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Abstract

The impact of natural disasters on inclusive growth has received little attention from empirical analyses compared to the attention focused on other growth parameters. Thus, this study considers country-level panel data (108 countries over 25 years) and estimates three econometric models to explore the nexus of natural capital depletion and climate-related natural disasters. The results indicate that the impact is nonlinear: there is an inverted 'U' shape for small-to-medium level disasters in which natural capital depletion is increasing. The impact of natural disasters is higher when the magnitude of resource depletion is lower or higher. Similarly, trade openness, FDI and GDP growth rate are other important determinants of natural capital. This paper provides insights into how sustainable development can be pursued by means of conserving natural resources in the face of frequent climate-related disasters. It particularly emphasizes the importance of considering small-to-medium size disasters and the threat of disaster in countries with low levels of natural capital depletion.

(*JEL*: O11, O13, O44, Q2)

Key words: Natural capital, disaster, inclusive growth, sustainability, semi-parametric panel fixed effect model, fixed effect, quantile regression

1. Introduction

Climate-related natural disasters are increasing, with significant impacts on human, animal, man-made and natural capital. The substantial body of literature on the effects of climate-related natural disasters ranges from micro-level case studies (see, for example, Olwin, 2012) to global-level macro studies. Within the latter, the macroeconomic consequences of natural disasters are well examined (see, for example, Cavallo et al., 2013; Schumacher and Strobl, 2011; Noy, 2009). Particularly, a substantial body of research has considered the impact of natural disasters on economic growth indicators (see, Schumacher and Strobl, 2011; Noy, 2009; Felbermayr and Gröschl, 2014). However, the literature on the growth effects of natural disasters remains inconclusive and provides little evidence regarding the nexus of natural disasters and inclusive growth across the globe. The conservation of natural capital is considered the key factor underlying ecology, societal sustainability and inclusive growth (Everett et al., 2010; Deutsch et al., 2003; Groot et al., 2003). Unlike studies based on GDP growth, studies approaching growth from the perspective of natural capital provide direction for integrated economic and environmental development[1]. To the best of our knowledge, researchers have rarely considered the effects that disasters have on inclusive growth. Thus, this paper investigates the impact of natural disaster on natural capital depletion.

In a study closely related to ours, Bergholt and Lujala (2012) found that the causality between natural disasters and economic growth is negative, whereas other researchers have shown it to be positive (Fumby et al., 2014). Many other studies have provided evidence that the growth impact of natural disasters is nonlinear (Schumacher and Strobl, 2011). It is obvious that natural disasters destroy man-made and natural capital. Subsequently, the man-made capital is replenished, which is made possible through greater extraction of natural capital, unless the country is able to rebuild its man-made capital with higher efficiency. For instance, post-disaster infrastructure may be better organized than its pre-disaster counterpart, and natural disasters may induce the development of producer capital. However, many factors are involved in this process (Noy, 2009). Importantly, the literature emphasizes the dynamics of natural capital's impacts on sustainable growth[2]. However, previous studies have explored the behavior of growth parameters while ignoring the behavior of natural capital.

[1] The inclusive growth approach is the focus of international organizations (see, World Bank, 2012: UNEP, 2011)

[2] The economical, societal and sustainable importance of natural capital is well documented in papers published in well-known journals (see, for example, Ekins et al., 2003; Groot et al., 2003, UNEP, 2011).

Given this important gap in the literature, this paper aims to describe the relationship between natural disasters and changes in natural capital under different circumstances at the global level. The paper first examines the impact of natural hazards on the depletion of natural capital. Both the level of development and trade openness are also considered important determinants of natural capital depletion. We further hypothesize that the relationship between natural capital depletion and natural hazards is nonlinear. Then, we further explore this relationship for different levels of natural capital depletion through quantile regression analysis of panel data. Finally, the nonlinear relationship between change in natural capital and natural disasters is examined using semi-parametric panel regression analysis.

