International Journal of Engineering & Technology, 7 (3.25) (2018) 299-305

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research paper

The Impact of Natural Disasters on Secondary School Enrollment Rates

Harpaljit Kaur[1]*, Muzafar Shah Habibullah[2] and Shalini Nagaratnam[3]

[1]*Taylors Business School, Taylors University, 47500, Subang Jaya, Malaysia*
[2]*Faculty of Economics and Management, Universiti Putra Malaysia, 43500, Serdang, Malaysia.*
[3]Universiti Putra Malaysia, 43500, Serdang, Malaysia
[*]*Corresponding author Email: HarpaljitKaur.PritamSingh@taylors.edu.my*

Abstract

This paper examines the impact of total disasters and four individual natural disasters (flood, storm, drought and earthquake) on secondary school enrollment rates using panel data over the period 1970 to 2014. For robustness check, we use four measures on each of these natural disasters; the number of occurrence, number of death, number of people affected and the estimated damages caused by natural disasters as a percentage of GDP; thus we employ twenty natural disaster variables. In addition, we re-estimate all specification using lag of natural disaster variables to capture the delayed effect of these variables on enrollment. Employing the system Generalized Method of Moment (GMM) model, the findings show that the number of occurrences and disaster related losses (death, affected and damages) significantly contribute to the rates of secondary school enrollment. The current study also found that the secondary school enrollment rates are more affected by the contemporaneous effects of natural disaster for the exception of total disasters and floods, which are affected by both the medium and long-term effects. One unanticipated finding that emerge from the analysis is that earthquake have a positive effect on secondary enrollment rates in the long-term.

Keywords: *Enrollment Rate; GMM; Natural Disaster; Panel Data.*

1. Introduction

Natural disasters have become among the most pressing issues facing the world today. It is becoming more recurrent and more intense worldwide in the recent decades due to changes in the global climatic environment and has influenced the human development drastically [16, 20, 28]. Human capital is vital to economic growth and education and is the most compelling indicator for human capital progress of a nation's economy. Natural disasters, whether big or small, have plausible impact on children, adolescents and the education system. Closure of schools due to destruction, damage to school related infrastructure and prolonged and repeated use of school infrastructure as evacuation shelters have disrupted education cycles, affecting the learning process of the students. There is an urgent need to address these disruptions as children and youth exposed to the disasters may not be able to continue schooling or follow up with their studies and could drop out of school or universities permanently due to conditions of the household [4, 6, 9]. Prolonged interruption in education whether in the short or long term, may decrease human capital accumulation through the disruption in education of children, development, outcomes and may decrease the lifetime earnings in the future, thus, creating inadequate and weak skills in the workforce in future [32, 30, 22]. These effects on human capital accumulation may significantly impact a country's economic development and expose children and adolescents to the risk of child labour, early marriage, exploitation and health problems.

Past research on natural disasters and human capital concentrated more on case studies, regarding specific disaster and at micro level, focusing on the effect of disasters on household level and country-specific [11, 13, 17, 18]. However, macro level analysis on the effect of natural disasters on human capital are rather limited [8, 21, 26]. Much of the macro level research on natural disasters and human capital up to now, focused on the effect of geological and climatological disasters [8, 26] and total disasters [21] on secondary school enrollment rates. Due to the need of addressing the alarming rate of increase in natural disasters and inconclusive nature of previous macro level empirical studies, the present intends to improve upon past studies in two major ways. First, we analyze the effect of total disasters and four individual natural disasters (floods, drought, storm and earthquake) separately, on secondary enrollment rates, covering more countries and a longer period, controlling a series of human capital determinants every time. The current study contributes on post disaster human capital accumulation with panel data over a 45-year period from the years 1970 to 2014 and the model is estimated by the Blundell-Bond [5] system GMM to control for potential measurement error and endogeneity issues. Beside the type of disasters, it is also vital to analyze the potential heterogeneity within disaster impacts as different measures imply a different impact of human capital. Past studies have focused on the impact of disaster on human capital using one measurement only [8, 21, 26], therefore the current study seeks to contribute further to literature by employing four natural disaster measures; number of occurrences, death, people affected and damages as a percentage of GDP, for each disaster. In addition, since the effects of natural disaster on human capital differ significantly across different types of natural disasters, the impact of these disasters, if not address well in a timely and systematic manner, will have a persistent effect on the future human capital accumulation. Generally in disaster response, education is

not prioritized and the restoration and reconstruction of damaged schools and universities is often delayed due to the high cost in emergencies interventions, leaving children and youths in need of education support to help ensure their long-term development. A report by Save the Children [25] concluded that temporary learning centres are still being used to teach children in Nepal and Vanuatu after a year of the earthquake. Thus, the motivation of the present study is to examine the impact of delayed effect of the measurements of natural disasters on human capital.

