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Economic Analysis of Death from Natural Disasters in Indonesia 1971-2012

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Indonesia is one of the countries that has an observable disaster intensity in the world. This is quite risky to the domestic economy and burdensome to society. The relationship between economic and disaster variables has not been studied and it is an interesting aspect to study further. This study aims to see whether the death caused by the disaster is affected by socio-economic variables such as the level of welfare in proxy with GDP per capita, level of trade openness, the role of government in proxy with the government expenditure, and education in proxy with the school enrolment rate at the tertiary level. This study uses the Negative Binomial Regression (Regression NB) approach with time series data from 1971-2012. After analysing the influence of socio-economic variables on the increase of death from disasters, this study will also calculate the value of the loss of death from the disasters experienced by Indonesia. Calculations use economic valuation techniques, namely Value of Statistical Life (VSL) with willingness to pay (WTP) approach and a meta-regression analysis to determine the nominal amount arising from the disaster. Through the NB Regression, it is proved that the variables affecting the number of deaths are GDP per capita, government expenditure and trade openness. The losses suffered by the people due to deaths from natural disasters are US$ 19,824.19.

Key words: *Economy disasters, socio-economy, VSL.*

Introduction

Climate change is a hot topic that has been discussed in recent decades. Climate change is one of the signs of environmental imbalance. Climate change has no direct impact on human life, but on environmental conditions that will ultimately distress human life (Nadal, Marquès, Mari, & Domingo, 2015). If climate change is not resolved, there will be an inevitable disruption of the economic system ranging from consumption, distribution and

production. The Centre for Research on the Epidemiology of Disaster (CRED) assesses that if the environmental damage is getting worse, the disaster will be more diverse and the impact will be more difficult to overcome (Centre for Research on the Epidemiology of Disasters, 2014). In 2011, CRED estimated that losses due to natural disasters occurring worldwide reached approximately US $246.8 billion in 2005. Compared to the amount of losses in 2001, which was US$109.3 billion, the amount of losses in 2005 increased by 235 percent (CRED, 2014).

Indonesia is one of the developing countries with a major risk of disaster. This is because Indonesia is the largest archipelagic state in Asia Pacific with 18,110 islands, a 108,000 km long coastline, and various active mountains (Dahuri & Dutton, 2000; Dwiningrum, Prihastuti, & Suwarjo, 2019). The handling of disasters occuring over the last few years is sufficient to prove that Indonesia has become a fairly progressive country in disaster management. This is marked by the publication of the national action plan for disaster risk reduction in January 2007 and Law no. 24 of 2007, which marked a new chapter in changing the perspective and management of disaster management.

The disaster experienced by Indonesia varies from natural disasters such as volcanoes, earthquakes and storms, to disasters caused by human activities such as storms, droughts and floods. The most dominant natural disasters are earthquakes and floods. The intensity of the greatest earthquake occurred between 2004 and 2005. Meanwhile, flood incidence in various regions of Indonesia is also reported to occur more frequently with 530 events in the period 1990-2005, similar to drought and forest fires. These droughts, floods and forest fires can affect agricultural systems and water availability in Indonesia. This disruption of water availability will affect the fulfilment of clean water for various sectors such as industry, household and agriculture, which will ultimately disrupt the macro-economy.

In a smaller scope, it can be seen that the disasters in Indonesia cause a lot of problems. The impact of the disaster on Indonesia's development is real. This can be seen in the 2004 Tsunami that caused more than 170,000 deaths. More than a million people became internally displaced and more than hundreds of thousand people lost employment. The direct losses equalling to 140 trillion rupiahs made the non-poor population become poor and the poor become poorer.

The perception and conception of a disaster as an uncontrolled, unexpected and/or sudden event is exogenous to the normal life of development. This was discussed at the World Disaster Conference in Kobe in 2005. The difficulty in analysing disasters and the potential distribution of risks nationally is due to the fact that the nature of each disaster and hazard is unique (Gallopín, 2003).

Based on a World Bank study in collaboration with UNISDR, the group that suffered the most from natural disasters was the low-income group. Albaba and Betrand (1993) added that the greatest impacts of natural disasters are accepted by countries with weak economies and relatively poorer institutions (Albala-Bertrand, 1993). This is because low-income people have limited ability to adapt in case of disaster. Most of them rely on the help of other communities and the government.

Skidmore and Toya (2007) and Noy (2009) conducted a study to examine the natural influences of socio-economic variables (GDP per capita, government expenditure, trade openness and education) on the number of disaster victims. Skidmore and Toya (2007) found that GDP per capita, government expenditure, and trade openness negatively affects the number of deaths from natural disasters in both developed and developing countries. Meanwhile, statistical education has no effect on the number of deaths from natural disasters (Toya & Skidmore, 2007).

Loayza et al. (2012) also found similar results with Skidmore and Toya (2007) However, this study adds other independent variables, such as inflation and trade growth. Loayza et al. (2012) found that there is a negative influence between GDP per capita, government expenditure, trade openness and education on the number of deaths from natural disasters. While the other two variables, namely inflation and trade growth, did not affect statistically the number of deaths from natural disasters (Loayza, Olaberría, Rigolini, & Christiaensen, 2012).