Our findings show that the relationship between natural capital depletion and natural disaster is nonlinear. Resource depletion shows an inverted ‘U’ shape with the level of natural disaster; it increases when the level of disaster (total damage and total population affected) is small and decreases when it is large. Furthermore, disaster positively impacts resource depletion when resource depletion is small, whereas the impact of disaster is negative when resource depletion is moderate.

The remainder of the paper is organized as follows: the next section (section 2) briefly discusses the growth effects of natural disasters and highlights the knowledge gap with regard to the inclusive growth effects of disaster. Section 3 discusses the paper’s global-level data sources and econometric methods. The empirical findings are discussed in section 4, followed by concluding remarks in section 5.

2. Natural disasters and economic development

The literature approaching natural disasters from a macroeconomic perspective suggests implementing economic and environmental policy reforms with a particular focus on disaster preparedness. Proper management both before and after a disaster is particularly important for food security in developing economies (Adedegi at al., 2016). It is clear that many pressing global issues are related to countries’ levels of economic development, and this relationship may be the rationale behind scholars’ focus on growth parameters. Most of the relevant literature considers economic growth, trade, investments, efficiency and demographics. However, the findings are subjected to debate: some argue that the relationship between disaster and growth is negative, whereas others argue that it is nonlinear.

Focusing on natural disasters for the period 1960-1990, Toya and Skidmore (2007) examine the nexus of natural disasters and economic growth. Their research shows that in developed economies with greater trade openness, the negative impact of natural disasters is reduced. It is obvious that more highly developed economies exhibit better preparedness for natural disasters compared to less developed economies. Importantly, the impacts of natural disasters are greater in small economies than in large economies (Noy, 2009).

Schumacher and Strobl (2011) show that economic losses due to natural hazards depend on the level of the natural disaster. Using cross-country panel data, their study indicates that for low- to medium-level hazards, the relationship is nonlinear and bell shaped, while for large hazards it is the opposite. Furthermore, larger economies with greater investments in preventive measures experience fewer losses. While the nonlinearity of the effect of development on natural disaster has been highlighted, Kellenberg and Mobarak (2008) demonstrated that not all cases exhibit this nonlinearity. Rather, nonlinearity depends on the type of disaster: for instance, hazards related to high temperatures do not show nonlinear behavior. Furthermore, empirical research highlights the importance of other determinants such as education, financial condition and trade openness (Noy, 2009).

Following a disaster, the resulting output loss is higher than the capital loss. Furthermore, capital loss does not affect productivity (Halligatte, 2016). Replenishing man-made capital using advanced technology may result in higher productivity after the disaster in situations where natural capital is well maintained. The importance of proper management of natural capital is well documented (see, Groot et al., 2003) [3]. Both nationally and internationally, alternative growth measures, such as the inclusive growth index, are proposed to address the shortcomings of traditional GDP [4], particularly with regard to sustainable development goals (see, Agarwala et al., 2014; UNU-IHDP and UNEP, 2014; Groot et al., 2003; UNEP, 2011; World Bank, 2012). Although the dynamics of natural capital are observed around the world (see, UNU-IHDP and UNEP, 2014), research has, so far, not explored the impacts of disaster on natural capital. Hence, our goal is to explore, using global data, the

[3] Highlighting the importance of natural capital in terms of sustainability and the economy, Groot et al. (2003) present the natural capital index for Europe.

[4] The traditional measure of GDP does not include or reflect sustainability. Particularly, it does not show whether sustainable development is in line with United Nations (UN) sustainable development goals.

causality between natural resource dynamics and frequent climate change-induced natural disasters.