The findings of this study indicate that the natural disaster occurrences and disaster related losses (number of people affected, number of death and damages as a percentage of GDP) decreases the secondary enrollment rates. The extent of these effects differs significantly across the types of natural disasters. Both contemporaneous and previous total disasters cause a decline in the rates of secondary school enrollment, which specifies that persistence in the observed effects of natural disasters on these enrollment rates exist. In the case of floods, damages has negative impact on delayed and contemporaneous enrollment rates. However, contemporaneous damages caused by earthquake caused a decline in secondary enrollment rates but the previous damages produce a positive effect.

The remaining part of the paper proceeds as follows. The second section deals with the literature review. The third section is concerned with the data and the method employed in this current study while the fourth section discussed the results and findings and finally the last section presents the conclusion.

2. Literature Review

Given the destructive nature of natural disasters, it is argued that disasters destroys and damages physical capital and human capital stock ([8, 21, 26], which have a detrimental impact on the country's economic growth. However, Skidmore and Toya [26] found that natural disasters gives opportunity to replace damaged and destroyed assets with newer and updated capital by motivating the implementation of new technologies, creating higher returns to human capital and increase prominence on human capital investment that substantially lead to higher economic growth.

The impact of different disaster subgroups on human capital is contested among researchers. Skidmore and Toya [26] found correlation between climatic disaster and human capital accumulation but not between geological disasters on human capital accumulation. In contrary, Cuaresma [8] found a negative long run effects between geological disasters and secondary school enrollment but no link between climatic disaster and enrollment using the same disaster risk measurement by Skidmore and Toya [26]. In another study, McDermott [21] found that in the long-term, aid flows are effective in mitigating health outcomes but the school enrollment rates are dependent on the credit availability of the households. Natural disasters, regardless of the size, destroy and damage infrastructure accompanied by household loss of assets and death of family members, teachers and support staff. Children are forced out of school for months or weeks depending on the effect of the disaster. This causes disruption of education cycles, drop in quality of education through loss in instruction time and delay in completion of school, thus compounding negative impact on educational outcomes and child's development [9, 10, 17, 19, 29].

Researchers have found that natural disasters significantly reduces individual's educational attainment. Spencer et al. [27] indicated that hurricanes negatively affect the academic year standardized examinations but not the test scores outside the academic year whereas Ureta [31] concluded that heavy rainfall decrease Nicaragua school retention and progression rates. Heat wave was found to decrease cognitive performance in India [14] whereas snowfall increases absenteeism [15]. In contrary, Park et al. [22] demonstrated that disasters have positive and significant influence on education. They found that the Chinese test scores improved in the aftermath of China's Great Sichuan Earthquake in 2008 due to relocation of classrooms and interestingly, the affected students were less depressed and had higher self-esteem. Another study found that older students, aged 21 or more, who were previously not able to afford higher education, enrolled themselves in the university due to high unemployment rates and tuition fees exemption after the earthquake in L'Aquila [7].

Past empirical studies showed strong relationship between disasters and increased work participation among affected children in either a short term or permanently. Studies have shown that due to shortfalls in income and to smoothen the household consumption, children are withdrawn from schools as parents are less willing to send their kids to school. De Janvry et al. [9] emphasized that droughts caused 36% of the children above 12 years old and more boys to quit school to work. Similarly, Bustelo et al. [6] and Baez et al. [3] concluded that children had to drop out of school to work to increase income of the household. In addition, children of El Salvador who were harder hit by earthquake were 3 times more likely to work in the aftermath of the shock [24] and Mitch Hurricane increased children's labour force participation in Nicaragua by 58% [4]. However, there is evidence suggesting that child labour participation decreased and school attendance rates increased in Brazil in the aftermath of hurricane [11], which could have been attributed by external aid flow.

3. Methodology

The human capital model used can be specified as follows:

$$\ln HC_{it} = \beta_0 + \beta_1 \ln ND_{it} \text{ by disaster k} + \beta_2 \ln EE_{it} + \beta_3 \ln GDPPC_{it} + \beta_4 \ln POPDEN_{it} + \beta_5 \ln LIEXP_{it} + \varepsilon_{it} \quad (1)$$

where $\ln HC_{it}$ denotes the relevant human capital measure in time period t and country i, $\ln ND_{it}$ represents the measures for the k^{th} type of natural disaster, $\ln GDP_{it}$ is real GDP per capita, $\ln EE_{it}$ denotes education expenditure, $\ln POPDEN_{it}$ denotes population density, lnLIEXPit is life expectancy and ε_{it} is the error term. For estimation, all variables were transformed into natural logarithm.

