Working Paper in Economics and Business
Volume V No. 6/2016

The Economic Development Impact of Natural Disasters in APEC Countries (1999-2013)

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June 2016

University of Indonesia

Working Paper in Economics and Business
Chief Editor: Hera Susanti
Editors: Muhammad Halley Yudhistira, Rus'an Nasrudin
Setting: Rini Budiastuti, Moslem Afrizal

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Abstract

Previous empirical literature has found that income reduced disaster risks in a form of human loss. This study will add socio-economic variables, such as trade openness, size of government and corruption level as well as economic damages as another disaster impact measurement. This study utilizes disaster impact data over 15 years span on 18 APEC economies, and have found that utilizing pooled least squares, random and fixed effect model, human losses and economic damages as a form of disaster risks reduced with higher income per capita, higher educational attainment and trade openness, accompanied with smaller government size and lower corruption level a country experience.

Key words: Economic Development, Natural Disasters, Trade, GDP per capita, Government Expenditure, Corruption.

1. Introduction

The strings of natural disasters have brought devastating impact across continents toward countries. Whether it came from high, middle or low-income countries, the tremendous power of nature has managed to disrupt the economies through generating severe both human and economic losses. Huge natural disasters worldwide including Tsunami of 2004 in coastal regions of Southeast Asia, Hurricanes in the coastal United States and the Caribbean, as well as floods as disasters with high level of occurrence in some countries, have acted as shocking reminders that nature could affect deaths and economic damages in all countries altogether.

Between 1970 and 2001, natural disasters in worldwide scale killed an estimated of 2.69 billion people and led to US $955 billion in economic damages (Kellenberg & Mobarak, 2008), and the number is still large even until current period. Through available evidences, it is very important for the damages impacts caused by natural disasters to be taken into full consideration by each country. The world had witnessed, APEC as an economic cooperation of Asia-Pacific region that accounted for 56 percent of global economic output in 2011, comprises for nearly three billion people in 2011 and 44 percent of global trade, during the past 10 years had suffered from an impressive amount of disaster events generating significant human, financial and economic losses.

Major earthquake that shook China in 2014 for instance, the typhoon that swept over the Philippines or the massive tsunami that struck Japan in 2011 as well as constant occurrence of floods that engulfed number of countries in Asia-Pacific including Indonesia. Natural disasters such as those; earthquakes, floods, tsunamis, and volcanoes are only a common threat to many in the Asia-Pacific economies that sit on the so-called "Pacific Ring of Fire", area of high volcanic and seismic activity surrounding the basin of Pacific Ocean which is home to over 75 percent of the world's volcanoes and 90 percent of the world's earthquakes (TFEP, 2008).

In 2012, seven of the ten costliest disaster events, measured by overall losses, occurred in APEC economies (OECD Secreatriat, 2013). Collectively, Japan and the 20 other APEC member economies that are home to about three billion people were hit by over 70 percent of natural disasters worldwide. As for the economic damages incurred, APEC member economies suffered USD 68 billion annually in related costs from 2003 until 2013. Economies in APEC are thus extremely devastated by disasters.

As economies develop, the impacts in a form of human losses and economic damages from natural disasters shall be diminished. The logic is as economies developed, it devotes greater resources to safety including implementing precaution measures designed to reduce the impacts of natural disasters (Toya & Skidmore, 2006). Income level and other variables of economic development are also better off hence reducing the impact. Thus for an economy to be better managed and mitigate the damage impacts from disasters, economic development is truly critical.

According to UNDP, countries might face similar pattern of natural disasters, but they often experience widely differing impacts when disaster occur. As countries become more prosperous, they are often better able afford the investments needed to build houses and infrastructures that are more likely to withstand earthquakes for example, in compare with the less prosperous one. It is intriguing then to dig the impact of economic development and reduction in natural disaster impact.

In a study conducted by Kellenberg and Mobarak in 2008 on natural disaster, using a country-year panel data set, shown that there is a non-linear relationship between disaster risk and income level. Kellenberg and Mobarak (2008) argue that disaster risk exposure might increase with rising income in low-income countries due to urbanization and development (p.789). And facing downturn, as countries get richer due to better institutions, infrastructure, better construction in dwellings and technologies as well as safety concern development.