3. Method and data

3.1 Data and variables

We use a cross-country panel data set to investigate our hypothesis and examine 108 countries over the period 1990 to 2014 (2,700 observations). As indicated in the supplementary material 1, the dataset represents OECD and non-OECD countries as well as developed and developing economies. Among the selected countries, per capita natural capita is higher in New Zealand, Kuwait and Iceland whereas low in Singapore, Lesotho and Bangladesh. The main disaster variables – economic damage, total size of the affected population and frequency of natural disasters – are available in the EM-DAT database maintained by the Center for Research on the Epidemiology of Disaster (CRED)[5]. EM-DAT compiles detailed disaster data based on different types of disasters. Existing studies are based on either single types of hazards (see, Bakkensen and Mendelsohn, 2016; Noy, 2015; Gignoux and Menéndez, 2014) or multiple hazards (see, Schumacher and Strobl, 2011). However, in this study, we considered six types of disasters: droughts, floods, storms, earthquakes, landslides and wildfires[6]. We included earthquakes as it is more frequent (except earthquakes all others are climate change induced disasters). We use supplementary data from other sources (World Bank Database[7], OECD). For instance, GDP growth rates (GDP_growth), GDP per capita, foreign direct investment and trade information can be obtained from the World Bank database. All necessary supplementary data were collected from secondary sources, and monetary values were adjusted for the 2005 constant US dollar value.

The most focused data for this study, that of country-level natural capital, are obtained from the inclusive wealth database[8]. The per capita natural capital considered in this study can be expressed as NC $=\sum X_i$, (Xi= forest, agriculture, mineral, and fossil fuels). The natural capital is defined as the total value of natural resources. The estimation of natural capital with

[5] Despite some criticism of the use of the EM-DAT database, almost all studies have used this database for empirical research. The EM-DAT database is a highly reliable and comprehensive database.

[6] The EM-DAT database reports only direct damages. All such disasters are associated with indirect costs as well. Economists have used indirect valuation methods.

[7] World Bank, World Development Indicators, available from: http://databank.worldbank.org/data.
OECD (2017), Gross domestic product (GDP) (indicator). doi: 10.1787/dc2f7aec-en (Accessed on 12 January 2017)

[8] Database prepared for forthcoming inclusive wealth report, 2017 (Urban Institute and UNEP, 2017).

relevant data sources is discussed in supplementary material 2. Then, per capita natural capital depletion (pcncndep) ≡ pcnc(t-1)-pcnc(t). Finally, the panel was prepared by removing missing data, and we obtained data on 108 countries for the period 1990 to 2014.

3.2 Method

This section provides an overview of our econometric approach. We have used three different estimations. First, the general specification of our model is expressed as follows:

$$pcncndep_{it} = \propto + \beta ND_{it} + \sum \gamma_i x_{it} + \varepsilon_{it} \text{ ……..………. (1)}$$

where $pcncndep_{it}$ is the depletion of natural capital, ND indicates the natural disaster variable (in our case either LnL1PC_damage or LnL1Affected) and x is the set of control variables. β represents the impact of the natural disaster, γ_i is a vector of covariates, and ε_{it} is a composite error term.

The omitted factors in ε_{it} can be correlated with other covariates. Hence, a pooled ordinary least square (OLS) estimation may biased, as the time invariant component of the error term may be correlated with independent variables, and in this case, an analysis of panel data is appealing. The composite error term for panel data can be expressed as $\varepsilon_{it} = v_i + \mu_{it}$. The terms v_i and μ_{it} are unobserved time-invariant and time-varying error components.

$$pcncndep_{it} = \propto + \beta ND_{it} + \sum \gamma_i x_{it} + v_i + u_{it} \text{ ……….. (2)}$$

The parametric panel fixed effect regression model is considered the base model to explore the nexus of natural disaster and natural capital depletion. We have noticed that countries are highly heterogeneous in terms of their natural resources, ranging from negative to positive resource depletion (see, Table 1). Given this variation, our intention is to examine the impact of natural disasters across different sub-groups, particularly to see whether the level of natural capital depletion is associated with natural disaster. We performed the analysis using non-additive fixed effect quantile regression, introduced by Powell (2016). For simplicity, consider the following linear model:

$$pcncndep_{it} = \beta ND_{it} + \gamma x_{it} + \varepsilon_{it} \text{ ……..………. (3)}$$

Based on equation (3), the quantile specification of the linear model can be expressed as:

$$pcncndep_{it}(\tau) = \beta ND_{it}(\varepsilon_{it}) + \gamma x_{it}(\varepsilon_{it}) \text{ ……….………. (4)}$$

where $pcncndep_{it}(\tau)$ is the conditional distribution for a given τ. We assume that ε_{it} is uniformly distributed on conditional ND_{it} and X_{it}.