General Method of Moments (GMM) approach was employed as it is suitable for panel data that has shorter time dimension and larger country dimension and this approach allows us to investigate the effect of the past dependent variable on the present dependent variable [23]. The dependent variable in this model is human capital and the proxy is log of gross rate of enrollment in secondary school. It represent the "ratio between the number of students enrolled in secondary school, respectively, to the number of people of the corresponding age" [32]. A lagged human capital term is incorporated as an explanatory variable as it can be reasonable to assume that the present enrollment is determined by its past level. All the data except for natural disaster data are obtained from the World Bank's Development Indicators, World Bank (2007). The natural disaster data was obtained from Emergency Events Database (EM-DAT) maintained by the Center for Research on the Epidemiology of Disasters (CRED). EM-DAT outlines a disaster as a "natural situation or event which overwhelms local capacity and/or necessitates a request for external assistance". For a disaster to be entered into the EM-DAT database, at least one of the following criteria must be met: (1) 10 or more people are reported killed; (2) 100 people are reported affected; (3) a state of emergency is declared; or (4) a call for international assistance is issued".

The variable of interest for this model is natural disasters. In the current study, we seek to study the impact of five types of natural disasters, separately, on enrollment rates. The five types of natural disasters are total disaster, flood, earthquake, drought and storm. For each disaster we employed four measures as follows: (1) the number of natural disasters occurred in country i and year t (number of occurrences); (2) the number of "people who lost their life and presumed dead" caused by natural disaster in country i and year t (number of death); (3) the number of "people affected which includes the number of people injured, affected and made

homeless" by natural disasters in year t and country i (number of people affected); (4) the estimated economic damages caused by natural disaster in year t and country i (in USD$) as a percentage of GDP (damages). Therefore, we employ 20 natural disaster variables for secondary school enrollment rates.

In addition, we re-estimate all specification-using lag of natural disaster variables to capture the persistence in human capital accumulation due to the impact of natural disasters, to further support the robustness of the findings. Four control variables have been included in the human capital model based on empirical literatures. The included variables are GDP per capita, population density, education expenditure and life expectancy.

4. Results and Findings

4.1. Empirical Results

The Generalized Method of Moment (GMM) dynamic panel approach developed by Arellano and Bover [2] and Blundell and Bond [5] is used to estimate the results. In this present study, the two-step GMM results are reported and will be used for interpretation purposes. Two-step system GMM is preferred as it corrects the residuals for heteroscedasticity and it outperforms one-step system GMM [1]. For each model, the Hansen J-statistics for over identification and the Arellano-Bond test for zero autocorrelation in first differenced errors are reported. First, we analyse the impact of total disaster and four individual natural disasters (flood, storm, drought and earthquake) on human capital, using four measures for each of the natural disaster. Thus, we employ 20 natural disaster variables, separately, for enrollment rates as shown in columns 1-5, 6-10, 11-15 and 16-20 in Table 1. The results of the two-step system GMM presented in Table 1 show that the hypothesis of over identifying restrictions is valid and that zero order autocorrelation cannot be rejected. This implies that the instruments used are valid and higher order autocorrelation is absent in the residuals. Therefore, the results comply with the expected diagnostics. The coefficient of the lagged dependent variable is positive and statistically significant at 10% level. The implication is that the enrollment in secondary level is likely to increase when it has increased in the previous period. All the coefficients of natural disasters are negative and most of the coefficients of the control variables are positive which concurs with most of the studies.

The secondary school enrollment rates decrease as a country experiences more events of drought, flood and total disasters, significant at conventional levels (columns 1 to 5). Natural disaster occurrences caused by storm and earthquake have an insignificant impact on secondary enrollment rates. Furthermore, the secondary school enrollment will decrease as more people are killed by natural disasters (columns 6 to 10). Deaths associated to earthquake have the greatest impact on secondary enrollment rates followed

