Preliminary Draft

Disaster and Decentralization

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Abstract

The role of decentralized government in disaster management is well recognized among donors and policy makers. However, there has been no rigorous attempt to address this issue. This paper studies the effect of fiscal and political decentralization on death toll and number of people affected by disasters for up to 46 developing and transition economies for the period 1974 – 2004. Since disaster is mostly a local phenomenon, results are found to be significant and robust only at the lowest level of government (e.g. Municipality). Elected government at the lowest level is found to increase the number of death and affected people while at the state level the effect is not significant. The effect of fiscal decentralization alone is negative, though the results are mostly insignificant. However, when fiscal decentralization is accompanied by political decentralization, it significantly reduces the number of total dead and affected people for the lowest tier of government.

Key words: Political decentralization, Fiscal decentralization, Natural disaster

JEL Classification: H7

1.0 Introduction

A seeming consensus has been growing among the donors and policy makers that a decentralized government is more efficient in mitigating disaster risk than the more centralized one. The UN World Conference on Disaster Reduction (WCDR), held in 2005 in Kobe, Japan considered the role of local government as a precondition for effective disaster risk reduction[1]. After 1999 Hurricane Mitch[2], a declaration was signed by El-Salvador and the donors and it called for "consolidating democracy and good governance, reinforcing the decentralization of governmental functions and powers, with the active participation of civil society" (UNDP, 1999). The multilateral donors such as World Bank have also embraced decentralization as a critical element in disaster risk mitigation. World Bank organized a workshop on "The Role of Local Governments in Reducing the Risk of Disasters" in Istanbul, Turkey in 2003 where the local government was recognized as an important trend in changing paradigm of disaster risk management (Demeter, et. al, 2006). The Asian Disaster Preparedness Center (ADPC) advocates strongly for strengthening local governments for disaster management[3]. Despite this growing recognition of decentralized government in disaster management, there has been no study to address this issue rigorously. To fill this void, this paper studies the effect of political and fiscal decentralization on the number of total death and total affected people by natural disasters.

Disaster Management Cycle (FAO, n.d.) involves 3 main phases: i) pre-emergency phase, ii) emergency phase, and iii) post-emergency phase. A decentralized government can be very effective in all three phases in disaster management. Since disaster is mostly a local phenomenon, which rarely hits the entire country, use of local knowledge and resources are critical for effective prevention measures and to tailor these measures to local threats and vulnerabilities (Messer, 2003). These prevention measures in pre-emergency phase typically include risk-mapping, application of building code, land zoning, construction of dam, embankment, etc. Moreover, macroeconomic stabilization, political conflict and

[1] http://www.unisdr.org/wcdr
[2] It devastated the coasts of Honduras, Nicaragua, El Salvador, and Guatemala with an estimated damage of one seventh of the region's gross domestic product
[3] http://www.adpc.net/v2007/

other national priorities of central government often overshadow local issues like disaster risks prevention and preparedness. In such cases, local politicians, who are accountable to their voters, can draw attention of the central government and also raise funds locally and allocate more resources for disaster preparedness. Intergovernmental competition over mobile factors of production, such as, labor and capital can also improve disaster preparedness. In the emergency phase, which requires immediate and quick response, local government can help mobilize resources very quickly using local knowledge and expertise. Local politicians who want to accumulate political capital have strong incentives to participate in relief and rescue efforts. Rehabilitation and reconstruction in post-emergency phase can also be effectively implemented and coordinated by local government with appropriate assessment of the damage and proper targeting. In short, greater information and accountability (Seabright, 1996), targeting efficiency and cost effectiveness (Bardhan and Mookherjee, 2000a), and competition for mobile factors (Tiebout, 1956) may lead to efficient disaster risk management by the decentralized government.

