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Redefinition of the Role of Asia-Pacific Region in the Global Economy ISSN 1899-3192

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NATURAL DISASTERS AND FDI INFLOW IN THE DEVELOPING COUNTRIES OF SOUTH-EASTERN ASIA

Abstract: The purpose of this paper is to investigate the impact of catastrophic events on FDI inflow in five developing countries with high catastrophic risk of South-Eastern Asia region, i.e. Indonesia, Malaysia, Philippines, Thailand and Vietnam. With the use of the OLS method I estimate the model in which the dependent variable is FDI inflow as a percent of GDP. Among explanatory variables I have included the number of natural disasters as well as types of them per year in respective year and two years back, GDP growth, GDP *per capita*, inflation and total trade to GDP ratio. The results show a negative correlation between FDI inflow and the occurrence of natural disasters for Thailand and Malaysia. In the remaining countries results do not give clear answer with respect to the relation between the number of disaster and investments in particular country.

Keywords: catastrophic risk, natural disasters, foreign direct investment, developing countries.

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1. Introduction

In the recent few decades there can be observed significant increase in the number of reported natural disasters as well as the economic costs caused by them. According to the Emergency Events Database (EM-DAT) collected by the Centre for Research on the Epidemiology of Disasters (CRED)[1] since 1950, 12 409 natural events have taken place from which 1409 (8.81%) have happened in South-Eastern Asia.

Within last years can also be noticed an increase in FDI inflow to developing economies, to South-Eastern Asia, among other regions. Therefore the question which may be asked is, if catastrophic risk might determine the decision about investment in particular area. The rest of the paper consists of three parts. In the

[1] The EM-DAT database contains data on the occurrence and effects of over 18 000 mass disasters in the world from 1900, www.emdat.be.

second section there is a short review of the literature on the economic consequences of natural disasters. The third section is the analysis of possible interrelation between FDI inflow to considered region and the occurrence of natural disasters after 1970. In this part I also present the methodology of my research and data sources. In the fourth section I show the estimation results of a model, followed by conclusions.

2. Economic impact of natural disasters

Due to the increasing number of reported natural disasters (Figure 1), greater level of damages, both to the society and the economy and the high importance of the issue of natural disasters and their impact on the decisions and behaviour of economic agents, more and more attention in the literature is paid to this phenomenon. But the literature is still limited and underdeveloped, especially in terms of empirical research.

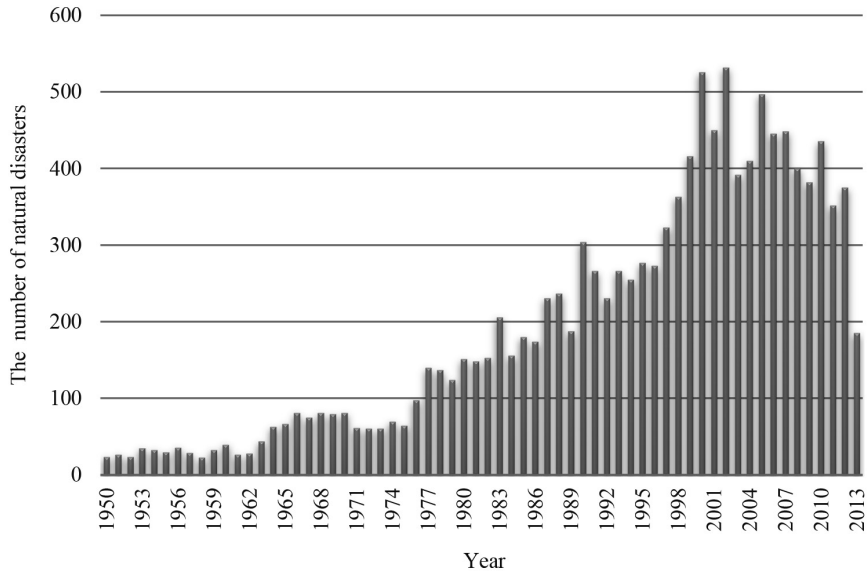

Figure 1. The number of natural disasters reported 1950–2013

Source: EM DAT, http://www.emdat.be/natural-disasters-trends (retrieved: 20.01.2014).