In recent decades, world researchers have been able to calculate the nominal value of deaths from natural disasters. Gibson et al (2007) assert that the most devastating impact of natural disasters is the loss of human life. Therefore, it is necessary to calculate the value of loss from the loss of a human life (Gibson et al., 2007). The study used a Contingent Valuation Method (CVM) and found that the nominal value of deaths from landslides in Thailand was US $250,000. Another study was Camerron et al. (2008), who found that the nominal value of deaths from natural disasters in Cambodia was US $2,000 using Benefit Cost Analysis (BCA) (Gibson et al., 2007).

Brata (2001) also conducted a study investigating the impact of disasters on macroeconomic variables, namely GDP per capita and government expenditure. In the study, Brata (2001) divided the loss into two: the loss of death (human loss) and material loss (material loss). Brata (2001) found that both mortality losses and material losses from disasters are capable of affecting per capita GDP and government expenditure (Brata, 2011). Based on this background, this study aims to examine the effects of socioeconomic variables (GDP per capita, government expenditure, trade and trade openness) on the number of deaths from natural disasters and calculate the losses due to deaths caused by natural disasters.

Literature Review

Effects of Socio-Economic Variables on the Number of Deaths due to Natural Disasters

The development of economic theory today is very rapid, but there is no main theory that reviews the impact of natural disaster victims on socio-economic variables. Economic theory that addresses the problem of disaster is the Neoclassical Sollow-Swan theory of economic growth. The Sollow-Swan model begins with the neoclassical model of the economic growth theory. In the theory, although disaster variables are not included as one of the indicators affecting economic growth, they are affecting economic growth. This means that disasters have an indirect impact on economic growth. Since this study has no grand theory, this study focuses on the same journals and studies, such as Kallenberd and Mubarok (2008), Adam (2013), Skidmore and Toya (2007), Balgah and Buchenrieder (2011), Gabriel and Groschl (2009).

Influence of GDP per capita on Natural Disaster Mortality

In the long run, the possibility of GDP per capita affecting the number of deaths from disasters is through factors of production and investment. The production factor is shaped by the level of output produced by a country and the standard of living of the society. People who have higher standards of living have more choices than people who have a relatively lower standard of living. In many cases, people with higher standards of living tend to avoid disaster. For example, people with higher income levels prefer living in places away from the flooded areas. In addition, about 13 percent of people who have a standard of living above average will use insurance services to reduce losses in the event of a disaster. A country with higher per capita GDP risks more to disaster than a country with lower GDP per capita. This is because the country has a higher level of demand for safety than a country with lower GDP per capita. If the two countries are facing the same natural disaster, a country that has a relatively higher GDP per capita can have more attempts to reduce the casualties of natural disasters, one of which by choosing the location and utilisation of anti-disaster technology. Adam (2013) adds that low-income communities will suffer the greatest losses caused by disasters. Other factors are low-income communities with little access to education, insurance, and health.

Effect of Government Expenditures on Natural Disasters

There are several frequently discussed questions about the role of the public sector in the economy. These questions relate to why the public sector is needed and what role it has in the economic system to reduce the number of deaths from disasters. Government spending may reflect government's policy. Government spending in real terms can be used as an indicator

of the magnitude of government activities financed by government spending. The government expenditure theory developed by Rostow and Musgrave in 1960 attributes government spending to the stages of economic development distinguishing between early, middle, and advanced stages (Todaro & Smith, 2000). This could explain the preparedness of a country in preparing for the disaster and facing the impact of the disaster. Countries that are in advanced development relatively have a lower number of deaths due to disasters compared to countries whose development is still in the early and medium stages.

Disasters put pressure on government spending in the short term, as stated by Adam (2013). Adam continued that government spending became one of the variables that affected the number of victims of natural disasters (Adam, 2013). Government spending is usually provided to communities through infrastructure improvements, school construction, hospitals and other infrastructure including disaster mitigation funds. Adam (2013) compares government spending in developed and developing countries. Developed countries generally have better infrastructure, school construction and more hospitals than the developing countries. This explains why in developing countries there are relatively more casualties when natural disasters occur than in developed countries. Adam found that government spending had a significant effect on the number of natural disaster deaths in both developed and developing countries. Furthermore, he found that the greater the government's spending, the lower the number of deaths from natural disasters (Adam, 2013).

Balgah and Buchenrieder (2011) brought similar argument. Cameroon is the country most frequently affected by tectonic earthquakes due to its geographic state. This study took a case study in villages closest to Cameroon, Vulcanik Line (CVL) which has the highest earthquake risk compared to other Cameroon regions (Balgah & Buchenrieder, 2011). The variables used are per capita income, the number of rooms owned in the house, the types of crops planted in their fields and the amount of funds to build the village's infrastructure. From the test results, it can be said that funds to build village infrastructure affect the number of deaths due to the disaster in each village.

The Influence of Openness to Deaths due to Natural Disasters

The affected country experiences output suppression because the disaster destroys the country's capital, both physical capital and human capital. If the country initially suffers from a trade deficit, the country will seek assistance from other countries to reduce losses due to disaster. Thus, countries with higher levels of disaster risk are relatively more open to trade compared to countries with lower disaster risk. The effect of trade openness on the number of deaths from natural disasters is derived from two transitions, namely capital flows and technology flows. In the event of a disaster, the flow of capital for trade is made easier so that the country is easier to get help and loans from outsiders to reduce the number of deaths from

natural disasters. The second transition is technology flow, which is seen from technology transfer from one country to another (Toya & Skidmore, 2007). If a country is more open, it will be easier for the country to transfer technology from other countries that have better technology. In so doing, the country can reduce the number of victims due to natural disasters.