The basic argument for decentralization is that it brings government closer to the people so that people's preferences are well reflected in public policy making. However, it is also argued that greater decentralization may encourage 'personalism' where government officials come closer to the citizens and it may breed inefficiency, unethical relationship and corruption (Tanzi, 1995; Prud'homme, 1995). Decentralization, if done right, is argued to make government more responsive to citizen's need and more accountable to the citizen for resource allocation and public service delivery. However, local politicians and interest groups may become more powerful through greater political decentralization, resulting in unaccountable and irresponsive nature of government. The possibility of this 'elite capture' (Bardhan and Mukharjee, 2000b) may increase during and post disaster period when local government receives aid and relief for the affected areas. Stealing and confiscating disaster aid by the local politicians is very common in developing countries. Also press, media and civil society, which play a critical role in providing information during disaster, are very weak and vulnerable to political and elite capture at the local level in developing countries. Local politicians and elites may engage

in land grabbing through deforestation, filling up water bodies and hill cutting, risky settlements of loyal voters in vulnerable places (e.g. steep land), massive land excavation in topographically unstable areas and these increase the vulnerability risk of natural disaster.

This study combines two strands of empirical literature – i) the impacts of decentralization on various outcomes and ii) the factors determining the risk of natural disaster. The first set of literature concentrates on the impact on long run growth (Davoodi and Zou, 1998; Woller and Phillips, 1998; Zhang and Zou, 1998; Lin and Liu, 2000; Jin et al., 1999; Akai and Sakata, 2002; Xie et al., 1999), government size (Heng-fu Zou, 2001), basic public service delivery (Enikopolov and Zhuravskaya, 2007) and governance (Treisman, 2009, 2000; Enikopolov and Zhuravskaya, 2007; Fisman and Gatti, 2002). However the results are mixed and the effect of decentralization is not conclusive. We argue that the impact of decentralization can be isolated more effectively for disaster than the cases in existing literature for two reasons: i) disaster is a local phenomenon and local government can address local issues more effectively, and ii) physical proximity of governments to the people is more crucial in emergency than in normal period.

The other strand of literature studies the factors that determine the death toll and damage by disasters. This literature primarily studies the role of geography, economic development and quality of institution. It shows that richer country tends to experience less damage and death from both natural and industrial disaster (Kahn, 2005; Anbarci, et al., 2005, Toya and Skidmore, 2007). However, Kellenberg and Mobarak (2007) argue that the relationship is not monotonic and found that disaster risks first increase before it diminishes with income for certain disasters. Democratic government and better quality institutions also reduce the mortality risk of disaster (Kahn, 2005). Our study of the impact of decentralization is also new to this literature.

In this study we investigate the effect of fiscal and political decentralization on death toll and number of people affected by natural disasters for the period 1974 – 2004 for up to

46 developing and transitional countries. Share of local revenues in total (local and central) is used to measure the extent of the fiscal decentralization and political decentralization is captured by elected government at the state/provincial and the lowest level of government. There are three major findings – (i) the elected government at the lowest tier of government is associated with higher number of death and people affected by disaster, whereas the effect of the elected government at state or provincial level is not significant; (ii) fiscal decentralization is found to be negatively associated with the number of death and affected, though the effects are mostly insignificant; (iii) however, the effects of fiscal decentralization on disaster outcome become significant and robust in the presence of political decentralization at the lowest level of government. But this result is not significant for the state or provincial level.

The above results draw attention to the following important issues regarding the role of decentralized government in disaster management. Firstly, natural disaster is mostly a local problem and the extent of the physical proximity of local government to the affected people determines its effectiveness in disaster management. Secondly, the result that elected government at the lowest level aggravates the disaster risks while the effects of the upper levels are insignificant sheds light on the fact that lower tires of local government are more vulnerable to corruption and 'elite capture' than the upper levels such as state or provincial governments in developing countries. Also local politicians may lack incentives to deliver due to very limited opportunity of the upward mobility of the political career. Finally, the results stress the joint significance of fiscal and political decentralization – the outcome of fiscal decentralization improves with elected government at the lowest level. It indicates that fiscal responsibility makes local government more accountable. However, it may also shed light on the fact that central government provides more transfer to the regions with more accountable government.

The rest of the paper is organized as follows. The section two describes the data used and the estimation techniques. Section three analyzes the results which include sub-sections on fiscal and political decentralization and their interaction. Section four brings up endogeneity issues while section five draws conclusion.