The research which examines the immediate impact of natural disasters on GDP was conducted by Albala-Bertrand, who considered the macroeconomic effect of disasters in the years 1960 to 1970 for 26 countries using statistical analysis "before – after".[2] The author demonstrates the positive impact of natural disasters on GDP level. However it is questioned by Skidmore and Toya, who pay attention to

[2] J.M. Albala-Bertrand, *Political Economy of Large Natural Disasters*, Clarendon Press, Oxford 1993.

the procedure of the counting of national income – what is destroyed is not usually included in the GDP, while the reconstruction efforts and modernization contribute to the growth of this indicator.[3]

With respect to the long-term macroeconomic impact of natural disasters, Skidmore and Toya show a positive correlation between economic growth and the occurrence of natural disasters.[4] The authors justify this by increasing the accumulation of human capital due to the risks and potential decrease in the expected return on physical capital in comparison to the human in the situation of catastrophic risk. In addition, losses in physical capital are often significantly higher than in human capital. Thus, new investment in human capital results in an increase in productivity (measured by TFP index). The example of another study which considers long-term impact is the article of Noy.[5] The most important conclusion is that natural disasters have a statistically significant positive impact on economic growth and is greater in developing countries than in developed ones.

In addition Skidmore and Toya noted that the higher the level of education, more developed financial system and more open the economy to some extent reduces the felt impact of the natural disaster.[6] Moreover, Noy concludes that the number of deaths due to a disaster is negatively correlated with the ability to read and write, and the openness of the economy to international trade.[7]

More detailed analysis is conducted by Loayza et al.[8] As the authors point out in their study, there is no reason to assume that natural disasters equally affect agriculture, industry or services. In addition, droughts, storms and earthquakes cause losses in various sectors of the economy. Drought, for example, may largely contribute to the losses in the agricultural sector, while earthquakes cause damage to the infrastructure, industry, through the destruction of companies, factories, roads, bridges. The study performed by the authors shows the dependence of the effects of natural disasters in terms of economic growth, both on the type and strength of natural disasters and on the economic development of a country. In developing countries, earthquakes can cause higher growth in the industrial sector. The study was conducted for two groups of countries in the period 1961–2005. The first group consists of 94 countries, while the second takes into account only the developing countries in the number of 68. The authors applied generalized method of moments (GMM) for the five-year average values of the particular variables. The results of

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[3] M. Skidmore, H. Toya, Do natural disasters promote long-run growth?, *Economic Inquiry* 2002, vol. 40, no. 4, pp. 664–687.

[4] *Ibidem*.

[5] I. Noy, The macroeconomic consequences of disasters, *Journal of Development Economics* 2009, vol. 88, pp. 221–231.

[6] M. Skidmore, H. Toya, *op.cit*.

[7] I. Noy, *op.cit*.

[8] N. Loayza, E. Olaberria, J. Gigolini, L. Christiaenses, Natural disasters and growth: Going beyond the averages, *World Development* 2012, vol. 40, no. 7, pp. 1317–1336.

the estimated models show that the greater number of the coefficients next to the variables describing the occurrence of natural disasters is statistically significant for developing countries. This is particularly visible in the industrial sector, in which there can be observed the interdependence between the types of natural disasters and growth in this sector in all estimated equations. As the authors point out, the economic growth in developing countries is more sensitive to shock, which is the occurrence of a natural disaster.

Another problem of the research undertaken in the literature is the question of the correlation between the inflow of foreign direct investment and the number of natural disasters. Escaleras and Register in their work check this correlation using quantitative methods.[9] In the regression equation as the dependent variable the authors take investment inflows into the country in a given year. The authors consider four models with different independent variables describing the occurrence of natural disasters. Those are: the number of natural disasters in the previous year, five-, ten- and twenty-five cumulative number of natural disasters in the preceding years. The other macroeconomic variables are: GDP *per capita* (in constant prices of 2000, USD), the GDP growth, the net trade in U.S. dollars in 2000, inflation, political stability, the rule of law. The most important conclusion of the estimated model is the statistical significance of the coefficients next to the number of natural disasters in each of the four cases (95 and 99% significance level). In addition, as indicated by the sign of coefficients, the correlation of considered variables is negative. However, the study takes into account both developed and developing countries and it would be better to separate these two groups of countries.