Effects of Education on Natural Disasters

A country's education indicates the level of human capital investment. This means the better the education of a country, the higher the human capital investment a country has. People with higher levels of education have relatively better access to information than people with lower levels of education. In addition to the problem of access to information, people with higher education usually prefer to avoid disaster risks and move disaster risk to others by way of insurance (Toya & Skidmore, 2007).

Economic Valuation of Deaths from Disasters (Human Loss)

Every disaster always has an impact on the environment, both physically and socially. Impact is a change that occurs as a result of an activity. The activity in this study means activities that cause natural disasters. For example, an earthquake is a physical activity which affects the community, such as loss of homes, infrastructure, schools or loss of life. The impacts are divided into two: social impact and health impact (Leech & Tech, 2017). According to Law no. 4 of 1982, the impact also includes non-physical environment including social culture. Based on it's influence, the impact is differentiated into positive impact and negative impact.

In Indonesia impacts often have negative connotations. For example, when natural disasters occur, people suffer from loss of houses, schools, infrastructure and loss of life. The impacts caused by natural disasters are very difficult to measure. This is because the impact of natural disasters does not have market prices. The impact on the environment measured using non-use value is more interesting to discuss than the effect on productivity changes that utilise use value. Environmental impacts that use non-use values are usually measured by the option value reflecting the motives and willingness to pay (WTP) of an individual.

Value of Statistical Life (VSL)

Researchers agree that human life is very unique and cannot be valuated or monetised using monetary indicators (Posner, Sunstein, Posnert, & Sunsteintt, 2005). The literature on the value of statistical life (VSL) began in the late 1970s and early 1980s. The VSL concept itself is widely used by researchers to see how much loss resulted from an event. VSL can be used

not only in the economic field, but also in the field of health, transportation or other fields. The VSL outlines more about the trade-off between wealth and probability for life (Hammitt & Robinson, 2011). Figure 2.2 explains how an individual process will trade some of it's wealth to avoid the risk of death. Indifference curves describe the same amount of wealth individuals can exchange to reduce disaster. Meanwhile, the elasticity of indifference curve itself is WTP (willingness to pay) and WTA (willingness to accept) an individual.