2.0 Data and Estimation Technique

We use the following regression specification:

$$Ln(1+disaster\ outcome_{it}) = \beta_1 + \beta_2.decentralization_{it} + \beta_3.controls_{it} + u_{it}$$

Since dependent variable contains a large number of zeros, Ln(1+disaster outcome) has been used as dependent variable. The disaster outcome includes number of total dead and total people affected in a year (*t*) by natural disasters in a country (*i*). These data are from The International Disaster Database OFDA/CRED.

We study two types of decentralization – political and fiscal. For political decentralization we use two variables: i) elected state/provincial government (dummy, 1 = if state/provincial level government locally elected, 0 = otherwise), ii) elected municipal/lowest level of government (dummy, 1= if municipal level government is locally elected, 0=otherwise). These variables are taken from Database on Political Institutions (Beck, et al, 2006). For fiscal decentralization, we use share of sub-national revenues in total revenue from IMF' Government Fiscal Statistics[4]. These measures are widely used in literature because of their strength in cross country comparison, despite the fact that these measures do not necessarily reflect local government's authority over taxation and expenditure.

Disaster risk depends on two components - hazard risks and vulnerability (FAO, n.d.). Hazard risks typically depend on geographical characteristics of a country as some countries are more disaster-prone than other countries. We include elevation and latitude. We also run country fixed effects to capture the country specific geographical, meteorological, and also social, cultural and institutional factors that are fixed over time and have bearing on disaster risk; and also time fixed effects to capture time variant unobservable such as advancement of knowledge and technological innovation in disaster management. The vulnerability of a country's population primarily depends on its size of population, income and population density. Between the two countries of same

[4] The correlation between share of revenue and expenditure is very high (0.8). We focus primarily on sub national revenue.

population size, the country with higher population density is more vulnerable to natural disaster than the sparsely populated one, holding other factors fixed. These variables are taken from Penn World Table (PWT 6.2). Moreover, country's vulnerability also hinges on the socio-political environment of a country. We use measure of democracy (polity score) and measure of ethnic diversity (ethnolinguistic fractionalization) to control for political aspects which add to the vulnerability risks of the population. Democratically elected governments are more accountable to the public for service delivery and media which helps ensure greater voice and accountability, flourishes under democracy. In ethnically fragmented nations where voters put more weights on ideology and ethnic identities than the performance of politicians in public service delivery, local politicians may lack incentives to deliver. Moreover, the central government may not have incentives to internalize the benefits and costs across jurisdictions if the national politicians identify themselves only to certain spatially located groups.

We use a host of estimation techniques, as each has its own strengths and weaknesses. We use GLS (UNDP, 2004; Kahn, 2005 and Kellenberg and Mobarak, 2007) and Negative Binomial (Anbarci et al., 2005; Kellenberg and Mobarak, 2007). Both of these methods also allow us to run country and time fixed effects. However, since dependent variable is in count data nature, GLS may not produce consistent estimates. Moreover, due to the presence of large number of zero observation, we also use Zero Inflated Negative Binomial (ZINB) model (Kahn, 2005). However, this estimation technique does not permit us to run country and time fixed effects. We choose negative binomial over Poisson because in the latter case mean and standard deviation are equal which is not supported by our data[5].

3. Estimation Results

3.1 Political Decentralization

Table 1 presents results for political decentralization where the dependent variable is total number of dead for first six columns and total number of people affected for the next six columns (7-12). In basic specification (column 1-3 and 7-9), we use only population

[5] Mean and standard deviation for total death are 472 and 6146 respectively.

density, GDP per capita, log of total population and number of times the disaster took place in a year in a country. In the extended specification (column 4-6 for total dead and column 10-12 for total affected), we add political and geographical variables.