Table 1: Dynamic Panel Estimation Results: Secondary School Enrolment

VARIABLES	Number of occurrences					Number of death				
	Dependent variable: School enrollment, secondary (% gross)									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$Total\ Disaster_t$	-0.097**					-0.046**				
	(0.044)					(0.022)				
$Drought_t$		-0.054*					-0.045*			
		(0.031)					(0.024)			
$Flood_t$			-0.059***					-0.049**		
			(0.022)					(0.020)		
$Storm_t$				-0.029					-0.051*	
				(0.023)					(0.028)	
$Earthquake_t$					-0.032					-0.053*
					(0.040)					(0.031)
$LNGESE_{(t-1)}$	0.744***	0.659***	0.757***	0.730***	0.800***	0.701***	0.669***	0.745***	0.673***	0.867***
	(0.094)	(0.087)	(0.063)	(0.118)	(0.105)	(0.061)	(0.077)	(0.055)	(0.099)	(0.134)
LNGDPPC	0.683*	1.239***	0.685***	0.826**	0.736***	0.660***	1.140***	1.164***	0.696**	-0.211*
	(0.351)	(0.458)	(0.246)	(0.361)	(0.232)	(0.246)	(0.376)	(0.275)	(0.306)	(0.124)
LNEE	0.097**	0.106*	0.084***	0.075***	0.039	0.073***	0.088*	0.065**	0.074*	0.039
	(0.042)	(0.061)	(0.027)	(0.024)	(0.037)	(0.024)	(0.049)	(0.031)	(0.039)	(0.070)
LNLIEXP	0.337	0.662**	0.662**	0.468	0.406	0.809***	0.721***	0.922*	0.642	1.631*
	(0.370)	(0.275)	(0.328)	(0.350)	(0.402)	(0.263)	(0.264)	(0.493)	(0.686)	(0.824)
LNPOPDEN	0.027	-0.018	-0.065	-0.049	0.047	-0.045	-0.010	0.091*	0.075*	-0.083
	(0.072)	(0.066)	(0.050)	(0.056)	(0.066)	(0.038)	(0.064)	(0.052)	(0.045)	(0.055)
Number of Countries	112	57	104	66	42	112	57	104	66	42
m_1 test	0.007	0.018	0.003	0.006	0.016	0.001	0.027	0.000	0.000	0.060
m_2 test	0.197	0.456	0.135	0.086	0.099	0.164	0.108	0.255	0.179	0.824
Hansen p-value	0.113	0.283	0.153	0.321	0.309	0.194	0.173	0.756	0.402	0.739

Notes: 1. t-statistics are shown in parentheses. *, ** and *** denote significance at 10%, 5% and 1%, respectively. 2. The values reported for Hansen test are the p-values. 3. The values reported for m_1 and m_2 tests are the p-values for the first and second order serial correlation.

Table 1 (continue): Dynamic Panel Estimation Results: Secondary School Enrolment

VARIABLES	Number of people affected					Damages				
	Dependent variable: School enrollment, secondary (% gross)									
	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
$Total\ Disaster_t$	-0.011***					-0.058*				
	(0.004)					(0.002)				
$Drought_t$		-0.004*					-0.135			
		(0.002)					(1.288)			
$Flood_t$			-0.008*					-0.072*		
			(0.004)					(0.237)		
$Storm_t$				-0.007**					-0.052	
				(0.003)					(0.306)	
$Earthquake_t$					-0.001					-0.071
					(0.003)					(0.086)

$LNGESE_{(t-1)}$	0.682***	0.705***	0.742***	0.700***	0.809***	0.748***	0.744***	0.697***	0.669***	0.772***
	(0.047)	(0.088)	(0.056)	(0.089)	(0.132)	(0.053)	(0.083)	(0.045)	(0.067)	(0.126)
LNGDPPC	1.002***	1.376***	0.771***	0.615**	0.596	0.786***	1.728***	0.984***	0.833***	0.623
	(0.247)	(0.456)	(0.231)	(0.301)	(0.216)	(0.224)	(0.320)	(0.208)	(0.209)	(0.211)
LNEE	0.029	0.118	0.056*	0.066***	-0.003	0.046**	0.015	0.020	0.034**	-0.030
	(0.021)	(0.075)	(0.033)	(0.021)	(0.025)	(0.022)	(0.066)	(0.027)	(0.013)	(0.026)
LNLIEXP	1.091**	0.604**	0.630**	0.571	1.286	0.666*	0.899***	0.718**	0.399	0.461
	(0.460)	(0.279)	(0.266)	(0.724)	(1.136)	(0.350)	(0.277)	(0.289)	(0.411)	(0.310)
LNPOPDEN	-0.061	-0.065	-0.059	-0.049	-0.053	-0.046	-0.011	-0.044	0.003	0.018
	(0.042)	(0.063)	(0.045)	(0.050)	(0.044)	(0.045)	(0.059)	(0.046)	(0.040)	(0.064)
Number of Countries	112	57	104	66	42	104	57	112	66	42
m_1 test	0.004	0.019	0.002	0.001	0.007	0.002	0.016	0.001	0.002	0.002
m_2 test	0.119	0.437	0.102	0.132	0.233	0.329	0.567	0.133	0.081	0.053
Hansen p-value	0.250	0.075	0.103	0.340	0.463	0.100	0.325	0.244	0.503	0.251

Notes: 1. t-statistics are shown in parentheses. *, ** and *** denote significance at 10%, 5% and 1%, respectively. 2. The values reported for Hansen test are the p-values. 3. The values reported for m_1 and m_2 tests are the p-values for the first and second order serial correlation.

by storm and floods. Number of people affected by total disasters affect the rates of secondary school enrollment. Among the individual natural disasters, the enrollment rates of secondary school decreases as more people are affected by flood, followed by storm and drought, as shown in columns 11 to 15. Surprisingly, earthquake is insignificant in explaining the enrollment rates. Secondary school enrollment rates decreases due to damages (as percentage of GDP) initiated by natural disasters, as shown in columns 16 to 20.