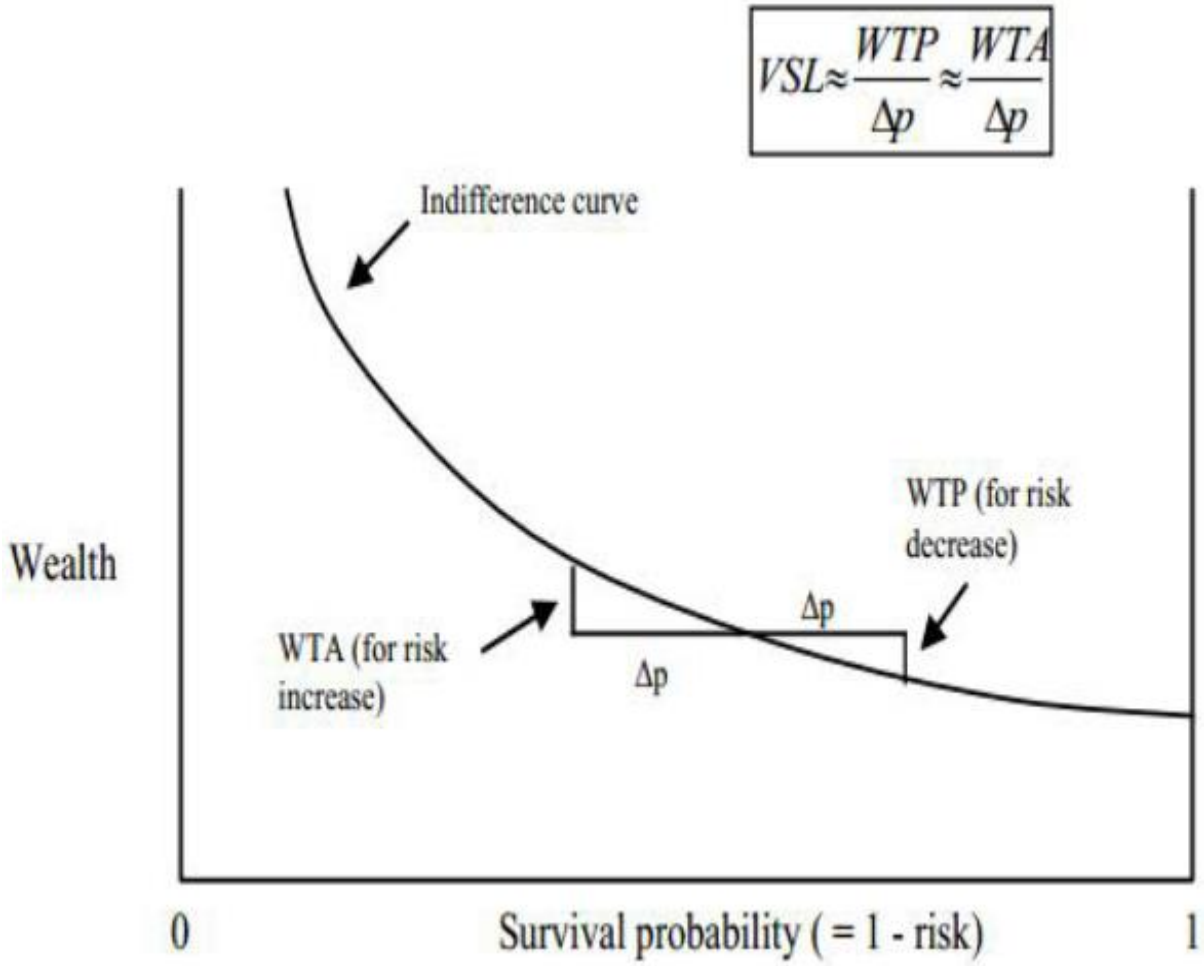


Figure 1. Trade-off between Wealth And Probability For Life

In this research, the economic valuation method is used to estimate the nearest value for loss of death due to natural disaster. It is used for the planning and construction of a country. As with other economic valuation methods, the VSL method is divided into two, namely human capital (HC) and willingness to pay (WTP) approaches. The human capital (HC) approach is still used by American and European researchers to see the average amount of dollars lost due to road deaths. This approach is used to see the amount of loss of production and loss of earnings due to death. However, this HC approach is very rarely used by researchers because this approach cannot be used to measure the value of intangible goods.

The WTP approach is used to measure the value of intangible goods and does not have market prices. This approach is based on consumer preferences. Usually researchers use Benefit Cost Analysis (BCA) to see consumer preferences (Milligan et al 2014). The WTP approach is divided into state preference and revealed preference.

The state preference can be used by conducting a survey to view PAPs from the community on the research topic. The concept of WTP calculation in this approach is done directly (direct method) by conducting a survey. This survey assumes that every individual of the community is able to know their preferences. The advantage of the state preferences approach (SP) is that the survey is flexible depending on the research objectives.

Unlike state preference that requires researchers to conduct surveys, the revealed preference (RP) uses market proxy to measure actual PAPs from the community. This calculation approach done indirectly (indirect method) is the calculation of the environmental degradation that has occurred. This approach usually uses averting behaviour approach and hedonic pricing method. This method is the most widely used method to evaluate in macro-spectacles (Milligan, Kopp, Dahdah, & Montufar, 2014). According to Smith et al (2006) the approach to calculate VSL itself is divided into four: unit value transfer, transfer function, meta-transfer model and structural transfer model. Unit value transfer is the most common and simple approach compared to other approaches. This first approach uses preference specification used to describe individual choices among non-market items (Smith, Pattanayak, & Van Houtven, 2006).

Research Methods

The approach used in this research is quantitative approach. This study used Poisson Regression or NB Regression to see the effect of per capita GDP, government expenditure, trade openness and education on the number of deaths from natural disasters. The tool used to see the effect was Stata 13 for NB Regression testing. Meanwhile, in order to answer the formulation of the second problem, the study employed Value of Statistical Life (VSL) technique by using meta-regression analysis method to know the nominal amount due to disaster borne by society. The meta-regression analysis test used OLS testing to determine VSL due to natural disasters.

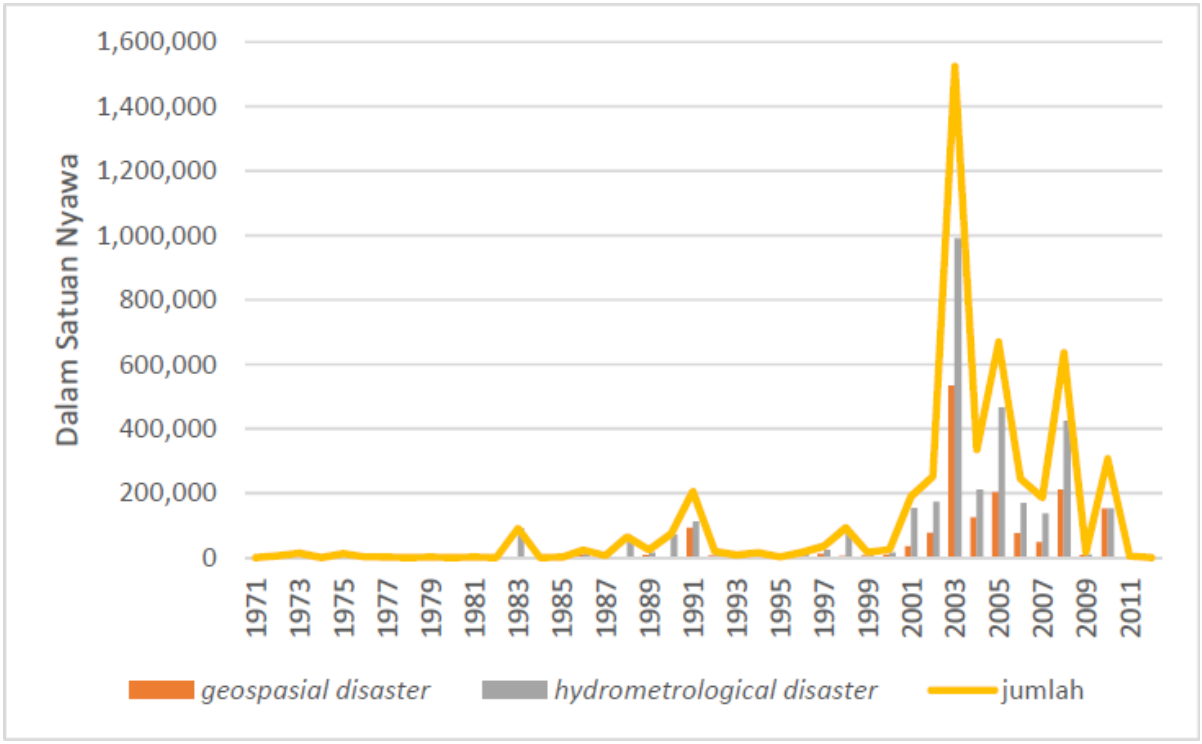
The data used in this research is secondary data. Secondary data is data obtained from various sites providing data, such as Emerging Data Statistic, BNPB Indonesia, World Bank and BPS Indonesia. The data used for the formulation of the first problem is the time series data of each variable used; those are between years of 1972-2012. The formulation of the problem of the two data used is cross-section data in 2012. Meanwhile, to know the VSL from disaster in