First consider the case where dependent variable is total dead (column 1-6). Results show that there is no pattern in signs for elected state/provincial government (STATE hereafter) and coefficients are not significant (except column 5). However, in case of elected government at the lowest level (MUNICIPALITY hereafter), all the coefficients are positive, and significant only for basic specification. Political variable such as democracy may have picked some effects of MUNICIPALITY. Higher per capita GDP reduces the death count while total population increases it. Both of these variables are highly significant across specifications and estimation techniques. Total number of disaster, as expected, increases the number of total death. Greater democracy is found to reduce the number of death, though the sign is not significant. For ethnolinguistic fractionalization the signs are negative, with significant negative effects for ZINB[6]. The signs of both latitude and elevation are positive. Interestingly, a country with higher elevation is found to experience higher death toll from disaster and this effect is highly significant.

In case of total affected, the effects of STATE and MUNICIAPALITY are similar to total death case. The coefficients for SATE are insignificant with no pattern in sign while the signs for MUNICIAPALITY are positive and mostly significant. Inclusion of political and geographical variables has not taken the significance away for GLS and ZINB. The only significant impact of ethnic fractionalization is positive but this result is not robust. The effect of democracy is also mixed. Higher latitude is associated with lower number of total affected.

[6] Kahn (2005) also found similar result

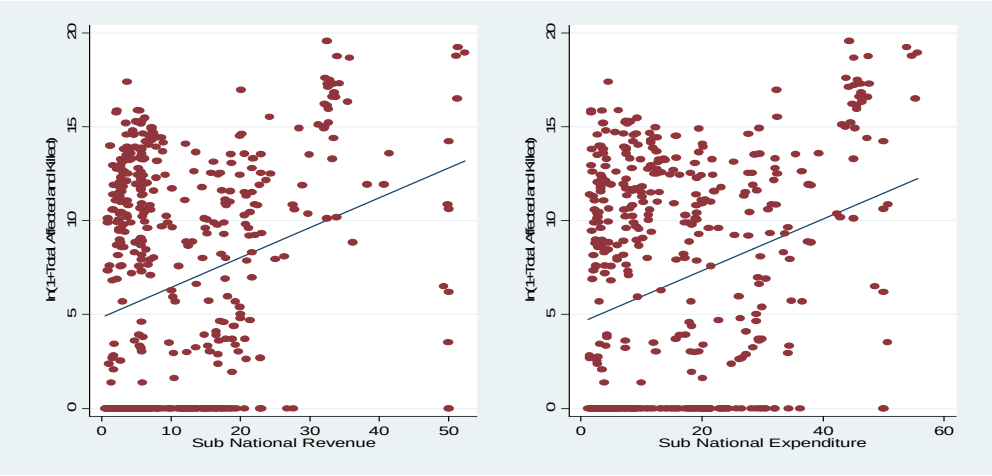
Overall, the elected government at the state or provincial level does not have significant impact on total dead and affected. But for the lowest level of government, this effect is positive and mostly significant. That is, political decentralization at the lowest tier of government makes the people more vulnerable to disaster.

Table 2 presents the results for GLS and NB with country and year fixed effect. In this case, the effect of STATE is mostly negative but insignificant (only NB is significant for total dead). However, political decentralization at the lowest level of government is associated with higher total deal and total affected as the signs of MUNICIPALITY are positive and significant for all specifications and estimation techniques. The signs for other controls are similar for total death and total affected. Compared to Table 1 now the effect of fractionalization is positive - countries with more ethnic division are more vulnerable to disaster risks. This effect is however not significant (except column 7).

From Table 1 and 2, we can conclude that only significant and robust impact of political decentralization is found at the lowest level of government. It sheds light on the fact that the impact of disaster is generally limited to only small areas and because of physical proximity, only the lowest level government can have significant impact on the disaster outcome. The result that elected government at the lowest level deteriorates the vulnerability risk of the local people is not surprising. It could be the case that in developing countries lower tires of local government are more vulnerable to corruption and 'elite capture' than the upper levels such as state or provincial governments. This result may also indicate that 'political market' works less efficiently at the lowest level than ones above. Election outcome at lowest level may depend less on politician's role in providing local public goods as the possibility of 'capture' of the political process is higher at the lowest level. Also the opportunity for upward mobility of political career is lower for the politicians at bottom and thus they have lesser incentive to deliver than the ones above them.