The omitted factor ε_{it} may be correlated with covariates, inducing endogeneity. Hence, the OLS specification of equation (3) can be modified considering time-invariant characteristics and idiosyncratic terms. Considering the error term (ε_{it}) specification in equation (2), the fixed effect quantile regression for panel data can be expressed as

$$pcncndep_{it}(\tau) = v_i(u_{it}) + \beta ND_{it}(u_{it}) + \gamma x_{it}(u_{it}) \text{ ……….………. (5)}$$

A Markov Chain Monte Carlo (MCMC) algorithm was used for maximization to estimate parameters.

Then, we hypothesized that natural capital depletion is affected non-linearly by natural disasters. We employed a semi-parametric panel fixed-effect model, as follows, to explore the behavior of natural capital depletion with respect to different levels of natural disaster. This model is appealing because it does not assume a strong functional relationship (Desbordes and Varardi, 2012). The semi-parametric specification can be expressed as follows:

$$pcncndep_{it} = \propto + f(ND_{it}) + \gamma_i x_{it} + \varepsilon_{it} \text{ …………… (6)}$$

Assume that a ND_{it} variable (for, example, total damage) is added to the main function as a non-parametric variable so that it does not linearly affect the dependent variable. The unobserved heterogeneity effect can be removed using the first difference.

$$pcncndep_{it} - pcncndep_{it-1} = [f(ND_{it}) - f(ND_{it-1})] + \gamma_i(x_{it} - x_{it-1}) + \varepsilon_{it} - \varepsilon_{it-1} \text{.. (7)}$$

Following Baltagi and Li (2002), a series of differentials are derived to estimate $[f(ND_{it}) - f(ND_{it-1})]$ as follows:

$$P^k(ND_{it}, ND_{it-1}) = [f(ND_{it}) - f(ND_{it-1})] \;\ldots\ldots\ldots\ldots (8)$$

where, the P^k series is the spline, which is estimated using piece-wise polynomials with smooth knots.

A large dataset is a requirement for the estimation of the semi-parametric panel fixed effect model. In our study, we have prepared a large panel dataset that is sufficient to perform the above model, as discussed in the next section.

4. Results and discussion

Table 1 shows the summary statistics. Per capita natural capital depletion (pcncndep) is considered the dependent variable. It is clear, in general, that natural capital is depleted over the years (with a mean value of $1,476 in 2005 constant US$); it varies from $-22,438 (natural capital increase) to $80,265. A total of 5,910 disaster events[9] for 108 countries have been reported within the study period. Some countries face frequent natural disasters (41 per year) with an average of two disasters per country (Dis_frequency). The average per capita total disaster damage – normalized by country GDP – is 3.58E-06. The proportion of the population affected is 1.2% and varies from 0 to 83% annually.

Table 1: Variables and descriptive statistics

Variable	Description	Mean	Std. Dev.	Min	Max
pcncn	Per capita natural capital	51258.72	139194.8	8.477639	1176814
pcncndep	Per capita natural capital depletion	1476.512	5968.594	-22438.09	80265.44
FDI	Foreign direct investment/GDP	9.64E+09	3.51E+10	-2.84E+10	7.34E+11
Trade	Trade/GDP	81.20397	50.60078	0.0209992	439.6567
LnPC_GDP	Natural logarithm of per capita GDP	9.131247	2.716819	3.468484	35.00534
Dis_frequency	Frequency of disaster	2.188889	4.117201	0	41
PC_damage	Per capita total damage/GDP	3.58E-06	3.32E-05	0	0.001208
Affected	Total affected/population	0.011984	0.046835	0	0.827413

