with a low Z value indicates the city's position in life-saving mode. On the other hand, for a city with a high Z, this city is growing because the PAD is very little burdened by the cost center, making it possible to invest in various product development programs. This variable is hypothesised to function as a measure of a city's economic resilience due to its function as a shield or protector for the economic conditions that a city wants to defend against the economic shocks that hit it. PAD is a determining element of Z as a variable of economic resilience. PAD as a key element of the economic resilience variable is supported (Rahayu et al., 2018), stating that the Local Own Revenue (PAD) and the Special Allocation

Fund (DAK) have a positive effect on economic growth in the Sarbagita region of the Province of Bali. Also reported that regional own-source revenues (PAD) significantly influence economic growth in the province of Central Java (Suryantini, 2017). It also shows the same results that simultaneously, there is a significant influence between the original income of the region and the balancing fund on the regional expenditure of the city of Bandung (Adur et al., 2019).

Local Own Income is used to measure the degree of fiscal decentralisation of a city (Lessmann, 2009). Stated that the amount of regional income that comes from regional original income can reflect independence for regional government and, at the same time, can reduce dependency or help from the superior government (Doh & Kim, 2014). PAD aims to give authority to the Regional Government to fund the implementation of regional autonomy following the regional potential as a manifestation of decentralisation. The decision variable Z will differentiate a city's economic resilience from other cities. Because the variable being compared is not a concern variable but a cushion variable that impacts a city's resilience, Z, as an economic resilience variable, must have a strong relationship with the disturbance variable and a strong link with the concern variable. Increases in the price of Pertalite fuel and the US dollar currency make the economic resilience variable of cities in Indonesia Z vulnerable.

5. Conclusion

In conclusion, this study has identified that the price of Pertalite fuel and the US dollar foreign exchange are two disturbance variables relevant to the decline in the resilience variable Z due to the parsimonious analysis. The joint effect of these two variables on the fall in the resilience variable Z is 73.63 percent. According to the model of the relationship between Z and these two disturbance factors, Z, the PAD ratio to the number of poor people in a city, is a city-level economic resilience decision variable that applies nationally in Indonesia.

6. Limitation and Further Studies

This study limits economic resilience at the city, not provincial or even country level. Furthermore, this study does not discuss unwanted conditions. Economic resilience requires unwanted conditions and the level of disturbance factors. This study identified the relationship model between Z and the two disturbance variables. The economic resilience model without considering the level of disruption and unwanted conditions is unrealistic. Disturbance and unwanted condition models are two important things that must be present as determinants in establishing the economic resilience status of a city, so this study cannot stand alone. Therefore, the disturbances model and the unwanted model study is our research plan. Determining the economic resilience status of a city cannot be done just by having an unwanted condition model or a disturbance model. Both models must be present.

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