The Effect of Natural Disasters on International Trade and Countries' Capital*

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Abstract

This paper studies the effect of natural disasters on international trade. The panel dataset of natural disaster number and international trade volume in 49 countries from 1990-2010 were used in this study. Four types of natural disasters of interest are Climatological disasters, Geophysical disasters, Meteorological disasters and Hydrological disasters. Only Hydrological disasters are found to be positively associated with the Export and Import volume over time. An important determinant of the impact of natural disasters on international trade is the level of income of the country. Natural disasters could encourage Human capital accumulation, although no association is found with physical capital counterpart.

Keywords: Natural Disasters, International Trade, Human Capital Accumulation

Introduction

Recently, the world has seen an increase of natural disaster events at an alarming rate. Today's technologies do not seem to help forecast the possibility of these harmful events. Due to their unpredictable nature, the impacts of natural disasters on life have been enormously beyond the sudden loss of life and assets. Psychological effects such as stress, sadness, and depression come afterward. Generally, the economy of the country will be affected and there is a possibility of domino effects of damage to the neighboring exporting and importing countries, due to global connection nowadays.

An international research unit that keeps and compiles and analyzes data and information in estimating the natural disasters impacts on populations at risk is the Centre for Research on the Epidemiology of Disaster (CRED) in Brussels. According to CRED, natural disasters are divided into 4 categories: Climatological, Geophysical, Meteorological, and Hydrological disasters. Climatological disasters refer to climate-related disasters such as extreme temperature, drought, and wild fire; Geophysical disasters involve the movement of the tectonic plates of the earth, for example, earthquakes and volcanoes; Meteorological disasters happen during atmospheric processes, e.g. storms and hurricanes; and Hydrological disasters relate to water cycle and/or overflow of bodies of water caused by wind set-up, i.e.

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flood and wet mass movement.

The growth of natural disaster occurrences is evident. Statistics collected by the Centre for Research on the Epidemiology (CRED) in Brussels show that from 2001 to 2010, the annual average disaster occurrence is 332 while 384 events were recorded in 2011 alone. Approximately 244.7 million people suffered and the death toll reached 30,733. Total economic losses were tremendous at an estimated 366. US$ 1 billion.(Guha-Sapir; Vos and Ponserre, 2011) exceeding the previous highest record in 2005 (US$ 246.8 billion). The losses were above a 200 percent increase from the annual average damage from 2001 to 2010 (US$ 109.3 billion). Among four disaster-types, geophysical disasters caused the highest losses in 2011 with 68.1 percent of the total disaster fatalities. For the past ten years, the countries most frequently hit by natural disasters have been China, the United States, the Philippines, India, and Indonesia.

Gassebner, Keck and The (2006) stated that natural disasters reduce trade in both exporting and importing countries and the governance are among key factors to determine the magnitude of trade effects. In particular, the lower the state of democracy in a country, the more the trading loss. This statement is supported by (Oh, 2009), who applies a large-N analysis which use a sample of countries and years to demonstrate that an increase in climatic disasters and political risk can lessen bilateral trade in both importing and exporting countries. Countries with lower political risk have a smaller reduction in trade flows even when they are more frequently struck by climatic disasters. The results of climatic disasters bring about macroeconomics impact on various economic variables, for example, consumption, investment, and government expenditure due to the essential role of economics and trade in the global system. Moreover, Mohan, (2009) found that hurricanes have a significant negative effect on exports particularly agricultural exports in the year when they occur and in the following year by using data obtained from 24 countries in the Caribbean and Central American region for the period 1961 to 2009. Finally, Bluedorn, (2005) maintains that hurricanes in Central America and the Caribbean region evoke a temporary trade reaction to the damage and loss they cause. The damages of hurricane disasters can ruin capital value at GDP in one year resulting in the decreasing value of the current account to GDP in those countries**.**

Although the negative side of the natural disasters seems apparent, Popp, (2006) stated that substitution away from physical capital accumulation might have a net positive effect on human capital accumulation (Albala-Bertrand, 1993; Dacy and Kunreuther, 1969). They found that, in general, gross domestic product (GDP) would increase in the period immediately following a natural disaster. In addition, (Skidmore and Toya, 2002) discovered that climatic disasters are positively correlated with human capital accumulation, total factor productivity growth, and GDP per capita growth. Natural disasters serve as a means of “creative destruction” through R&D spillovers (R&D stock embodied in the imports of developing countries) by providing an opportunity for capital accumulation and enabling higher long run growth rate of GDP per capita (Cuaresma, Hlouskova and Obersteiner, 2008).