[9] EM-DAT data base

Our intention in this paper is to capture the relationship between natural hazards and inclusive growth/ sustainable development. We considered natural capital depletion as a proxy for sustainable development. First, we use a parametric estimation of a panel data fixed effect model (equation 2), considering other determinants as well (Table 2). Model 1 considers total damage as the determinant of natural capital depletion and, alternatively, model 2 considers the total number of people affected. The significant negative coefficient of the frequency of natural disasters indicates that a high frequency of natural disasters impacts favorably on the environment. This can be understood, to a certain extent, with frequent disasters, which are an integral part of nature. Contrary to our expectations, all disaster-related variables show significant negative causality with natural capital. One can conclude that natural disasters are favorable for natural capital, which prompts us to pursue further investigation.

Indeed, more foreign direct investment (LnFDI) and trade (LnTrade) negatively impact natural resource depletion, which implies that they are favorable to the environment. This is similar to the results of economic growth studies and reconfirms previous empirical findings (see, Noy, 2009). Additionally, trade positively impacts the environment (Managi et al., 2009). The lag value of GDP growth (L1GDP_growth) and GDP per capita show positive causality with natural capital depletion. It is noted that stronger economies (per capita GDP) are increasing their natural resource depletion.

Table 2: Fixed effect panel regression

	Model 1	Model 2
Constant	-4200.7***	-3004.2**
	(-1149.7)	(-1060.1)
LnFDI	-422.1***	-447.7***
	(-89.34)	(-89.65)
LnTrade	2.984	21.63
	(57.32)	(57.54)
L1GDP_growth	113.1***	121.2***
	(23.11)	(23.17)
LnPC_GDP	169.7***	170.9***
	(43.1)	(43.07)
Dis_frequency	-82.03**	-76.67**
	(-30.95)	(-31.26)
LnL1PC_damage	-104.8***	
	(-25.35)	
LnL1Affected		-101.7***
		(-23.89)
adj. R-sq	0.026	0.027

within	0.0384	0.0389
between	0.0791	0.1448
overall	0.0356	0.0338

*Note: significant at * p<0.10, ** p<0.05, *** p<0.001*

LnL1PC_damage = natural logarithm of lag value of total damage cause by disaster,

LnL1Affected = natural logarithm of lag value of total affected/ population

4.1 Distribution of natural capital depletion

The existing literature indicates the heterogeneous impacts of natural hazards on economic development (Schumacher and Strobl, 2011). Similarly, we assumed that the causality between natural capital depletion and its determinants would be different based on the level of natural capital depletion. Hence, a fixed effect quantile regression analysis was performed, and the results are depicted in Tables 3 and 4.

Regardless of magnitude, foreign direct investment (LnFDI = natural logarithm of foreign direct investment) negatively impacts natural capital depletion, which indicates that this policy favors the environment. Particularly, our findings indicate that FDI may favor countries with higher natural capita depletion. In contrast, trade is more advantageous in countries with lower natural capital depletion than in countries with higher depletion. These findings are consistent with past research. For instance, Managi et al. (2009) show positive impacts in terms of emissions, and recently, Felbermayr and Gröschl, (2014) showed that trade openness is favor in managing disaster. In general, GDP growth and per capita GDP show positive correlations with natural capital depletion.

One of the most important variables in this study – frequency of natural disasters (Dis_frequency) – has different impacts across different levels of natural capital depletion, in contrast to the results in Table 2. As the results indicate, a low-to-medium level of natural capital depletion is positively correlated with disaster frequency, whereas the correlation with disaster frequency is negative for higher levels of natural capital depletion (Table 3 and 4). These results indicate that less frequent disasters cause large depletions of natural capital. However, countries that face frequent disasters do not show declines in natural capital. Obviously, frequent disasters lead to well-preparedness and post-disaster measures. Total damage and total number of affected people show similar patterns. When natural capital is smaller, it is positively associated with natural disaster. Such dynamic behavior is possible, as natural disasters are a part of the environment. For instance, Fenichel et al. (2016), using world fisheries as an example, show the reallocation of wealth due to climate change.