Based on a cross-sectional sample of countries in 2004, UNDP reports on disaster risks reduction provide evidences on how economic development (GDP per capita and the Human Development Index) have negative correlations with deaths caused by natural disasters event in a country.

Previous literature by Toya and Skidmore in 2006 had also argues that countries with higher economic development experience fewer losses overall, and that other indicators beside income, such as educational attainment, trade openness and government expenditure play a big role in mitigating the disaster damage. Richer nations also claimed to suffer less death and damages according to Kahn (2005), although they do not experience fewer disasters compare to poor countries (p. 283).

This research is premised on the belief that as economies developed, the process of development itself will cater reduction upon natural disaster impact. Specifically the study will see how APEC countries' level of development, ranging from developing to developed countries affects its vulnerability to natural disasters during 1999 - 2013. In differentiating this

Table 1: Natural Disaster Classifications

Disaster Subgroups	Disaster Main-Type	Disaster Sub-Type
Geophysical	Earthquake, Mass movement, Volcanic activity	Ground shaking, Tsunami, Ash fall, lahar, lava flow
Meteorological	Storm, Extreme temperature, Fog	Thunderstorm, Tornado, Wind, Freeze
Hydrological	Flood, Landslide, Wave Action	Coastal, Riverine, Ice jam Flood, Avalanche (snow, debris, mudflow)
Climatological	Drought, Glacial lake outburst, Wildfire	Forest Fire, Land Fire
Biological	Epidemic, Insect infestation, Animal accident	Bacterial, viral, fungal, parasitic prion diseases
Extraterrestrial	Impact, Space weather	Airburst, shockwave

Source: OFDA/CRED EMDAT classification

study with prior ones, the period being used will be renewed and the observed countries will be narrowed down into 18 of APEC member economies. Considering APEC member countries have suffered massive amount of natural disasters followed by related tragic losses and yet the understanding of their relevance to economic development is still poor, it is thus intriguing to conduct a study on this issue and concentrating on APEC as the subject.

2. Economic Development and Natural Disaster Impact

2.1. Basic Development Indicators

A very wide variety of indicators then can be used to characterize the difference between developed and developing countries. However, according to (Todaro & Smith, 2012), there are basic indicators of three aspects of development: real income per capita adjusted for purchasing power; health as measured by life expectancy, undernourishment, and child mortality; and educational attainments as measured by literacy and schooling.

2.2. Natural Disasters and Damages

Natural disaster defined as a serious disruption triggered by a natural hazard causing human, material, economic or environmental losses, which exceed the ability of those affected to cope (UNDP, 2004). It refers to natural processes or phenomena occurring in the biosphere that may constitute a damaging event.

The Centre for Research on the Epidemiology of Disasters (CRED) defines a disaster as a "situation or event, which overwhelms local capacity, necessitating a request to national or international level for external assistance; an unforeseen and often sudden event that causes great damage. Natural disasters as defined by CRED are further classified into several groups namely stated in the Table 1 above.

As for the five types of natural disasters that will be used in this study, according to various sources, Floods are defined as significant rises of the water level in stream, lake, reservoir and coastal region (Kahn, 2005). Earthquakes are sudden breaks within the upper layers of the earth, sometimes breaking the surface resulting in the vibration of the ground (Kahn, 2005). Oxford defines storm as a violent disturbance of the atmosphere with strong winds and usually rain, thunder, lightning, or snow while vol-

Table 2: Comparisons between Types of Damages

Direct Damages	Indirect Damages	Macroeconomic Impact
Damages to home and content	Business interruption	The loss of the sector's contribution to the development growth rate of the national or local economy
Damages to firm structure, inventories and content	Losses in industrial and farming production	Effects on employment (labor force)
Damage to infrastructure	Costly adaptation from loss of use (i.e. greater transportation costs)	Effects on the external sector
Mortality and injury	Mortality and morbidity	Effects on public finances
Environmental degradation	Decreased tax revenues	Effects on prices and inflation

Source: Kousky, Carolyn; Informing Climate Adaptation; and ECLAC; further processed

canic activity is an opening in the earth's crust from which lava, ash, and hot gases flow or is ejected during an eruption. And Landslides as the downward falling or sliding of a mass of soil, detritus, or rock on or from a steep slope.