a country, the study used some research that can be obtained to perform meta-regression analysis.

Analysis and Discussion

The Dynamics of Natural Disasters in Indonesia

Natural disasters are mostly unpredictable events. The disaster trend that occurs in Indonesia varies widely because the topography is different from one region to another region. Viewed from the state of geography, Indonesia is among the 10 most risky countries. Disasters that occur in Indonesia vary widely due to the location of Indonesia which is in the ring pattern of volcanoes and tropical climate. Hydrometrological disaster is a disaster that can occur due to human activities, while geospatial disaster can only happen because of natural activity from nature. Hydrometrological disaster include floods, landslides, droughts and storms. Every hydrometrological disaster can occur for one reason, that is climate change (Gallopín, 2003).



Source: Emerging Data Statistic (2014)

Figure 2. Hydrometrological and Geospatial Disaster in Indonesia

Figure 2 shows a comparison between hydrometrological as well as geospatial disaster. The intensity of hydrometrological disaster and geospatial disaster does not form a certain pattern but hydrometrological disaster has more continuous intensity and long term compared to

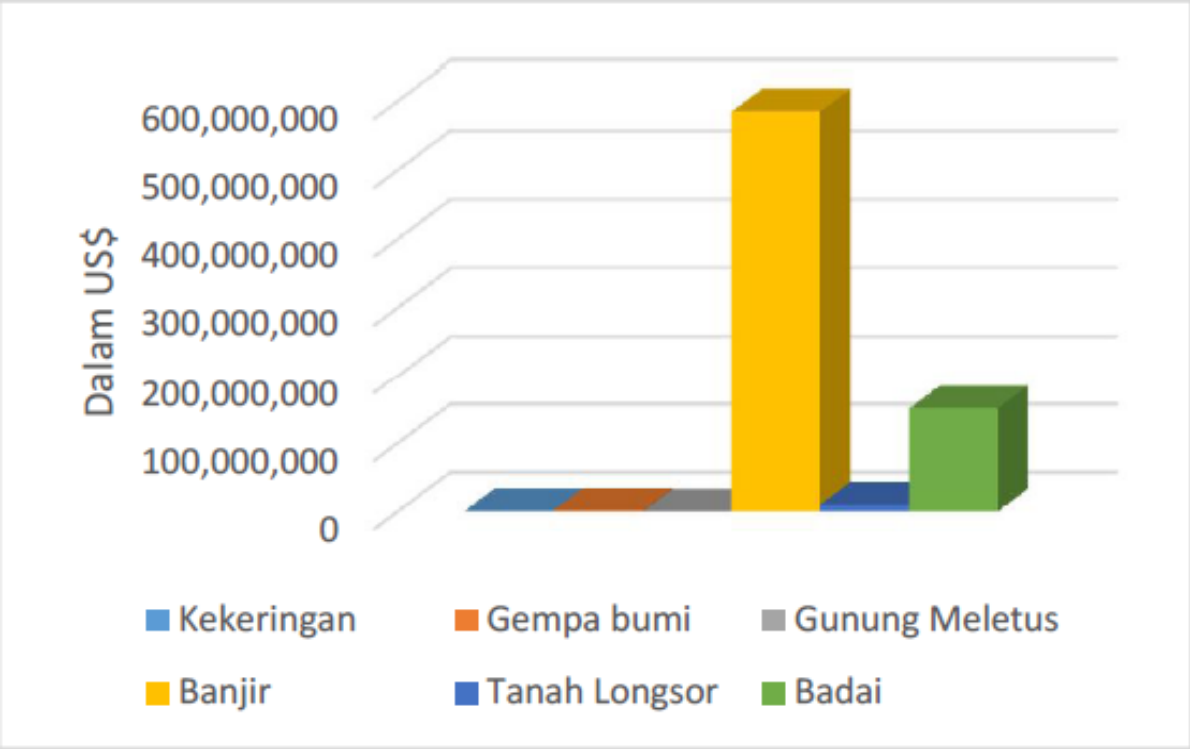
geospatial disaster. There are several years that are dominated by hydrometrological disaster and geospatial disaster. The year 1974 was dominated by disasters occurring as a result of human activities such as floods, storms, landslides and droughts. When compared to the four disasters that dominated that year, the two biggest disasters are floods and droughts. In 1974 floods and droughts impacted 3,113 and 319 people mostly in the agricultural sector which resulted in a decline in agricultural productivity during the year. From 1971 to 2005 the dominance of hydrometrological disaster was comparable with the geospatial disaster. Disaster has a tremendous impact on society, both from the economic performance and the natural resources of the affected country. The impact was suffered in a short time or in a long time. According to Loayza et al (2012) the impact of natural disasters can be divided into two, namely economic impact and geographical impact (Loayza et al., 2012).