Table 3: Quantile regression (natural disaster as natural logarithm of per capita total damage)

	Quantiles				
	0.1	0.25	0.5	0.75	0.9
LnFDI	-1.908***	-0.46	-7.390***	-36.83***	-203.8***
	(-0.0173)	(-1.083)	(-0.96)	(-0.957)	(-2.064)
LnTrade	-3.424***	-1.859***	-8.492***	42.35***	336.0***
	(-0.00589)	(-0.287)	(-0.582)	(0.392)	(6.634)
L1GDP_growth	0.333***	0.0454	-2.689***	5.295***	26.09***
	(0.00405)	(1.056)	(-0.669)	(0.13)	(0.815)
LnPC_GDP	-0.861***	1.752**	2.397**	45.99***	340.7***
	(-0.00319)	(0.804)	(0.751)	(0.295)	(1.293)
Dis_frequency	1.786***	1.181***	-2.623***	-2.386***	-66.10***
	(0.00283)	(0.343)	(-0.467)	(-0.162)	(-0.88)
LnL1PC_damage	0.325***	0.651***	-1.704***	1.098***	0.817
	(0.00377)	(0.106)	(-0.147)	(0.121)	(0.671)

*Note: significant at * p<0.10, ** p<0.05, *** p<0.001*

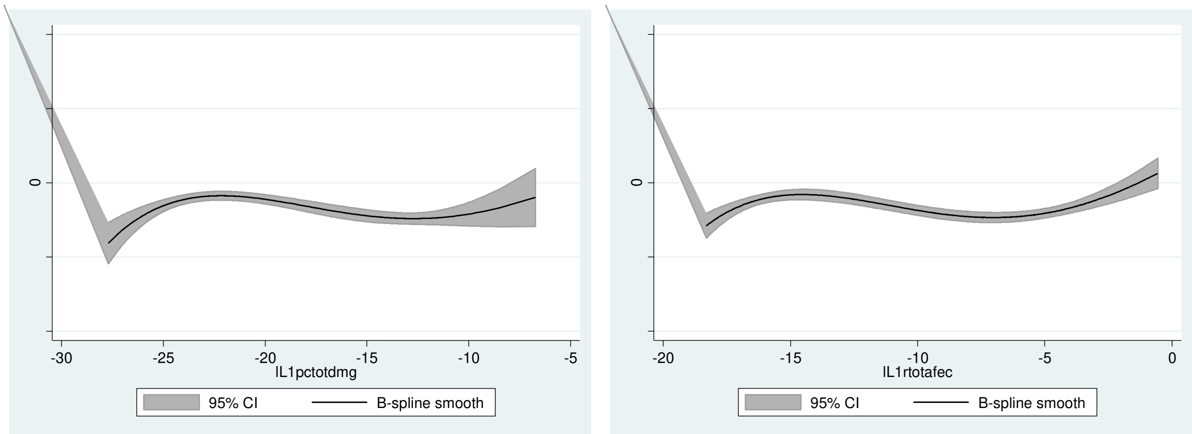
Table 4: Quantile regression (natural disaster as natural logarithm of total affected population)

	Quantiles				
	0.1	0.25	0.5	0.75	0.9
LnFDI	-4.583***	-3.253***	-8.009***	-11.24***	-91.91**
	(-0.0922)	(-0.36)	(-0.378)	(-1.961)	(-36.67)
LnTrade	-1.043***	1.930***	29.25***	26.85***	61.17***
	(-0.0481)	(-0.383)	(1.496)	(0.228)	(3.082)
L1GDP_growth	-0.720***	-0.728**	0.298*	4.747***	13.72***
	(-0.0365)	(-0.249)	(0.16)	(0.19)	(4.05)
LnPC_GDP	-0.135**	2.277***	10.03***	38.71***	254.7**
	(-0.0473)	(0.197)	(0.123)	(0.444)	(83.23)
Dis_frequency	0.980***	0.958***	-0.783***	-2.356***	-0.205
	(0.00888)	(0.0224)	(-0.16)	(-0.2)	(-19.18)
LnL1Affected	2.861***	-0.00068	-1.790***	4.068***	-6.169
	(0.0205)	(-0.0736)	(-0.165)	(0.304)	(-17.11)