3.2 Fiscal Decentralization

Figure 1: Correlation between fiscal decentralization and disaster outcome



The Figure 1 shows that sub-national revenue and sub-national expenditure are positively correlated with total dead and affected by disaster for our sample. However, this correlation tells nothing about the causality unless we control of other covariates. Table 3 presents the results on the effect of revenue share on death count (column 1-6) and total people affected (column 7-12). Similar to Table 1, we use two specifications and three estimation techniques. For sub-national revenue most of the effects are negative and four of them are statistically significant. It is interesting that fiscal decentralization is found to reduce the total dead and affected people while the correlation shows otherwise. Sings of other controls especially the geographical and political variables are not significant and robust.

Table 4 shows the results for GLS and NB, controlling for year and country fixed effects. Now the significance of sub national revenue has disappeared, though the signs remain negative. The signs of other controls remain similar to Table 3. The reason behind the insignificant coefficients can be argued as follows. Fiscal decentralization variables of IMF do not distinguish between state and the lower level of governments - revenues of all tiers of government are lumped together. Share of local revenue does not capture the actual variation of fiscal decentralization at different tiers of the government. If the extent of fiscal decentralization varies across tiers sub-national revenue will not be able to distinguish effects between STATE and MUNICIPALITY. Note that for political decentralization, the signs of the effects of elected state and municipal government are

found opposite. If this is also true for fiscal decentralization, effects of different tiers of government may have canceled out each other to produce insignificant results.

3.3 Interaction between Political and Fiscal Decentralization

It is also argued that the effectiveness of local government depends on how different forms of decentralization interact with each other. Citing several cases of 'mismatch' among political, fiscal and administrative decentralization in developing countries, Ahmad et al (2005) note that lack of balance in different forms may weaken the efficacy of public service delivery of decentralized government. Riker (1964) also argues that locally elected government and strong political party at the top improves the outcome of fiscal decentralization. While elected government at the local level ensures accountability, strong national political party provides incentives for upward career mobility for the local politicians. Following Riker's (1964), Enikopolov and Zhuravskaya (2007) test these hypotheses for various measures of governance, basic public service delivery and long run growth and found evidence in support of them.

Table 5 and 6 show the results for interaction for both total dead and total affected. In these cases STATE and MUNICIPALITY are used separately in regression to avoid high multicollinearity among the interaction terms and to make the results comparable to the literature[7]. Table 5 shows that in case of STATE the sings of the interaction term between sub national revenue and STATE are all negative but significant for ZINB only. But when we control for country and year fixed effect, the signs are mixed and not significant (Table 6). The signs of revenue are not robust while signs of STATE are positive but insignificant. In case of MUNICIPALITY, the signs of the interaction terms between MUNICIPALITY and revenue are all negative and four out of six coefficients are significant (Table 5). These results are more robust in Table 6 where we control for country and year fixed effects – all the signs are negative and highly significant. In this case the individual effects of MUNICIPALITY are positive and significant as well.

[7] Enikopolov and Zhuravskaya (2007) used STATE and MUNI separately.

These results imply that fiscal decentralization with elected government at the lowest level reduces the number of total death and affected people. But in case of elected government at the state level the effect of fiscal decentralization is not robust. Therefore, our results confirm Riker's hypothesis at the lowest tier of government but not for the level above it. These results shed light on the fact that accountability of lower level of government may depend on the expenditure and financing responsibilities. Local governments in developing countries are not self-sufficient and transfer from the central constitutes a large portion of their budget. Ahmad et al. (2005) argued that there are two parts of central's transfer to local government – conditional and unconditional. While the former ensures accountability to the central, the latter leads to accountability to the local people. Generally, the allocation for disaster management includes both type of transfer; conditional transfer for pre-disaster period for prevention and preparedness purpose and unconditional transfer for emergency period. Therefore, the results indicate that the fiscal responsibility makes local politicians accountable to both central government and also to local electorate and help manage disaster risks better.