2.3. Types of Damages

Disasters present a broad range of impacts, with potentially long-lasting, multigenerational effects. In other words, Natural phenomena not only produce immediate apparent effects, but they also unleash aftereffects that evolve slowly or emerge a relatively long time after the disaster has occurred. In addition to causing direct damages to lives, buildings, equipment and infrastructure, they may produce major indirect consequences such as business interruption, loss of employment and output, and the like. Thus through this, such classification of natural disasters' damages exist.

Expressed in simplest terms based on ECLAC report on estimating damages from disasters, a disaster could affects assets (direct damages); the flow for the production of goods and services (indirect losses); and the performance of the main macroeconomic aggregates of the affected country (macroeconomic effects).

3. Links between economic development and natural disaster risk

Economic development effect upon disaster impact reduction becoming more apparent until today. Not only measuring the impact of natural disaster toward economies, but it is becoming critical to measure the relationship in reverse. That the higher the economic development hence the lesser it would be for that particular economy to suffers from higher level of death counts and economic damages caused by natural disaster event. Numbers of sources and previous findings have also provided evidences upon the negative relationship between economic developments improving hence disaster impact will be reduced.

It is only natural to state that as economies develop, the impacts in a form of deaths and economic damages, from natural disasters shall move in the opposite direction. The logic is when economies developed, income level and other variables of economic development are better off hence reducing the impact.

By measuring the economic development impact on human losses and economic damages from natural disasters specifically, Toya and Skidmore in 2006 have found that countries with higher economic development do experi-

ence fewer losses. And the authors' main contribution is to show that higher income followed by high education, greater openness, more complete financial systems and smaller government are also important. The study was conducted using annual data across 151 countries over the 1960 - 2003 period.

Adding prior finding, one of the most visible conceptual links between economic development indicators and natural disaster impact is that as GDP per capita increases, the numbers of deaths are reduced along the way. Kahn in 2005 had found that richer nations do not experience fewer disaster shocks than the poorer nations, but they do suffer fewer deaths from natural disasters and concludes that there exists a negative relationship between GDP per capita and deaths from natural disasters. Some of the possible reasoning are when income per capita increases, people would demand homes located in safer communities and homes that are built on stronger and durable material hence help to reduce death counts (Kahn, 2005).

Another possible link would be according to Kellenberg and Mobarak study in 2008, that in metropolitan areas, disaster impact may be mitigated by larger numbers of people having access to more adequate economic and social institutions, well designed infrastructure, and competent urban planning that are not found in more rural locations (p. 792).

Following Kellenberg and Mobarak study, development may also lower disaster risk exposure by raising the quality of education and access to health care (p. 792). Education level serves as one of the standard measurement of economic development, which holds certain impact upon disaster risk. Kellenberg & Mobarak (2008) however found that there is a nonlinear relationship where disaster risk associated with flooding, landslides and windstorms increases with income up to GDP per capita levels of $5044, $3360, and $4468 per year respectively and decrease after that (p. 795). They argue that disaster risk might increase with rising income in low-income countries due to urbanization and development. While the downturn in disaster damages as countries get richer due to better institutions, infrastructure, better construction in dwellings and technologies as well as safety concern development.

A better-developed economy followed by a higher level of education (Toya & Skidmore, 2006) where in this study indicated by mean of total years schooling implies that citizens are able to make better choices with safety concern on location decisions that subsequently resulted in fewer deaths from disasters (p. 22). Educated populations are also naturally more capable of circulating information and relaying risk prevention measures (UNDP, 2004).

Greater openness from trade that represents the degree of competition and transfer of technological knowledge from abroad might also lead to a reduction in damages risk from natural disasters (Toya & Skidmore, 2006). A higher degree of technological transfer would improve disaster prevention program and improve building codes thus reducing disaster impacts.

Another conceptual link, according to Toya and Skidmore findings in 2006, a larger government, measured from its expenditure, may indicate greater public assistance hence stronger social response mitigating disaster risk. Infrastructure and structural soundness of a building should also become better made as the general government spending grow and thus lead to a reduction in human loss and monetary damages related to disasters. Richer nations with higher economic development and large government, may also invest in specific technology for instance computer modeling of storms which spread early warning information before the storm hits shore and thus saves lives (Kahn, 2005, p. 277). Kahn also believed that government corruption could increase deaths counts through the lack of enforcement of building codes, zoning, and infrastructure quality.