Table 1: Impact of Economic Disasters and Geography

	Economically Localised	*Economically Widespread*
Geographically Localised	All disasters	Some disasters are causing physical capital and industry disturbance
Geographically Widespread	Some disasters are impacting only the economic sector (drought, flood and storm)	Disaster causing disturbance to the agricultural sector

Source: Loayza et al (2012)

The frequency of disasters does not necessarily indicate the impact both economically and geographically. A types of disaster that is not frequent but more harmful than frequent disasters is flood. This is supported by data released by BNPB (2014) and shown in Figure 5. According to data from BNPB (2014) the worst disaster is the flood natural disaster which loss amounted to 584 million rupiah. The high frequency of floods can cripple the overall economic activity. In addition to flooding, storm is the second kind of disastrous natural activity. The frequency of storms in 2014 was only 4 times but it cost the community about 151 million rupiah.



Source: Emerging Data Statistic (2014)

Figure 3. Disadvantages of Natural Disasters in Indonesia 2014

Dynamics of Socio-Economic Variables

At the time of REPELITA, Indonesia was spoiled with high economic growth of about 6 percent to 8 percent in the 1990s. The highest peak of economic growth ever achieved by Indonesia was in 1995 that is 8.22 percent (Cropper & Sahin, 2009). Indonesia experienced a new phase of economic development until 2007. In this year Indonesia's economic growth is relatively stable with growth between 3.45 percent to 6.35 percent, with an average growth of 5.04 percent per year. In the following year Indonesia experienced a decline in economic growth in 2008 and 2009.

The Variable Dynamics of Economic Values of Natural Disasters Due to Disasters

The economic valuation of deaths due to natural disasters in Indonesia cannot be separated from per capita income and disaster vulnerability index. These two things directly affect the value of VSL due to disaster. The risk of a national disaster cannot be separated from the conditions and the global environmental situation.

Analysis of Model and Evidence Hypothesis

Table 2. Description of Statistical Data

Variables	Observation	Average	Standard Deviation	Minimum	Maximum
Death	42	7.813	427,600.5	593	2629605
GDP per capita		947.7266	836.4255	84.18337	3551.424
Government Spending		1.72 trillion	1.9 trillion	8.33 billion	7.81 trillion
Trading Openness		5.56 trillion	5.56 trillion	1.48 billion	2.23 billion
Education		10.77139	7.642746	2.33635	31.51226

Before entering the model analysis and verification of hypotheses, the researchers performed statistical analysis of data. This study is based on 42 observations from the year 1971-2012. Death has an average total of 157,052 inhabitants with a minimum value of 0 and a maximum of 2,629,605 inhabitants. As for GDP per capita the average is US $947,266 to US $ 84.18337 minimum value and a maximum value of US $3,551,424. The government spending shows an average of US $ 1.72 trillion with a minimum value of US $ 8.33 billion and a maximum value of US $ 7.81 trillion. Trade openness has an average of 5.56 trillion with a minimum value of 1.48 billion and a maximum value of 2.23 billion. The last variable is education, which has an average of 10.77139 per cent with a minimum value and a maximum value of 2.33635 percent and 31.51226 percent, respectively.

After finding that all data have state *overdispersion*, NB *Regression* was then tested. NB Testing *Regression* was done with *the Maximum Likelihood Ratio Test* performed partially and simultaneously. In this study the simultaneous testing used the *p-value*, while the simultaneous testing used a summary of all the results of the estimation carried out in this study. Table 2 shows that the effect of GDP per capita, spending government, trade openness and education has a significant effect on the total number of deaths. Four independent variables have a *p-value* varying but significant at the 5 percent level of confidence. This means that Ho is rejected, which means that the GDP per capita, government spending, trade openness and education have partially negative effect on the number of deaths due to natural disasters.

From the results of the regression, it can be seen that all the independent variables negatively affect the number of deaths due to flooding. Examining the *p-value* of each independent variable, the researchers can see that per capita GDP, government spending and trade openness has a *p-value* of 0.000; 0.000 and 0.065, respectively. It means GDP per capita, government spending and trade openness have a partially negative impact on the number of deaths due to flooding. An increase of one unit of GDP per capita, government spending and trade openness will decrease the number of deaths due to flooding. Education has a *p-value* of 0512 which means it is not significant at the 1 percent level of confidence, 5 percent and 10 percent. That is, education has no effect partially on the number of deaths due to flooding.