3. Natural disasters and FDI inflow in South-Eastern Asia

My study focuses on five developing countries in the region of South-Eastern Asia, i.e. Indonesia, Malaysia, Philippines, Thailand and Vietnam. The number of reported natural disasters in those five countries accounts for about 95% (1337 out of 1409) of all events which took place in considered region. Table 1 presents the number of events by country and by main type in a period 1950–2013. The highest number was registered in Philippines (545), followed by Indonesia (420) and Vietnam (184). The dominant types of natural disasters in this area are floods (465), storms (441) and earthquakes (131). Material losses due to all disasters in five countries are estimated to be about USD 103 billion USD.

Since this region is highly vulnerable to natural disasters, the question which arises here is whether the occurrence of natural disasters affects foreign direct investments inflow to considered countries. Data about the FDI inflow are available from 1970 (available via WDI and UNCTAD). During more than four decades

[9] M. Escaleras, Ch. Register, Natural disasters and foreign direct investment, *Land Economics* 2011, vol. 87, no. 2, pp. 356–363.

Table 1. Natural disasters in South-Eastern Asia in 1950–2013

Country	Frequency				
	Natural disasters	Earthquake	Flood	Storm	Other
Indonesia	420	101	158	12	149
Malaysia	67	1	36	7	23
Philippines	545	25	135	299	86
Thailand	121	4	66	32	19
Vietnam	184	0	70	91	23
Total	1337	131	465	441	300

Source: own calculations based on EM-DAT, http://www.emdat.be/advanced_search/index.html (retrieved: 20.01.2014).

after 1970, there could be observed in general significant increase in FDI inflow to developing countries of South-Eastern Asia (data for particular years are presented in Table 2). However, through the years the value of FDI inflow varies for all five countries. For Indonesia the dynamic takes negative value 14 times, Malaysia – 8, Philippines – 11, Thailand – 9 and Vietnam – 2.

Table 2. The value of FDI inflows between 1970 and 2010, USD million

Country	1970	1980	1990	2000	2010
Indonesia	145	188	1,093	–4,550	13,771
Malaysia	94	934	2,611	3,788	9,060
Philippines	–1	144	550	2,240	1,298
Thailand	43	189	2,575	3,410	9,147
Vietnam	0	2	180	1,289	8,000
Total	281	1,457	7,009	6,177	41,276

Shaded areas indicate decline in the value of FDI inflow.

Source: UNCTAD database, http://unctadstat.unctad.org/ (retrieved: 20.01.2014).

There are many factors which influence the decision about the location of FDI and catastrophic risk may be one of them. It is noteworthy that Indonesia and Philippines out of five considered countries have had the highest number of natural disasters since 1950, therefore the effect on investment's decision may be stronger. In addition, the highest inflow of FDI takes place in Indonesia. Table 3 presents FDI inflow, the number of natural disasters and total economic losses due to all disasters in particular year for those two countries. In a case of Indonesia the highest decline can be seen in 1998. In 1997 the most costly in terms of economic losses natural disaster took place. Wildfire in September caused damages equal to 8 billion and drought about 88 million USD. It can be noticed that three years after 1996 losses increased while investments decreased significantly.