Purposes of the study

1. To determine the effect of total natural disasters -Climatological disasters, Geophysical disasters, Meteorological disasters and Hydrological disasters on export volume and import volume.

2. To analyze the effect of natural disasters -Climatological disasters, Geophysical disasters, Meteorological disasters and Hydrological disaster- on human capital accumulation and physical capital investment.

Methods

This study attempts to analyze the effects of natural disasters on international trade by using panel data. The approach adopted in this study will mainly utilize the approach used by Skidmore and Toya, (2002). Yearly panel time series data of natural disasters normalized in each of the 49 countries included in the sample during the period 1990-2010 are used to run the panel regression model in order to analyze these following objectives:

Simple Model:

$$\ln(export)_{it} = \beta_1 + \beta_2 (income)_{it} + \beta_3 (fert)_{it} + \beta_4 (govc)_{it} + \beta_5 (disasters)_{i,t-k} + \varepsilon_1 \quad ...(1)$$

$$\ln(import)_{it} = \gamma_1 + \gamma_2 (income)_{it} + \gamma_3 (fert)_{it} + \gamma_4 (govc)_{it} + \gamma_5 (disasters)_{i,t-k} + \varepsilon_2 \quad \ldots(2)$$

Where the subscript i denotes country, t denotes year, k denotes a number of lag-time for k = 0,1,2,..,n and the Greek symbols denote the empirically-estimated coefficients. Equation.1 and equation.2 are the two main equations that are used to calculate the effect of natural disasters on international trade, which employs the widely used exports and imports in the fixed-effect Model.

The dependent variables, $export_{it}$ and $import_{it}$ are the export volume and import volume as reported by 49 countries respectively. There is a rival independent variable, or key variable of total natural disasters lagged t-k year. The variable $disasters_{i,t-k}$ measures the logarithm of (1 + number of total disasters events) following (Skidmore and Toya, 2002), for the period 1990-2010 in 49 countries in t-k year. A total natural disaster consists of Climatological disasters, Geophysical disasters, Meteorological disasters and Hydrological disasters. In some years natural disasters do not occur, thus natural disasters are set to zero if there were no events. This study includes the usual control variables such as $income_{it}$ which measures initial income for the period 1990-2010, $fert_{it}$, which measures the fertility rate for the period 1990-2010, $govc_{it}$, which measures the ratio of government consumption expenditure to real GDP for the period 1990-2010. These control variables are not lagged. Moreover, we scope this empirical analysis to disasters which occur in countries at three income-levels, see in table 1, as divided by the World Bank using gross national income (GNI) per capita: (i) low income countries (earnings of $1,035 or less), (ii) middle income countries (earning of $1,036- $12,615) and (iii) High income countries (earning of $12,616 or more) that effect international trade, to be precise, export and import volume. This study intends to interpret the relationship between natural disasters on export volume and import

volume in term of percentages. For example, if natural disasters change by 1 percent, by how much percent will export volume increase or decrease?

Table1 1 Countries for Estimating the Effect of Natural Disasters on International Trade

Low income	Middle Income		High Income
Bangladesh	Bolivia	Brazil	Chile
Burundi	Cameroon	Colombia	Hong Kong SAR, China
Central African Rep.	Congo, Rep.	Costa Rica	Korea, Rep.
Chad	Egypt, Arab Rep.	Dominican Rep.	Singapore
Gambia, The	Guatemala	Ecuador	United States
Kenya	Honduras	Malaysia	Uruguay
Madagascar	India	Mauritius	
Malawi	Morocco	Mexico	
Mali	Nigeria	Peru	
Mozambique	Pakistan	Thailand	
Niger	Philippines	Tunisia	
Rwanda	Senegal	Turkey	
Uganda	Sri Lanka	Venezuela, RB	
Zimbabwe	Sudan	Zambia	
	Swaziland		