*Note: significant at * p<0.10, ** p<0.05, *** p<0.001*

4.2 Semi-parametric panel fixed effect model

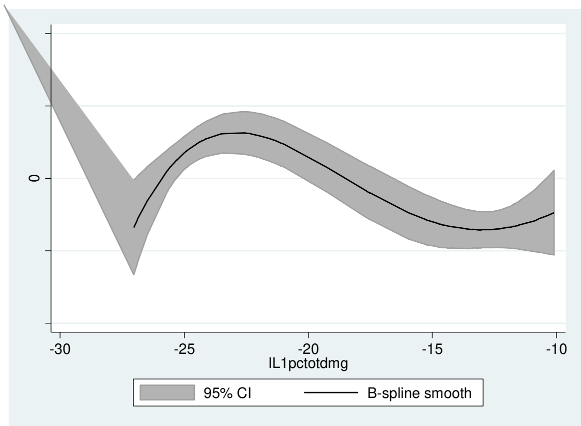
We then specify the semi-parametric panel fixed-effect model to explore the relationship between natural capital depletion and disaster parameters, with a focus on examining the magnitude of the disaster. Figure 1 depicts the relationship between natural capital depletion and (a) total damage and (b) total affected (Figure 1: (a) and (b)). Unlike the results of parametric analysis, the semi-parametric panel analysis identifies the nonlinear relationship. Obviously, the semi-parametric estimation has an advantage as lack of theoretical foundation. Of course, as with the level of natural disaster, the level of natural capital depletion is not evenly distributed across the globe. For small-to-medium level disasters, there is an inverted U shape relationship, and then for large disasters, the level of depletion once again increases. These results are consistent with previous research on GDP growth. Kellenberg and Mobarak (2008) found that the damage caused by natural disasters and the level of economic development show an inverted U-shaped relationship. With increasing income, it is possible to increase investments in disaster precautions.