Classical Assumption Test

Table 3. Heteroscedasticity Test Results

Heteroscedasticity Test Results	
Breusch-Pagan / Cook-Weisberg test for Heteroscedasticity	
Ho: Constant variance	
Variables: fitted value of VSL	
Chi (1)	4.69
Prob> chi2	0.0703

Heteroscedasticity test can be done by doing a comparison of the *p-value* of LM statistical value. If the significance level is less than the probability, the data will not experience heteroscedasticity problems. However, if the significance level is greater than the probability, there will be problems with the heteroscedasticity on the data. In the classic assumption test, heteroscedasticity was not found as seen from the level of significance that is greater than the probability.

Table 4. Multicollinearity Test Results

Multicollinearity Test Results			
	VSL Ln	Income Ln	Ln IKB
VSL Ln	1	0.1946	0.0157
Income Ln	0.1946	1	0.2076
Ln IKB	0.0157	0.2076	1

The second classical assumption is a classic assumption test for multicollinearity. Multicollinearity problems can be seen by looking at the value of the *pairwise correlation matrix*. Each dependent and independent variable has a value *of*

pairwise correlation that is small enough, i.e. 0.1946, 0.0157, and 0.2076. This indicates that the data used in this study did not experience multicolinearity.

Table 5. Autocorrelation Test Results

LAGs (1)	Chi2	Df	Prob> chi2
1	0.185	1	.6674
Ho: no serial correlation			

The autocorrelation test values obtained *p-value* of 0.6674 which is greater than 5 percent (Table 5). From this test, it can be ascertained that data are not affected by the problem of autocorrelation, and OLS estimates could be done. Explanation of descriptive statistics can be seen from Table 6. This study estimates from 15 studies of 93 developing and developed countries. VSL own value are obtained from a variety of ways, including Contingent Valuation, Life Satisfaction Approach, Cost Benefit Analysis, State Preferences and quantitative Risk Analysis. VSL value that has been compiled from 15 of these studies had an average of US $ 9,951,494 with a minimum value of the VSL of US $ 2,250 and the maximum of US $ 15,510,059. The average income is US $ 9.3965 million with a minimum value of US $ 2,120,264 and a maximum value of US $ 16.49446 million. Meanwhile, the disaster vulnerability index value has an average of 2.6 percent with a value of at least 0.9 percent and a maximum value of 4.3 percent.

Table 6. VSL Description Data

Variable	Average	Standard Deviation	Minimum	Maximum
VSL	9951494	3.61176	2.2508	15,510,059
Income	9.3965 million	2.394413	2120264	16.49446 million
IKB	2.60408	0.5832582	0.9162907	4.379524

In the table 6 it can be seen that the two independent variables to see VSL are statistically significant with a confidence level of 5 percent (Table 6). This implies that the revenue and disaster vulnerability index statistically affects the value of a country's VSL. The next thing to do is to enter the coefficient values in the equation that has been defined previously.

Table 7. Estimation Results VSL with Meta-Analysis Regression

Independent variables	Coefficient	*p-value*
Income	0.3174719	0.055
IKB	1.214969	0.096

Estimated VSL = 5.79682 + 0.3174719 GNIP $_{ind}$ + 1.214969 IKB $_{ind}$

After the value of VSL is calculated by the equation above, the next step to do is to aggregate or insert date socio-economic data of the country which VSL we want to count. The purpose of this study is to calculate Indonesia's VSL in 2012. The per capita income in 2012 was US $ 2159.56 with Disaster Vulnerability Index of 24.2 percent, the value of the VSL is US $ 19,824.19.

Limitations of Research

Influence of Socio-Economic Variables - Number of Deaths from Disaster

Discussion of statistical estimation may seem meaningless when it is not connected with the real situation occurring in the community. Every natural disaster has a different character and causes different impacts on society. Differences can also affect the impact of differences in the variables that influence the number of deaths due to natural disasters. A more detailed explanation is required in order to avoid misunderstanding. From the regression results presented earlier, the four socioeconomic variables, namely GDP per capita, government spending, and trade openness significantly affect the number of deaths due to natural disasters. However, unlike the estimation results on any type of disaster, GDP per capita, government spending and trade openness affect the number of deaths due to natural disasters such as floods, droughts, storms and landslides. The independent variable which was not statistically significant against any type of disaster is education.

Influence of Per capita income to Total Death from Disaster

From the statistical test results, it can be known that the GDP per capita has a significant effect on the testing of all types of disasters, except the mountain eruption. In conjunction with the natural disasters, the variable GDP per capita is able to be one of the influential factors. Indonesia is a developing country with a recognisable growth. One of the indicators of economic growth that can be used as a reference is the growth of GDP per capita. GDP per capita growth is only used as one indicator of economic progress but also can be used to measure the well-being of society. The higher level of GDP per capita, the higher the welfare of the community is.