The significance of these effects differs across the types of natural disasters with flood having the greatest impact on rates of secondary school enrollment, followed by total disasters. Economic damages caused by storm, drought and earthquake have insignificant impact on secondary enrollment rates. The results above evidently supports the hypothesis that the effects on enrollment rates differ significantly across the different types of natural disasters. More precisely, the results show that the number of occurrences, number of death, number of people affected and damages as a percentage of GDP decreases the enrollment rates of the secondary school. GDP per capita is positive and significant at least at 10% significant level for all the equations with the exception of earthquake (columns 15 and 20), suggesting that higher level of income increases the enrollment rate of secondary school. In addition, the variable education expenditure is positive and significant at least at 10% significance level in most specifications indicating that higher spending of education rises the rates of secondary school enrollment. Moreover, higher level of life expectancy increases the enrollment rates with the exception of storm and earthquake. The variable population density is positive and significant only for number of people killed by flood and storm. These results above evidently endorse that disaggregation of the impact of natural disasters by types of enrollment rates yield additional insight.

To examine the persistence in the observed effects of natural disasters on enrollment, one period lag of the disaster measures are included in the model in equation (1). The two-step system GMM results in Table 2 indicate that all the diagnostic tests have been complied with and the lagged dependent variables have significant and positive coefficients. Secondly, most of the coefficients of the natural disaster are negative and significant. The third aspect is that secondary enrollment rates are not only affected by contemporaneous natural disaster but also by previous natural disasters. Most of the sign and significance of the contemporaneous effects of the natural disasters on secondary school enrollment remain unaffected as compared to the results without the lagged natural disaster variables. However, the effect of drought (number of death), storm (number of people affected) and total disaster (damages) on enrollment rates retained their signs but lose their statistical significance. In addition, the effect of earthquake (number of people affected and damages) and storm (damages) become significant when lagged natural disaster is included in the model.

The findings in Table 2 show that both contemporaneous and previous total disaster cause a decline in the rates of secondary school enrollment. This indicates that persistence in the observed effects of natural disasters on secondary enrollment rates exist. In the case of floods, damages has negative effects on delayed and contemporaneous enrollment rates, meaning that damages caused by floods affect enrollment rates in long-term. The other measurements (number of occurrences, number of people affected and killed) have an impact on the enrollment rates in the short and medium term. All the natural disaster measurements for drought

Table 2: Persistence effect: Secondary School Enrolment

VARIABLES	Number of occurrences					Number of death				
	Dependent variable: School enrollment, secondary (% gross)									
Lagged Natural Disasters	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$Total\ Disaster_t$	-0.029*					-0.022***				
	(0.018)					(0.008)				
$Total\ Disaster_{(t-1)}$	-0.032*					-0.016**				
	(0.017)					(0.007)				
$Drought_t$		-0.141*					-0.002			
		(0.084)					(0.030)			
$Drought_{(t-1)}$		-0.036					-0.011			
		(0.067)					(0.019)			
$Flood_t$			-0.042**					-0.023**		
			(0.020)					(0.011)		
$Flood_{(t-1)}$			-0.011					-0.002		
			(0.015)					(0.008)		
$Storm_t$				-0.015					-0.060**	
				(0.028)					(0.029)	
$Storm_{(t-1)}$				-0.027					-0.023	
				(0.020)					(0.025)	
$Earthquake_t$					-0.107					-0.071*
					(0.068)					(0.042)
$Earthquake_{(t-1)}$					0.001					-0.006