However, higher general government expen-

diture, or the larger the size of the government, it might also means they become less efficient in handling disaster response; such for in Kobe Earthquake case in Japan, studied by (Horwich, 2000) where they receive slow government response.

Apart from its positive sides, economic development however may also presents significant impacts on environmental quality and impacts of natural disasters according to (Kellenberg & Mobarak, 2008), for example, in some South and Central American countries, (p. 792) where destruction of forests occurred due to pressure in developing agricultural land, the populations are more exposed to floods and landslides risk.

The last relevant findings would came from (Padli & Muzafar, 2009) where the authors found results suggesting that the relationship between disaster losses and the level of economic development is nonlinear in nature and reporting that at lower income level, a country is more disaster resilience but at higher income level, an economy become less disaster resistant.

4. Empirical Model

This study employs *pooled* data on selected natural disaster events and macroeconomic data act as a proxy of economic development of each country across 15 years span (1999 - 2013) and thus the data collected will be limited to this period only. The data being utilized in this study will be secondary data for all variables being experimented, including natural disaster impacts and economic development indicators data. Natural disaster impacts as dependent variables, labeled into (DEATHS) total human loss and missing but presumed dead and (Econ_Damages) the monetary damage caused by the natural disaster event data will be obtained from the EM-DAT database by OFDA/CRED, which has proven to be a very useful tool for analyzing human losses or monetary damages caused by natural disasters (Felbermayr & Grschl, 2014).

As for the macroeconomic data that act as independent variables, different sources will apply for certain variables. GDP *per capita* (PCGDP) that reflects income per capita, *Trade openness* (OP) as a percentage of GDP, size of government as indicated by *general government expenditure per GDP* (SIZE) are extracted from the World Bank database. While *Corruption Perception Index* (CPI) that measures perspective of corruption level in a country is obtained through Euro-Monitor International from Transparency International.

The natural disasters selected will vary from different natural disaster subgroups; geophysical (earthquake and volcano), hydrological (flood and landslides) and meteorological (storm) which appear to be top most frequent disasters suffered by APEC countries. All of the samples will be limited to APEC member countries only and narrowed down to 18 countries observed in total, and further classified into nine middle-income countries and nine high-income countries that can be observed through Table 3.

Two sets of models will be used in this research where it is constructed based on Toya & Skidmore (2006), and are being modified by adding new independent variables that apply for both models.

$$\begin{aligned}(ln\ death_{jit}) = {} & \beta_0 + \beta_1(PCGDP_{it}) + \beta_2(Op_{it}) \\ & + \beta_3(SIZE_{it}) + \beta_5(CPI_{it}) \\ & + \beta_6(y_{jit}) + \epsilon_{jit} \qquad (1)\end{aligned}$$

Where the dependent variable in the first model above (Eq. 1) denotes $deaths_{jit}$ or human loss (total deaths) that comprises of number of people who lost their life from the disaster and number of people missing that the whereabouts is unknown since the time of the disaster event and thus presumed dead. It basically reflects as number of human losses caused by natural disaster event j in country i during period t. The value of deaths is measured in

Table 3: Samples of 18 APEC Member Countries

Developing Countries	**Developed Countries**
China	Japan
Indonesia	USA
Vietnam	New Zealand
Philippines	Russia
Thailand	Canada
Korea Rep	Australia
Mexico	Chile
Malaysia	Hong Kong
Peru	Singapore

natural logarithmic forms.

$$(ln\ econ\ damages_{jit}) = \beta_0 + \beta_1(PCGDP_{it}) + \beta_2(Op_{it}) + \beta_3(SIZE_{it}) + \beta_5(CPI_{it}) + \beta_6(y_{jit}) + \epsilon_{jit} \quad (2)$$

While the second model measures the impact of the independent variables upon economic damages ($damages/GDP_{it}$), in which the damages value refers to the amount of damage to property, crops and livestock, measured in logarithmic form. The figure is the estimated damage in real US$ at the moment of the event or it simply reflects monetary damage caused by disasters incurred from a natural disaster event j in country i at time t. To better identify damages suffered in proportioned to countries' GDP, the economic damages will be presented as a share of GDP in respective countries.