The result that the lowest level of elected government, which is otherwise vulnerable to corruption and thus increases the disaster risk of the local people, becomes effective in mitigating disaster risk with more fiscal responsibility may be indicative of the following too. The central government is aware which local governments are more susceptible to corruption and thus inefficient in managing disasters. Therefore, they provide transfers more to the regions where governments have cleaner image and have good reputation in disaster risk mitigation. Therefore, we observe that when elected local government is more fiscally decentralized it tends to reduce the disaster risk. So, fiscal responsibility can make local government more responsible or central government delegates more fiscal responsibility to the local governments which are proven to be more responsible.

We also test if Riker's other hypothesis hold – whether strong national party provides enough incentives for local politicians to perform. Using the same two variables (age of government and opposition parties and fractionalization of government) to capture national party strength (and lack thereof) and the same proxies for the political institution

variables as Enikolopov and Zhuravskaya (2007), we did not find support for this hypothesis (Table 7). The strong central government which is argued to provide incentives for local politicians for upward mobility does not work in case of disaster. One reason could be that fiscal decentralization fails to distinguish between different tiers of government and as we have seen it is only the lowest level of government that matters. The interaction terms between sub national revenue and party age and sub national revenue and government fractionalization cannot distinguish the effects of different tiers.

4.0 Endogeneity Issues

One can argue that there is omitted variable bias – some unobservable may affect both the decentralization decision and the disaster outcomes[8]. Note that we have already controlled for country specific unobservable which include social, cultural and political norms and institutions which are constant over time. The year fixed effect also capture the wave of reforms including decentralization that swept the most developing countries in 1980s and 1990s, especially the Latin America and Eastern Europe. One weak candidate is time varying country specific institutional factors which may have impact on both decentralization and disaster management. It is very hard to come up with examples of such institutional factors. Another possibility is simultaneity bias in this case – decentralization decision is influenced by disaster risk mitigation strategy. Though now-a-days multilateral donors are strongly advocating the decentralization agenda to include in disaster risk mitigation strategy, it is very unlikely that governments of developing countries becoming more decentralized in order to mitigate disaster risks. In developing countries the major forces that lead to decentralization include collapse of centralized economies in Eastern Europe, transition to strong democracy (Latin America), and response to ethnic conflicts in Africa (Ahmad et al, 2005). Treisman (2006) also identified country size, former colony, federalism, and democratization as the key determinants of decentralization.

[8]Fisman and Gatti, (2002) argued that inefficient and corrupt government officials can influence the decentralization decision and deteriorates mortality risks of disaster. However, it is the national politicians who make the decision about decentralization and its extent.

Moreover, there is no good instrument available for political decentralization[9]. For fiscal decentralization, Fisman and Gatti, (2002) used legal origin; Enikolopov and Zhuravskaya (2007), Arzaghi and Henderson (2005), Panizza, (1999) also used country size as an instrument but it violates exclusion restriction in our case as country size is an important determinant of the extent of disaster outcome. We used legal origin to instrument fiscal decentralization and the results are qualitatively similar to Table 3. Also due to count data nature of our dependent variable, usefulness of standard IV or GMM are limited.

5.0 Conclusion

This paper studies the effect of political and fiscal decentralization on disaster outcomes. This study is important for two reasons. Firstly, there is a vast literature on the effectiveness of decentralization where results are inconclusive. We argue that the impact of decentralization can be isolated more effectively in crisis than in normal period as the physical proximity of local governments has the potential to impact crisis management more than a centralized one. This paper sheds light on the joint role of fiscal and political decentralization in disaster management at the lowest tier of the government. Secondly, there is a growing literature which focuses mainly on income, geography and institutional quality to explain the cross country variations in disaster outcomes. This paper also contributes to this literature by studying the role of decentralized government in disaster risk mitigation.

[9] Acemoglu (2005) argues that instruments used for political institutions are valid only for broad categories; no good instrument available for particular political institution. See footnote 21 in Enikolopov and Zhuravskaya (2007) for detail.