					(0.021)					(0.011)
$LNGESE_{(t-1)}$	0.707***	0.658***	0.707***	0.654***	0.902***	0.671***	0.681***	0.780***	0.682***	0.820***
	(0.050)	(0.104)	(0.062)	(0.099)	(0.087)	(0.049)	(0.077)	(0.091)	(0.089)	(0.238)
LNGDPPC	0.770***	0.885*	0.965***	0.781***	-0.058	0.614***	0.930*	0.680***	0.683***	-0.219
	(0.209)	(0.533)	(0.168)	(0.272)	(0.093)	(0.223)	(0.532)	(0.253)	(0.260)	(0.134)
LNEE	0.066**	0.043	0.042**	0.052	0.015	0.109***	0.108*	0.039	0.054	0.068
	(0.027)	(0.050)	(0.021)	(0.036)	(0.047)	(0.034)	(0.058)	(0.028)	(0.033)	(0.092)
LNLIEXP	0.747**	0.764	0.570	0.139	-0.038	0.908***	0.385	0.238	0.757	1.501
	(0.290)	(0.511)	(0.510)	(0.446)	(0.873)	(0.347)	(0.636)	(0.404)	(0.851)	(1.545)
LNPOPDEN	0.057	0.129	0.006	0.017	0.026	0.063	0.003	0.023	0.076	-0.077
	(0.119)	(0.092)	(0.044)	(0.089)	(0.090)	(0.228)	(0.046)	(0.052)	(0.120)	(0.050)
Number of Countries	112	57	104	66	42	112	57	104	66	42
m_2 test	0.059	0.760	0.158	0.630	0.139	0.172	0.337	0.316	0.689	0.870
Hansen p-value	0.162	0.061	0.155	0.554	0.065	0.219	0.163	0.146	0.665	0.371

Notes: 1. t-statistics are shown in parentheses. *, ** and *** denote significance at 10%, 5% and 1%, respectively. 2. The values reported for Hansen test are the p-values. 3. The values reported for m_2 test are the p-values for the first and second order serial correlation.

except for number of deaths, have an impact on enrollment rates in the short and medium term whereas the contemporaneous damages and number of deaths caused by storm decreases the enrollment rates. However, number of occurrences of earthquake is insignificant in explaining enrollment rates but the other measurement of natural disasters are significant. Interestingly, contemporaneous damages caused by earthquake caused a decline in secondary enrollment rates but the previous damages produce a positive effect. In addition, all the coefficient of control variables have the expected sign.

4.2. Discussion of the Findings

The findings of the current study suggest that number of occurrences and disaster related losses (death, affected and damages as a percentage of GDP) significantly contribute to the rates of secondary school enrollment. These findings are coherent with Skidmore and Toya [26], Cuaresma [8] and McDermott [21] who found that natural disasters decreases secondary school enrollment. Furthermore, our results are broadly in line with De Janvry et al. [9], Bustelo et al. [6], Baez et al. [4], Santos [24] Baez and Santos [3] and Duryea and Arends-Kuenning [11] who found that natural disasters cause children to leave school to increase work participation due to shortfalls in income and to smoothen the household consumption. The findings of this study have shown that natural disasters have persistent effect on human capital. The secondary school enrollment rates are more sensitive to contemporaneous effects of natural disaster for the exception of total disasters and floods, which are affected by both the contemporaneous and lagged effects. In contrary, earthquake have a positive effect on secondary enrollment rates in the following period. These findings show that disasters have persistent effect on human capital at up to10 years in the aftermath of the disaster indicating the potential for natural disasters to have a long-term impact on human capital accumulation, consistent with the study done by McDermott [21]. Secondary students have higher opportunity cost of enrollment, as they are able to work in and out of the home and due to various job opportunities related to age explains the

Table 2 (continue): Persistence effect: Secondary School Enrolment

VARIABLES	Number of people affected					Damages				
	Dependent variable: School enrollment, secondary (% gross)									
Lagged Natural Disasters	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
$Total\ Disaster_t$	-0.011**					-0.003				
	(0.004)					(0.002)				
$Total\ Disaster_{(t-1)}$	-0.007**					-0.005***				
	(0.004)					(0.002)				
$Drought_t$		-0.008**					-0.008*			
		(0.003)					(0.004)			
$Drought_{(t-1)}$		-0.004					-0.005			
		(0.004)					(0.004)			
$Flood_t$			-0.010***					-0.011***		
			(0.004)					(0.004)		
$Flood_{(t-1)}$			-0.005					-0.002**		
			(0.003)					(0.001)		
$Storm_t$				-0.001					-0.020*	
				(0.005)					(0.012)	
$Storm_{(t-1)}$				-0.003**					-0.007	
				(0.002)					(0.005)	
$Earthquake_t$					-0.039*					-0.029**
					(0.025)					(0.014)
$Earthquake_{(t-1)}$					0.012					0.011**
					(0.007)					(0.005)
$LNGESE_{(t-1)}$	0.644***	0.918***	0.708***	0.683***	0.969***	0.687***	0.698***	0.743***	0.651***	0.806**
	(0.082)	(0.140)	(0.062)	(0.097)	(0.225)	(0.040)	(0.167)	(0.057)	(0.078)	(0.334)
LNGDPPC	0.824***	0.709	0.950***	0.940***	-0.205*	0.769***	0.930*	0.553***	0.686***	-0.077
	(0.264)	(0.655)	(0.169)	(0.256)	(0.104)	(0.179)	(0.532)	(0.190)	(0.227)	(0.123)
LNEE	0.082**	0.177**	0.042**	0.018	0.043	0.680**	0.161**	0.039***	0.053	-0.043
	(0.033)	(0.071)	(0.017)	(0.013)	(0.031)	(0.273)	(0.069)	(0.013)	(0.034)	(0.055)
LNLIEXP	0.315	0.715	0.598	0.808**	1.114	0.519	0.448	0.262	0.529	1.752
	(0.317)	(1.305)	(0.507)	(0.325)	(1.171)	(0.519)	(0.566)	(0.324)	(0.502)	(1.359)
LNPOPDEN	0.021	0.035*	0.011	0.071**	-0.131**	0.106	0.023	0.053*	0.004	-0.025
	(0.063)	(0.059)	(0.038)	(0.032)	(0.056)	(0.192)	(0.074)	(0.032)	(0.081)	(0.062)