As for the independent variables in both Eq. 1 and 2 consist of $pcgdp_{it}$ that represents natural logarithm of real gross domestic product per capita; Op_{it} serves as trade openness ((Export+Import)/GDP) in a country; $SIZE_{it}$ represents general government expenditure / GDP; CPI_{it} indicates corruption level measured through Corruption Perceptions Index; while y_{jit} represents additional variables that could affect deaths from natural disasters such as series of occurrence per natural disaster events and number of population.

The authors hypothesize that higher income per capita, increases sense of safety allowing countries to employ more costly precaution measures and further lead to lower disaster impacts. Greater openness here serves as a proxy for the degree of transferal of technological knowledge from abroad that reduces impact, the higher the trade openness the lower it should be the disaster impact. The larger the size of the government the more sources a country has to improve the infrastructure, education services and stronger disaster response impact, lead to disaster impact reduction. On the other hand, higher corruption leads to lower quality of building blocks, and reduce fund allocated for disaster management, thus increase deaths and damages caused by natural disaster events. The lower the CPI means the more corrupted a country is, thus the relationship will be negative. Higher disaster events occurrences and number of population lead to higher death counts and economic damages.

5. Estimation Results

This study basically involves two different models that require separate treatment or method to generate the estimation results. There are three types of method of processing the data and performing the regressions that will be used in this study; PLS (Pooled Least Squares), Fixed Effect and Random Effect method, founded from proper testing for method with the best fit for each model.

After applying the required procedures in finding the proper method to be used to estimate the model, the first model will be run with Error Components Model or simply *Random Effects Model* that was obtained through proper tests procedures that have been elaborated in previous chapter.

However when the regression is restricted into two parts, into developing and developed economies only, the method being used differ from the prior full sample models. The restricted regressions on the first model are happen to use *Pooled Least Squares* approach, derived from the *Breusch/Pagan Test*. As well as Fixed Effect Model, used based on significant value in Chow Test results. This condition again applies for the second model on economic damages as well.

Table 4 presents regression estimates for the number of deaths and economic damages equations using the full sample or all 18 APEC member countries. The results suggest that for the variables of interest, the only significant variable was income per capita, which is consistent with the prior findings by Toya and Skidmore. While the rest of the significant variable is the number of occurrence of storm, earthquake, landslides, and volcanic activity, in affecting the total deaths.

While for the second dependent variable in column (2), income per capita is significant in affecting economic damages. Trade openness also plays a significant role, followed by some controlling variables of disaster occurrences namely; earthquake, as the type of disaster that are most significant in affecting economic damages suffered.

GDP per capita has significantly able to inversely affect the dependent variable, total deaths counts caused by natural disaster event in APEC economies, consistent with the proposed hypothesis. In column (1) a coefficient of 0.74 in GDP per capita represents that when income per capita increases by one percent, the total deaths by disaster will be reduced by 0.74 percent during the observed years. This condition is appropriate as the higher the income per capita in a country, the higher it will be their sense of safety and their willingness to afford any additional costly precautionary measures for avoiding disasters. For instance, houses that are located near landslides prone area are usually cheaper than the one that do not, hence higher income per capita will let them to pick more costly but safer housing location. Aside from location, houses that are built on stronger and durable material also help to reduce death counts (Kahn, 2005), and can be achieved by higher level of income per capita.

Size of government is also consistent with the hypothesis that it has inverse relationship with deaths. As general government expenditure increases by one percent, human fatalities will decrease by 0.004 percent. Reduction in corruption level, that is shown in higher Corruption Perceptions Index value, by one unit also able to reduce deaths by 0.074 percent which again consistent with the hypothesis. It goes the same for trade openness where an increase in trade by one percent leads to increase in deaths by 0.001 percent. However, these three variables are not significant in the human losses model.

In Table 4 it appears that storm, earthquake, landslide and volcanic activites are the disaster events that are significantly increasing the human fatalities in the 18 APEC economies, with volcanic activity having the largest coefficient magnitude in increasing death counts. An increase in volcanic activity event by one time will increase deaths by 0.511 percent. As some of the APEC countries sit in the so-called Ring of Fire where they experienced severe volcanic activity.