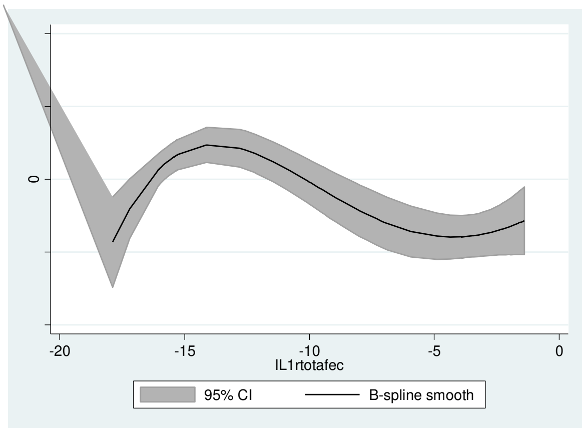
(a) Total damage (b) Total affected

Figure 1: Natural capital and natural disaster

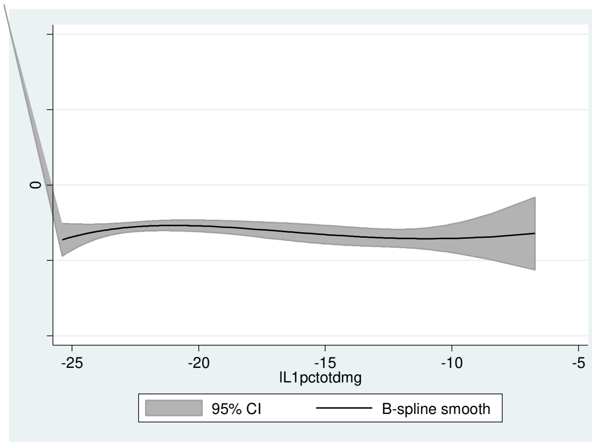
We further investigate whether the OECD countries behave differently compared to other countries (see, Figure 2). As shown, the nonlinear inverted U shape is prominent in OECD countries (Figure 2: (c) and (d)). In a recent study, Halcos et al. (2015) found that the relationship between natural and man-made disasters and countries' production efficiencies has an inverted U shape. In this study, we observed a similar relationship between natural capital depletion and disaster level. More specifically, a medium level of disaster shows a higher level of natural capital depletion compared to lower and higher levels of disaster. Alternatively, when the level of disaster is lower, natural capital depletion increases with the natural disaster, whereas when the level of disaster is higher, the depletion decreases. Importantly, with higher levels of disaster, natural capital depletion increases.



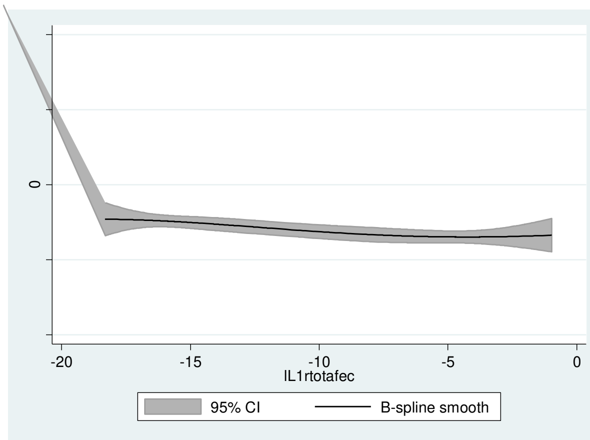
(c) Total damage (OECD)



(d) Total affected (OECD)



(e) Total damage (non-OECD)



(f) Total affected (non-OECD)

Figure 2: Natural capital and natural disaster – OECD and non-OECD

5. Conclusion

With the increasing frequency of natural disasters globally, researchers have invested considerable interest in seeking the best policy options for combatting economic downturns. However, research so far has rarely considered the sustainability impacts of natural disasters. In this study, we explore the sustainability impact by modeling the nexus of natural capital depletion and natural disaster. The importance of natural capital is well documented (see, Deutsch et al., 2003; Groot et al., 2003). Although there is growing interest in inclusive growth (see, UNEP, 2011; World Bank, 2012), this paper is the first to provide evidence of natural disaster's impacts on natural resource depletion.

Natural disaster impacts the depletion of natural capital nonlinearly; the impact varies depending on the level of natural capital depletion as well as the level of magnitude of the disaster. The smaller the depletion of natural capital, the higher the impact of the disaster. More frequent small disasters have an adverse impact on sustainability. It is possible, with small impacts, the pre- and post-disaster measures are not well-organized. However, with the higher magnitude, the disaster management receive higher priority. The depletion of natural capital and the magnitude of the natural disaster show an inverted U shaped relationship. Again, small disasters are needed for proper and sustainable resource management.

Both development parameters and sustainable resource management must be considered in connection with climate-related disasters. For instance, natural capital depletion increases when the magnitude of a disaster is small-to-medium, and natural capital depletion decreases when the magnitude of the disaster is medium-to-high. This indicates that following a small natural disaster, most economies do not efficiently manage their natural resources. However, following a major disaster, countries may make natural resource management a priority, as reflected in the results. This paper emphasizes the importance of proper planning for the management of natural capital. Particularly, pre- and post-disaster management policies are needed for frequent small-to-medium level disasters.

This paper also highlights some caveats that can be addressed in future research. The damage of disasters to nature tend to recover long time as well as it depends on the magnitude and the type of the disaster. Our econometric model does not capture the long-term impacts. Further, this study did not consider country-specific policies related to the environment and disaster preparedness. Future work should target micro-level disaster-specific data in the way that this paper analyses global-level data.

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