Influence of Government Expenditure to Total Mortality due to Natural Disasters

On the other hand, the variables which also significantly affect the number of deaths caused by natural disasters is government spending. The greater the government spending, the lower the number of death due to natural disasters. Government spending is divided into two parts, namely recurrent expenditure and infrastructure spending. Routine expenditure is used to pay civil servants, and to purchase equipment and other stationary. Spending for infrastructure is used to hold national physical development. The item listed is government spending on disaster mitigation funds, which is included in unexpected funds amounting to 5 percent of total government expenditure. With greater government spending, the preparations made by the community when disaster strikes will be better. Government regulations on disaster response expenditure are contained in Regulation 21 of 2011 article 162 paragraph 8, which states that spending on emergency response needs to be done with direct loading on an unexpected expenditure. It's use is only for search-and-rescue disaster victims, emergency aid, evacuation of disaster victims, the need for clean water and sanitation, food, clothing, medical care and shelter as well as transitional shelter.

Effect of Trade Openness to Total Death from Natural Disasters

Trade openness has a significant effect on the number of deaths due to natural disasters. If viewed more closely in addition to catastrophic volcanic eruptions and earthquakes, the degree of trade openness affects the number of deaths. The greatest influence on the reduction of trade openness on the number of deaths caused by natural disasters, is on the case of natural disaster landslides. The level of trade openness affecting the number of deaths caused by disasters can be explained on the flow of capital and technology flows that occur in a country. The flow of capital in and out of a state would allow a country to borrow or receive assistance when disasters occur and this will lead to a reduction in the impact and the number of victims of natural disasters in the country.

Influence of Education to Total Deaths - Natural Disasters

The influence of education on the number of deaths still shows a bias in this study. Of all the types of disasters tested in this study, only education significantly affect the number of deaths caused by the earthquake. According to Skidmore and Toya (2007) education should have a negative coefficient on the number of deaths due to natural disasters. In other words, the higher the education of a country, the fewer the number of deaths is expected. Higher education will result in the rapid advancement of the individual mindset. Individuals with higher education will select places of residence with lower risk of disaster compared to other places. In addition, higher education will also have an impact on increased knowledge about

natural disasters, for example disaster prevention measures and what to do when a disaster strikes.

The Victims of Natural Disasters Statistics

World researchers in recent decades are often engaged in VSL debate. There are some researchers who agree that the loss of human life deserves to be taken into account since the largest loss from a disaster is the loss of human life. But some researchers did not agree because human life cannot be measured in accordance with the monetary standard. Bellavance (2007) said that the best way to calculate the loss of a catastrophic loss due to changes in the environment is the meta-regression analysis (Bellavance, Dionne, & Lebeau, 2009).

The results of this research which gets VSL of US $ 19824.19 is in line with those found by Khan (2007) and Bellavance (2007) who argued that VSL caused by natural disasters in developing countries is between US $ 18,000 and $ 23,000. The VSL value equals to the value of 2.25 percent of Indonesia's GDP (Bellavance et al., 2009; Haughton & Khandker, 2009). Meanwhile, each disaster loss associated with losses due to natural disaster deaths is able to be obtained by multiplying the value of individual VSL with the number of victims of natural disasters in every kind of disaster. The total death from natural disasters in 2012 was 49,516 inhabitants, or about 981 million US $ (Table 8). The disasters with the greatest disadvantage are flooding and storms, which amounted to US $ 641,530,613 and US$ 209,561,512, while the lowest is the volcanic eruption in the amount of US $ 2,418,551.

Table 8. VSL of Every Type of Disaster

Type of Disaster	VSL	Percentage to Total VSL
Flood	US $ 641 530 613	65%
Drought	US $ 4,579,388	1%
Storm	US $ 209 561 512	21%
Landslide	US $ 4,896,575	1%
Volcanic eruption	US $ 2,418,551	0%
Earthquake	US $ 118.627953	12%
Total	US $ 981 614 592	100%

Conclusion

GDP per capita significantly affects the number of deaths caused by natural disasters in the case of total deaths, floods, storms, landslides, droughts and earthquakes. This means a reduction in the number of deaths caused by natural disasters can be done. One of them is by

increasing GDP per capita. Government spending has a significant effect on the number of deaths due to natural disasters, floods, landslides, drought, storms and volcanic eruptions. Government spending did not significantly affect the number of deaths from the earthquakes. The level of trade openness significantly affects the number of deaths due to floods, droughts, landslides and storms. In the case of volcanic eruptions and earthquakes, the degree of trade openness is not significant. Education has no significant effect on the number of deaths caused by natural disasters in all kinds of disasters, except in cases of deaths from total disaster. GDP per capita, government spending, trade openness and education together (simultaneously) has an effect on the number of deaths due to natural disasters, both in testing deaths from total disaster, floods, droughts, hurricanes, landslides, volcanic eruptions and earthquakes. Based on calculations using the meta-regression method, it is known that one case of death due to natural disasters can be valued at US $ 19,824.19 equals to about 2.25 percent of Indonesia's GDP. For the total of all types of disasters the VSL is US $ 981,614,592. VSL on each type of disaster is as follows: flood US $ 641,530,613 (65 percent), dryness US$ 4,579,388 or approximately 1 percent, storm US $ 209,561,512 (21 percent), landslides US$ 4,896, 575 (1 percent), volcanic eruption US $ 2,418,551 (0 percent) and earthquakes US $ 118,627,953 (12 percent).

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