As for the second model (damages/GDP) in column 2, the method being used for this particular model is Fixed Effect, as proven through the value of Prob>F in *chow test* of 0.000 and an insignificant value of Prob>Chibar2 with 0.1831 in *Breusch and Pagan Langrangian Multiplier test*.

Table 4: Natural Disaster losses and Economic Development: All Countries

Dependent Variables	Log (Deaths) (1)	Log (Economic Damages) (2)
GDP per Capita (**Ln_PCGDP**)	-0.739843**	2.801371**
Trade Openness (**OP**)	-0.0015594	-0.0302093*
Size of Government (**SIZE**)	-0.0044542	0.0063779
Corruption Level (**CPI**)	-0.0746305	-0.612304
Log of Population (**Ln_Pop**)	0.3349821	-
Storm	0.1286944***	0.1257169
Flood	0.0023391	-0.0431219
Earthquake	0.2456528***	0.4809086***
Landslide	0.2966076***	0.0949199
Volcanic	0.5112635**	0.4701551
No of Observations	211	189
R^2	0.6223	0.0260

Notes: *) Significant at the 10% level, **) idem, 5%, ***) idem, 1%

In column 2 however the result is inconsistent with the hypothesis for having a positive relationship between GDP per capita and economic damages/GDP for all APEC countries. The positive coefficient of 2.8 indicates that a one percent increase in GDP per capita will increase economic damages in proportion to GDP by 2.8 percent. Such thing can happen because when income per capita increases, like what happened in most of the time in developing countries, the higher the income, the higher as well the damages suffered from disasters. When income per capita is increasing, it means that countries are becoming richer and when development takes place, numbers of infrastructure being built by removing forests and or are locating buildings near the shores will increase. When this happened, more infrastructures are being built and reduction in forestry that could reduce disaster damages will increase the damages/GDP suffered.

Trade openness as another significant variables of interest in reducing damages/GDP is consistent with the hypothesis by embedding a negative relationship. The negative coefficient of 0.03 indicates that when trade openness increase by one percent; it will reduce damages/GDP suffered by 0.03 percent. This condition persists because as openness increases, the degree of technological transfer will improve, and higher technological transfer can lead to better building codes and better construction of dwellings, and thus strengthen the infrastructure capability in facing disasters, which ultimately lead to lower damages from disasters. Corruption level although have a consistent relationship with the hypothesis is not significant in affecting damages/GDP. Size of government on the other hand, is not consistent with the hypothesis by having a positive relationship however it is not significant as well.

The most significant disaster events in affecting damages/GDP in APEC countries would be earthquake with a p-value of 0.005. That an

increase in earthquake occurrence by one time will increase damages in proportioned to GDP by 0.48 percent.

This restricted model for developing countries only, utilizes different method, which is Fixed Effect Model. Different with the full sample model, in column (1), none of the variables of interests are significant in affecting death counts in developing countries. While for the disaster events occurrences as the controlling variable that could also affect deaths; storm, earthquake, landslides, volcanic activity are the four disasters that significantly increase total death counts in APEC developing economies.

The four variables of interest are having consistent relationship with the proposed hypothesis, except for trade openness for having positive relationship with the death counts in APEC developing economies. This can happen because a high level of trade for developing countries could endanger domestic firms for having to compete with international firms. They might need to lay offs workers to cut costs causing unemployment and lower income per capita preventing them to perform additional costly disaster prevention and lead to more deaths. However still none of them are significant in affecting death counts in APEC developing economies.

Storm, earthquake, landslide and volcanic activities are the four disaster events that manage to bring significant impact upon the increase in deaths by disasters. All of them are positively correlated which are aligning with the hypothesis. With Volcanic holding the highest coefficient magnitude of 0.66 that represents, an increase in volcanic events by one time, will increase the death counts by 0.66 percent. Second largest coefficient magnitude is held by earthquake with 0.33.

Since some of the APEC member economies are located in pacific *ring of fire*, namely Indonesia and Philippines, then it is consistent with the results that earthquake and volcanic activity will be the disaster events that will significantly bring largest impact upon human losses in APEC developing countries.