Number of Countries	112	57	104	66	42	112	57	104	66	42
m_2 test	0.256	0.686	0.078	0.176	0.273	0.075	0.448	0.194	0.127	0.243
Hansen p-value	0.203	0.290	0.189	0.338	0.443	0.100	0.465	0.300	0.881	0.454

Notes: 1. t-statistics are shown in parentheses. *, ** and *** denote significance at 10%, 5% and 1%, respectively. 2. The values reported for Hansen test are the p-values. 3. The values reported for m_2 test are the p-values for the first and second order serial correlation.

reduction in enrollment rates. The significant and positive coefficient of the lagged dependent variable indicate that enrollment rates is likely to increase when it has increased in the previous period. The results of the control variables are consistent with past literature. Our results show that income have a positive effect on human capital accumulation whereas improvements in life expectancy enhance longer-lived populations who have stronger incentives to acquire human capital skills.

5. Conclusion

The literature has been inconclusive about the effect of natural disasters on human capital. Several studies have shown negative relationship between natural disaster and human capital whereas others report positive effects or no effects between these variables. The present study examined the effect of natural disasters, separately, by types of disaster on secondary enrollment rates across countries. The results of the present study show that number of occurrences and disaster related losses (death, affected and damages) significantly contribute to the rates of secondary school enrollment. The current study also found that the secondary school enrollment rates are more affected by the contemporaneous effects of natural disaster for the exception of total disasters and floods, which are affected by both the medium and long-term effects. The impact of these disasters, if not addresses well in a timely and systematic manner, will have a persistent effect on the future human capital accumulation. There is, therefore a definite need for the policy makers to place greater emphasis on expanding access to education and improving the quality of educational system in order to promote human capital formation, especially in the aftermath of a disaster to ensure the children and youths long-term development. We recommend that governments and policy makers place greater emphasis on the importance of disaster preparedness and risk reduction for different level of education. In addition, governments should provide education subsidies to secondary students, who come from lower income households, in the aftermath of disasters, to ensure the continuation of their studies. Since education is vital to reduce the cycle of poverty and to improve income and health in the long-term, the government should prioritize the restoration and reconstruction of damaged schools and education related infrastructure, with high quality materials that can withstand the impact of disasters, hence reduce the prolonged disruption to schooling. Policy makers should also create new alternative places for the students to study and establish campaigns to create awareness to the public about the importance of continuation of schooling after disaster. In addition, policy makers could remove school fees and provide school related items such as books, stationary and uniforms for some period in the aftermath of the disaster to ease the family burden. Policy makers and government must attempt to utilize government spending on education efficiently in order to produce educated people through higher education and training, which can increase the economic productivity of the individual and hence contribute to more sustainable and efficient development. In order to reduce the rate of fatalities during natural disasters, the government should discourage people, particularly the poor, from living at disaster prone areas, by imposing stricter policies.

References

[1] Arellano M, Bond S. Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. The review of economic studies. 1991 Apr 1;58(2):277-97.

[2] Arellano M, Bover O. Another look at the instrumental variable estimation of error-components models. Journal of econometrics. 1995 Jul 1;68(1):29-51.

[3] Baez JE, Santos IV. Children's vulnerability to weather shocks: A natural disaster as a natural experiment. Social Science Research Network, New York. 2007 Mar.

[4] Baez J, De la Fuente A, Santos IV. Do Natural Disasters Affect Human capital? An assessment based on existing empirical evidence.