Table 3. Indonesian and Philippines FDI inflow and natural disasters

Indonesia					Philippines				
Year	FDI inflow, million USD	FDI – % GDP	Number of natural disasters	Total economic losses, million USD	Year	FDI inflow, million USD	FDI – % GDP	Number of natural disasters	Total economic losses, million USD
1990	1,093	1.0	7	14.9	2000	2,240	2.7	13	89.8
1991	1,482	1.2	12	47.0	2001	195	0.3	11	109.6
1992	1,777	1.3	4	105.4	2002	1,542	1.9	13	17.5
1993	2,004	1.3	4	19.3	2003	491	0.6	10	42.3
1994	2,109	1.2	15	195.9	2004	688	0.8	13	138.9
1995	4,346	2.2	8	50.4	2005	1,854	1.6	4	2.5
1996	6,196	2.7	9	567.8	2006	2,921	2.2	20	347.3
1997	4,677	2.2	6	8,089.1	2007	2,916	2.2	16	16.8
1998	–241	–0.3	7	1,500.0	2008	1,544	0.8	20	481.2
1999	–1,866	–1.3	8	5.7	2009	1,963	1.6	25	962.1
2000	–4,551	–2.8	15	240.6	2010	1,298	0.8	15	335.1

Shaded areas indicate potential relationship between FDI inflow and number of natural disasters or economic losses.

Source: UNCTAD and EM-DAT, http://unctadstat.unctad.org; www.emdat.be (retrieved: 20.01.2014).

Table 4. Descriptive statistics

Variable	Mean	Standard dev.	Max	Min	Source	No of observ.
Natural disaster	5.37	5.82	36	0	EM-DAT	220
Earthquake	0.55	1.18	6	0	EM-DAT	220
Flood	1.85	2.35	14	0	EM-DAT	220
Storm	1.75	2.77	15	0	EM-DAT	220
FDI inflow	2,251.00	2,268.10	19,852.57	–4,550.36	UNCTAD	215
FDI, % GDP	2.28	2.34	11.94	–2.76	WDI	200
CPI	7.61	7.84	58.39	–1.71	WDI	194
GDP growth	5.79	3.60	13.29	–13.13	WDI	200
GDP pc	1,655.10	1,428.71	6,786.19	262.95	WDI	201
Trade	88.49	47.67	220.41	18.95	WDI	199

Source: own estimation based on EM-DAT, WDI and UNCTAD, http://www.emdat.be; http://databank.worldbank.org/data/databases.aspx; http://unctadstat.unctad.org (retrieved: 20.01.2014).

Losses due to natural disasters in Philippines are not as high as in Indonesia. Philippines is smaller country and economy, however, experiences more natural disasters per year. In Table 3 it is seen that the change in the value of FDI inflow may be related with the number of reported natural disasters. Both for Philippines and Indonesia there may exist negative correlation either with the occurrence of natural disasters or economic losses.

Data concerning natural disasters are publicly available at the Emergency Events Database (EM-DAT) collected by the Centre for Research on the Epidemiology of Disasters. An event is included in the database if it fulfils one of four conditions: (1) 10 or more people reported killed, or (2) 100 or more people reported affected, (3) or the declaration of a state of emergency or (4) a call for international assistance. Descriptive statistics for natural disasters data and FDI as well as other macroeconomic indicators are presented in Table 4.

To estimate the model, the OLS method with robust standard errors is implemented for each country separately. In addition independent variable ND describes not only the number of natural disasters in particular year but also one and two years before, as well as three different types of disasters. The estimated equation is as follows:

$$y_t = \beta_0 + \beta_1 ND_t + \beta_2 ln\text{GDP}pc_t + \beta_3 \text{GDP}gr_t + \beta_4 cpi_t + \beta_2 \text{trade}_t + \varepsilon_t,$$

where: y_t – FDI/GDP ratio at t,
ND_t – the total number of reported natural disasters,
$ln\text{GDP}pc_t$ – logarithm of the level of GDP *per capita*,
GDPgr – GDP growth,
cpi_t – inflation level,
trade_t – total trade/GDP ratio,
ε_t – error term,
β_i – estimated coefficients.