Part 1: This study uses the same control variables as a simple model and four main types of natural disasters: Climatological disaster, Geophysical disaster, Meteorological disaster, and Hydrological disasters as independent variables instead of total natural disasters. This study evaluates the effect of frequency of each type of natural disasters on international trade. Additionally, this study uses time-lag methods on each type of natural disasters variables to find how long it takes international trade to recover after natural disasters occur. Compared with value economic loss of natural disasters, we employ the value of economic loss of total natural disasters and each type of natural disasters (in thousand US dollars) as independent variables on export volume and import volume as well. We use the same control variables as a simple model and merely use the t-k lags on each type of natural disasters variables but not the other control variables.

Part2: This study looks deeply into to effect of natural disasters on human capital accumulation and physical capital by using the same panel dataset as in Part 1. Due to the unavailability of data, only 7 countries (eg. Morrocco, Costa Rica, Malaysia, Mexico, Peru, Tunisia, Korea,Rep.) from the 49 countries can be the impact of natural disasters on countries' capital. To measure impact of natural disasters on human capital accumulation, the control variable is the income variable following Skidmore and Toya (2002). To measure impact of natural disasters on physical capital accumulation, school variable is represented by secondary school enrollment and income variable are set as control variables. We estimate either frequency or value of economic loss of each type of natural disasters: Climatological, Geophysical, Meteorological and Hydrological disasters on human capital accumulations and physical capital investment which are represented by secondary school enrollment and growth of capital formation respectively. This model also focuses on countries at three different income levels that effect countries' capital.

Data collection Procedures: The dataset obtained either directly from the World Bank Database (e.g. export volume, import volume, the growth rate of GDP per capita, fertility rate, government consumption expenditure, secondary school enrollment, growth of capital formation) or from the Center for Research on the Epidemiology of Disasters (CRED), EMDAT (e.g. Climatological, Geophysical, Meteorological and Hydrological disasters) that must fulfill at least one of the definitions as follows; (i) 10 or more people reported killed that are confirmed as dead or persons missing and presumed officially dead. (ii) 100 or more people reported affected which means people requiring sudden assistance during a period of disasters emergency. (iii) Declaration of a r state of emergency for countries in which the disaster has occurred. (iv) The country with disasters calls for international assistance.

Empirical Results

Given the other things being held constant, a panel dataset of 49 countries for the period 1990-2010 was used to determine the effect of natural disasters on international trade and countries' capital with different income-levels, i.e., low- income, middle-income, and high income countries by employing the fixed-effect model. The results with a 1 percent level of significance was chosen for the ease of explanation and used the maximum lags at 13 years because all disasters are not statistically significant from the 13th year onwards after using lags 20 years following the1990-2010 period.

Natural disasters and international trade

In 49 countries, natural disasters have different impacts on export and import[1]. The frequency of total natural disasters has a positive effect on exports but a negative effect on imports. Surprisingly, a frequency of total natural disasters has a statistically significant positive impact on imports in low-income countries. This impact would increase import volume in the year that the disaster happens and continues to have a statistically positive effect on imports for two more years. In the third year, even if a positive sign can be seen, it is no longer significant. For middle-income countries, the significantly positive impact on imports can be found only in one particular year, to be precise, the third year after the disaster. There was no significant impact in the first two years as well as the fourth year onward. Middle income countries will import more commodities to substitute domestic production along with new machinery and equipment for restoration and rebuilding. There is no relationship between total natural disasters and exports. Middle income countries can still export goods and services. The total natural disaster consists of Climatological, Geophysical, Meteorological, and Hydrological disasters that present different effects on international trade

On the subject of disaster, in 49 countries, Hydrological disasters strongly promote international trade unexpectedly, frequencies of Hydrological disasters have a statistically significant positive impact on both export and import volume in the same year the disasters take place and this continues to increase international trade significantly year by year. Hydrological disasters could increase import volume sizably the year that the disaster occurs

[1] They are non-significant at the 1 percent level of significance.