[5] Blundell R, Bond S. Initial conditions and moment restrictions in dynamic panel data models. Journal of econometrics. 1998 Nov 1;87(1):115-43.

[6] Bustelo M, Arends-Kuenning M, Lucchetti L. Persistent impact of natural disasters on child nutrition and schooling: Evidence from the 1999 Colombian earthquake.

[7] Cerqua A, Di Pietro G. Natural disasters and university enrolment: evidence from L'Aquila earthquake. Applied Economics. 2017 Mar 22;49(14):1440-57.

[8] Cuaresma JC. Natural disasters and human capital accumulation. The World Bank Economic Review. 2010 Jan 1;24(2):280-302.

[9] De Janvry A, Finan F, Sadoulet E, Vakis R. Can conditional cash transfer programs serve as safety nets in keeping children at school and from working when exposed to shocks?. Journal of development economics. 2006 Apr 1;79(2):349-73.

[10] Di Pietro G. The academic impact of natural disasters: evidence from L'Aquila earthquake. Education Economics. 2018 Jan 2;26(1):62-77.

[11] Duryea S, Lam D, Levison D. Effects of economic shocks on children's employment and schooling in Brazil. Journal of development economics. 2007 Sep 1;84(1):188-214.

[12] EM-DAT: The Emergency Events Database-Universite catholique de Louvain (UCL)- CRED, D. Guha-Sapir- www.emdat.be, Brussels, Belgium.

[13] Fitzsimons E. The effects of risk on education in Indonesia. Economic Development and Cultural Change. 2007 Oct;56(1):1-25.

[14] Garg T, Jagnani M, Taraz V. Temperature and Human Capital in India.

[15] Goodman J. Flaking out: Student absences and snow days as disruptions of instructional time. National Bureau of Economic Research; 2014 Jun 12.

[16] Guha-Sapir D, Hoyois P. Measuring the human and economic impact of disasters. 2012.

[17] Jacoby HG, Skoufias E. Risk, financial markets, and human capital in a developing country. The Review of Economic Studies. 1997 Jul 1;64(3):311-35.

[18] Jensen R. Agricultural volatility and investments in children. American Economic Review. 2000 May;90(2):399-404.

[19] Kim N. Impact of extreme climate events on educational attainment: Evidence from cross-section data and welfare projection. In-Risk, Shocks, and Human Development 2010 (pp. 185-206). Palgrave Macmillan, London.

[20] Mach K, Mastrandrea M. Climate change 2014: impacts, adaptation, and vulnerability. Field CB, Barros VR, editors. Cambridge and New York: Cambridge University Press; 2014.

[21] McDermott T. The effects of natural disasters on human capital accumulation.

[22] Park A, Sawada Y, Wang H, Wang S. Natural Disaster and Human Capital Accumulation: The Case of the Great Sichuan Earthquake in China.

[23] Roodman D. How to do xtabond2: an introduction to 'difference'and 'system. GMM in STATA', Center for Global Development Working Paper No. 103 2006.

[24] Santos I. Disentangling the effects of natural disasters on children: 2001 earthquakes in El Salvador. Kennedy School of Government, Harvard University. 2007 Apr.

[25] Save the Children (2016). Education Disrupted: Disaster Inpacts on Education in the Asia Pacific Region in 2015. Available online: https://reliefweb.int/sites/reliefweb.int/files/resources/education_disrupted_save_the_children_full_report.pdf, last visit:30.3.2018
[26] Skidmore M, Toya H. Do natural disasters promote long-run growth? Economic inquiry. 2002 Oct 1;40(4):664-87.
[27] Spencer N, Polachek SW, Strobl E. How Do Hurricanes Impact Achievement in School? A Caribbean Perspective.
[28] Strobl E. The economic growth impact of natural disasters in developing countries: Evidence from hurricane strikes in the Central American and Caribbean regions. Journal of Development economics. 2012 Jan 1;97(1):130-41.
[29] Thai TQ, Falaris EM. Child schooling, child health, and rainfall shocks: Evidence from rural Vietnam. Journal of Development Studies. 2014 Jul 3;50(7):1025-37.
[30] UNICEF news (2015, May 7). Nepal Earthquake: Education for nearly 1 million children in jeopardy [Press release]. Available online: https://www.unicef.org/media/media_81802.html
[31] Ureta M. Hurricane Mitch, family budgets and schooling in Nicaragua. InInterAmerican Development Bank conference on remittances, February 2005 Aug (Vol. 10).
[32] World Bank. 2018. World Development Report 2018: Learning to Realize Education's Promise. Washington, DC: World Bank. doi:10.1596/978-1-4648-1096-1