The second model for developing countries as seen in column (2), utilizing Pooled Least Square as the appropriate method from conducting the proper testing. However heteroskedasticity was found (Prob>Chi2 = 0.0232) and thus further treatment by making the regression *robust* is done, results reported below are in robust estimates. Both autocorrelation and high multicollinearity between the regressors are absent.

After performing robust, The R^2 has improved to value shows 0.235, which indicates that this model is able to explain 23.5 percent of all the variability effect between independent variables and the dependent variables.

As what can be observed from Table 5 column (2) the only significant variable is the size of government as measured with general government expenditure in proportioned to GDP coefficient and couples of disaster event occurrences, storm and flood.

Size of government was consistent with the hypothesis, that is negatively related the damages/GDP. A coefficient of -0.024 in the Size of Government and with a p-value of 0.000 indicates that size of government is highly significant in reducing the damages/GDP caused by disasters. The interpretation stands for an increase in general government expenditure (size of government) by one percent, will reduce damages/GDP by 0.024%.

This condition holds because, as what the hypothesis has proposed, higher general government expenditure means that government in a country have increased its spending and allocate it to different sectors including infrastructure, building codes, education, as well as disaster management program that will eventually lead to lower damages/GDP. In developing countries, government expenditure will certainly play a big role in affecting the economic development. And the country holding highest general government expenditure in propor-

Table 5: Natural Disaster losses and Economic Development: Developing Countries

Dependent Variables	Log (Deaths) (1)	Log (Economic Damages) (2)
GDP per Capita (**Ln_PCGDP**)	-0.4167842	-0.9591021
Trade Openness (**OP**)	0.0036423	0.0083765
Size of Government (**SIZE**)	-0.0047623	-0.023786***
Corruption Level (**CPI**)	-0.3333658	0.748385
Log of Population (**Ln_Pop**)	1.615866	-
Storm	0.122764*	0.3096725***
Flood	-0.0179998	-0.1459954*
Earthquake	0.3277999***	0.2601806
Landslide	0.2896762***	-0.1489856
Volcanic	0.6630816***	0.3998032
No of Observations	127	105
R^2	0.5431	0.2347

Notes: *) Significant at the 10% level, **) idem, 5%, ***) idem, 1%

tioned to GDP is Philippines with 109 percent, which is a country inside developing group.

The rest of the variables of interests, GDP per capita is consistent with the hypothesis with negative relationship and so do the corruption level. While trade openness are again positively related with damages/GDP. However, those three variables are not significant in affecting damages/GDP in developing countries.

Storm and flood also significantly affecting the damages/GDP in developing countries. With storm holding the highest coefficient magnitude in compare to flood. Strom and flood are basically types of disaster events that could cause significant damage on crops, property, and livestock, thus it is consistent with the estimation results.

Results from Table 6 will be restricted on APEC nine developed countries only. In the deaths model regression, the method being used will be Pooled Least Squares in accordance with the developing model.

The only significant variable of interest in Column (1) is corruption level. In addition, log of population, storm, earthquake, and landslide occurrences are also significant and positively correlated with the dependent variables.

Corruption level is significant in the developed countries. However the relationship is not in accordance with the proposed hypothesis. The coefficient value of 0.374 indicates that an increase in one unit of CPI will increase deaths by 0.374 percent. In other words when corruption level decreases (increase in CPI), deaths by disaster also increases.

This positive correlation can be affected by certain factors. Financial crisis in 2007-2008 have brought impact upon United States as a whole including hurting government budget. Assuming that the corruption level is declining hence lead to more funds to be allocated for disaster management, however during the recovery period, the Federal spending are allocated

Table 6: Natural Disaster losses and Economic Development: Developed Countries

Dependent Variables	Log (Deaths) (1)	Log (Economic Damages) (2)
GDP per Capita (**Ln_PCGDP**)	-1.508026	2.058986
Trade Openness (**OP**)	-0.0006105	-0.0947243*
Size of Government (**SIZE**)	-0.0212908	0.7322295**
Corruption Level (**CPI**)	0.3740325*	-1.507622*
Log of Population (**Ln_Pop**)	0.8851633***	-
Storm	0.127391*	0.0207771
Flood	0.0201241	0.0623536
Earthquake	0.4509196*	0.9990224**
Landslide	0.9049964*	0.9075745
Volcanic	-0.3461145	-0.0680176
No of Observations	84	84
R^2	0.4910	0.1333

Notes: *) Significant at the 10% level, **) idem, 5%, ***) idem, 1%

mostly in government's bailout for banks to revive the economy. To get the funds for bailout, government must either borrow or taxed out of the economy. Tax revenue allocation will then mainly used for huge bailouts, and automatically reducing the fund allocation for other sector including infrastructures, and disaster management, which might lead to more deaths.