and last as statistically significance for 13 years. There is no significant effect from 13th year onwards. On the export side, the impact is significantly positive in the shorter period and last as statistically significant for 8 years after the Hydrological disaster happens. For low-income countries, the frequencies of Hydrological disasters have a significant positive impact on imports for 12 years consecutively; however, Hydrological disasters have no significant impact on exports. Hydrological disasters in middle income countries show a statistically significant effect on both exports and imports. The coefficient sign of Hydrological disasters on exports in middle-income countries demonstrates an increase of the significant positive effect on export volume every year until 6th year while the disasters continue to have a significant positive effect on import volume up to 9th year. Middle-income countries have the same significant positive effect as international trade outcome in 49 countries.

Furthermore, Geophysical disasters, in terms of frequency, negative impact on exports in high-income countries greatly. These effects finish in the 3rd year. The value of economic losses of Geophysical disasters has no relationship with exports in any level-income countries. On the other hand, either frequency or values of the economic loss of Climatological and Meteorological disasters have a non-significant effect on international trade at any income-level.

Natural disasters and countries' capital

Human Capital has a significant relationship with Hydrological disasters only since the first year onwards. This effect keeps a positive trend but in magnitude gradually year by year. This empirical study for the period 1990-2010 shows stronger evidence for Hydrological disasters leading to human capital accumulations. This is consistent to the statement that natural disasters can increase human capital accumulations (Skidmore and Toya, 2002). By focusing in countries with different income levels, the countries which are presented in middle-income countries strongly confirms that Hydrological disasters encourage human capital accumulation extensively. However, no relationship among all of value of the economic losses of natural disasters and human capital can be found. On the other hand, Physical Capital has no significant relationship with either total or all types of natural disasters not only in frequency but also value of the economic losses.

Conclusion

In 1990-2010, only Hydrological disasters strongly promote international trade, both imports and exports in 49 countries. The effect of the frequency of natural disasters on export volume is ambiguous depending on types of natural disasters and the income level of the country. Geophysical disasters such as earthquakes have a significantly negative effect on exports in only high-income countries. Conversely, Hydrological disasters such as floods can strongly promote exports in only middle-countries. Meanwhile the value of the economic losses from natural disasters has no significant effect on exports in countries at any income level. Similar to export volume, the effect of the frequency of natural disasters on import volume is ambiguous depending on the types of natural disasters and the income level of the country as well. Both low- and middle-income countries have a significant positive

relationship between the frequency of total natural disasters and imports. Furthermore, Hydrological disasters in low- and middle income countries have the same significant positive effect as total natural disasters. Additionally, all values of the economic losses of natural disasters has no significant effect on imports.

Human capital has a strong positive relationship with Hydrological disasters. Neither natural disaster frequency nor value of the economic loss has a relationship with Physical Capital. This finding matches results from Skidmore and Toya, (2002). It also shows strong evidence for supporting the idea that natural disasters could lead to human capital accumulation. This paper finds that Hydrological disasters can promote both exports and imports. A possible reason may be creative destruction that is substitution away from physical capital which may have a net positive effect on human capital accumulation, some regions may have experienced Hydrological disasters and they are able to build embankments and/or dams to prevent flood damage when disasters strike again. Hydrological disasters can promote exported and imported goods and services.

Limitations and Suggestions

This study had to drop some control variables due to an unavailable panel dataset. Because of the unavailability of some variables data, particularly, the data on the value of the economic loss of natural disasters in the period of 1990-2010, the result does not accurately represent each level-income group and the effect of natural disasters on countries' capital cannot be generalized to the level-income countries at large. This study does not take the severity level of disasters, for example, a hurricane intensity scale and an earthquake measuring on the Richter scale, into account. Since CRED records only the frequency of disasters, no data on the severity of disasters is available. The severity of disaster could be a good variable to measure the impact on international trade, human capital accumulation, and physical capital investment because one catastrophic disaster could have greater impact than many small or moderate disasters. These are some suggestions for further study that could be accomplished by obtaining more refined estimates of the severity of disaster and the different characteristics of each country to be put into both the theoretical model and empirical analysis.

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