4. Empirical results

The results of the estimation are presented in Table 5 (only for independent variable describing natural disaster). The most significant relationship between the occurrence of natural disaster and FDI inflow is visible for Thailand (the country with the highest level of FDI inflow after Indonesia). The coefficient is statistically significant in 8 out of 12 equations. Moreover the coefficient is negative, meaning that natural disaster, or flood, or storm decreases, *ceteris paribus*, the FDI inflow to Thailand, where since 1970, 505 natural disasters have taken place, with the majority of storms – 271, and floods – 134. Second country where coefficient next to variable "natural disaster" is statistically significant and negative is Malaysia (7 out of 12). The impact of earthquake is questionable because since 1950 only one such phenomenon has happened. However, floods are in majority (34 out of 63 disasters), therefore there can be concluded that flood may influence investments in Malaysia negatively.

Table 5. Estimation results

Type of disaster	Indonesia	Malaysia	Philippines	Thailand	Vietnam
Natural disaster (t)	–	–***	+	–**	–
Natural disaster (t – 1)	+	–**	+	–***	–
Natural disaster (t – 2)	+	–	+	–***	+
Earthquake (t)	–	–*	–	–	No EQ
Earthquake (t – 1)	+	–**	–	–	No EQ
Earthquake (t – 2)	+	+	+	–	No EQ
Flood (t)	–	–**	+	–***	–**
Flood (t – 1)	–	–**	+	–***	–
Flood (t – 2)	+*	–	–	–***	+*
Storm (t)	–	–	–	–	–
Storm (t – 1)	+	–**	+	–**	+
Storm (t – 2)	+	–	+	–**	+

*, **, *** – significance level 0.1, 0.05 and 0.01, respectively.

Source: own estimation.

For 3 remaining countries the occurrence of natural disaster seems not to affect the FDI inflow. Philippines has relatively low level of investment in comparison to the rest of considered countries, while for Vietnam full data set is available from 1996, hence the number of degree of freedom is small as well. In the case of Indonesia it looks like there is no relationship between the number of disasters and investments, nonetheless as shown in Table 3. For this particular country maybe it would be better to take into consideration the economic damages (or losses to GDP ratio). However, the problem in doing so is the fact that missing data might stand for, either the lack of value, or no damages at all.

5. Conclusions

As I have shown in my research, the natural disasters may negatively affect the inflow of FDI to South-Eastern Asia. This is especially visible in Thailand and Malaysia, where the majority of coefficients are statistically significant. However, it could be a case that not the number of events is important, but rather the impact of disasters in terms of economic damages – like for Indonesia. Moreover, the origin of investment as well as the kind of it might be crucial. All five countries are members of ASEAN and intra-ASEAN investments' decisions might not be determined by situation in host countries only but also in a country of origin. Therefore the extension of the model is planned in the future research.

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KATASTROFY NATURALNE A BEZPOŚREDNIE INWESTYCJE ZAGRANICZNE W KRAJACH ROZWIJAJĄCYCH SIĘ AZJI POŁUDNIOWO-WSCHODNIEJ

Streszczenie: Celem artykułu jest zbadanie wpływu zjawisk katastroficznych na napływ BIZ do poszczególnych krajów rozwijających się Azji Południowo-Wschodniej o podwyższonym ryzyku katastroficznym, tj. Indonezji, Filipin, Malezji, Tajlandii i Wietnamu. Z wykorzystaniem klasycznej metody najmniejszych kwadratów oszacowano model, w którym za zmienną objaśnianą przyjęto napływ BIZ jako procent PKB w danym roku. Wśród zmiennych objaśniających znajduje się liczba katastrof bądź poszczególne typy katastrof w ujęciu rocznym, w roku obecnym oraz dwóch poprzednich, wzrost PKB, PKB *per capita*, inflacja oraz stosunek sumy eksportu i importu do PKB. Wyniki estymacji potwierdzają negatywną korelację pomiędzy napływem BIZ a występowaniem katastrof naturalnych w Tajlandii oraz Malezji. W pozostałych trzech przypadkach wyniki estymacji nie dają odpowiedzi o związek pomiędzy liczbą katastrof a inwestycjami w danym kraju.

Słowa kluczowe: ryzyko katastroficzne, katastrofy naturalne, bezpośrednie inwestycje zagraniczne, kraje rozwijające się.