Another significant variable is log of population where it shows a positive correlation with human losses by disaster. This estimation results are align with the proposed hypothesis, that the larger the population might increase deaths caused by natural disaster events.

As for the column 2, the R-squared has improved to 0.1333, which indicates that the model can explain 13.3 percent of all the variability effect between independent variables and the dependent variables.

Variables of interest being significant here in affecting damages/GDP in APEC developing economies will be trade openness, size of government and corruption level. Followed by controlling variable of disaster events namely earthquake.

Trade openness shows an increase relationship with the damages derived from disasters in developing economies. A negative coefficient of 0.095 indicates that an increase in trade openness by one percent will significantly reduce damages/GDP in developing countries by 0.095 percent. This condition persists because again as openness increase, the degree of technological transfer will improve, and higher technological transfer can lead to better building codes and better construction of dwellings, which ultimately lead to lower disaster impacts.

According to Kahn in 2005, richer governments or governments with high level of expenditure can provide implicit disaster insurance through effective regulation and planning and by providing quality infrastructure. However, Toya and Skidmore in 2006 also found that size of government is inversely related with

the damages/GDP suffered from disasters. As they say the larger the government, they may become less responsive and less efficient at handling disaster response initiatives like in the case of Kobe earthquake where the government has a slower response than the market-oriented Japanese Mafia.

This study has found similar founding with Toya and Skidmore in 2006 that when size of government increases by one percent, it will increases damages/GDP in developed countries by 0.732 percent, showing inconsistency with the hypothesis.

Corruption level measured with Corruption Perceptions Index (CPI) has the desired coefficient direction and significantly affects the damages/GDP derived from disasters in APEC developed economies. It is crucial to remember that the lower the value of the CPI, the more corrupted a country is and vice versa. Thus the negative relationship implies for every increase in the CPI value, it will reduce disaster damages. The statement meant that when CPI value increases by one point, means lower corruption level, and will reduce damages/GDP significantly by 1.51 percent.

This estimation results is in accordance with the hypothesis that higher corruption lead to more damages/GDP incurred, especially when earthquake, flood, storm and landslides play a role in it. Funds that are supposedly allocated for improving infrastructures or building codes are corrupted and lead to poor level of building codes. Shoddy school construction for instance in Sichuan China due to corruption, was politically alleged in increasing the amount of deaths caused by Earthquake with 88305 people were confirmed dead and missing thus presumed dead, the highest death counts in China since 1999-2013 (EM-DAT). Higher corruption level makes infrastructure becoming less resilient in facing disaster events and lead to more damages being suffered from disasters

Earthquake events being the controlling variable holds significant impact in increasing the damages/GDP suffered in APEC developed countries. That an increase in earthquake occurrence by one time will increase damages/GDP by 0.99 percent. Aside from being the only significant disaster events, earthquake also holds the highest magnitude among the others in affecting damages, as earthquake might be able to bring largest impact in increasing damages per GDP like what happened in Japan where the damages reached 212 billion USD in 2011 due to earthquake.

6. Conclusion

In general, the results obtained from both model regressions conclude that higher income per capita managed to reduce total deaths when regressing all countries altogether, however it increases economic damages/GDP induced from disasters. Higher trade openness reduces damages/GDP in all countries regression plus when it was restricted to developed countries regression. Larger size of government has significantly reduces damages/GDP in developing countries especially. As at this stage of economies, government may have greatest impact in reducing disaster impacts and to economic development. Lower corruption level reduces damages/GDP from disasters in developing countries but increases deaths in developed countries, because some of the un-corrupted funds might not be efficiently allocated toward disaster impacts reduction measures. And for population and disaster events it was proven to have positive impact upon increasing both disaster impacts. Some differences were also found in the variables of development being significant in reducing the disaster impacts, between developing and developed countries.

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