Table 1: Effect of political decentralization on total death and total affected

	Dependent Variable: Total Dead						Dependent Variable: Total Affected					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	GLS	NB	ZINB	GLS	NB	ZINB	GLS	NB	ZINB	GLS	NB	ZINB
State	-0.283	0.003	-0.037	0.342	0.242	0.073	0.090	0.181	-0.003	0.271	0.149	-0.068
	(0.341)	(0.106)	(0.077)	(0.278)	(0.128)+	(0.106)	(0.824)	(0.113)	(0.044)	(1.166)	(0.152)	(0.062)
Municipality	0.576	0.263	0.186	0.279	0.050	0.132	1.422	0.195	0.107	1.841	0.187	0.150
	(0.310)+	(0.129)*	(0.086)*	(0.298)	(0.139)	(0.102)	(0.672)*	(0.122)	(0.048)*	(0.789)*	(0.132)	(0.058)*
Population density	-0.107	-0.083	-0.026	-0.323	-0.145	-0.082	-0.357	-0.088	0.007	0.257	0.051	0.009
	(0.136)	(0.043)+	(0.029)	(0.128)*	(0.065)*	(0.051)	(0.329)	(0.040)*	(0.017)	(0.635)	(0.070)	(0.030)
GDP per Capita	-0.380	-0.203	-0.166	-0.449	-0.122	-0.175	-0.886	-0.210	-0.089	-0.915	-0.098	-0.101
	(0.155)*	(0.054)**	(0.041)**	(0.146)**	(0.067)+	(0.058)**	(0.414)*	(0.056)**	(0.022)**	(0.671)	(0.064)	(0.031)**
ln(population)	0.234	0.040	0.112	0.194	0.011	0.148	-0.063	-0.114	0.006	-0.511	-0.174	0.044
	(0.177)	(0.061)	(0.043)**	(0.147)	(0.071)	(0.052)**	(0.431)	(0.062)+	(0.024)	(0.591)	(0.073)*	(0.029)
Number of disaster	0.896	0.397	0.092	0.859	0.324	0.084	1.728	0.407	0.035	1.656	0.310	0.022
	(0.067)**	(0.041)**	(0.019)**	(0.073)**	(0.042)**	(0.025)**	(0.154)**	(0.051)**	(0.010)**	(0.177)**	(0.049)**	(0.012)+
Democracy				-0.014	-0.013	-0.003				-0.098	0.001	0.001
				(0.028)	(0.013)	(0.011)				(0.107)	(0.014)	(0.006)
Ethno-linguistic				-0.464	-0.098	-0.361				0.640	0.507	-0.146
fractionalization				(0.555)	(0.264)	(0.204)+				(2.405)	(0.295)+	(0.116)
Latitude				0.024	0.009	0.002				-0.023	-0.002	-0.002
				(0.007)**	(0.003)**	(0.003)				(0.034)	(0.004)	(0.002)
Elevation				0.001	0.001	0.001				0.001	0.001	-0.001
				(0.000)**	(0.000)**	(0.000)**				(0.001)	(0.000)	(0.000)
Constant	0.258	1.121	0.503	1.951	1.249	0.277	12.078	4.703	2.769	17.589	4.225	2.385
	(3.181)	(1.123)	(0.815)	(2.537)	(1.324)	(0.989)	(7.767)	(1.070)**	(0.414)**	(11.015)	(1.228)**	(0.515)**
Observati	546	546	546	375	375	375	547	547	547	375	375	375
Number of group	29			22			29			22		

Robust standard errors in parentheses
+ significant at 10%; * significant at 5%; ** significant at 1%

Table 2: Effect of political decentralization on total dead and total affected with country and time fixed effects

	Dependent Variable: Total Dead				Dependent Variable: Total Affected			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	GLS	NB	GLS	NB	GLS	NB	GLS	NB
State	-0.049	-1.044	-0.321	-2.629	0.438	-0.150	0.240	-0.321
	(0.188)	(0.539)+	(0.237)	(0.749)**	(0.505)	(0.235)	(0.602)	(0.286)
Municipality	0.374	0.654	0.676	0.549	0.955	0.564	1.382	0.565
	(0.207)+	(0.179)**	(0.261)**	(0.184)**	(0.493)+	(0.197)**	(0.598)*	(0.205)**
Population Density	-0.123	-0.071	-0.062	0.454	-0.583	-0.188	-0.106	0.057
	(0.071)+	(0.145)	(0.096)	(0.271)+	(0.181)**	(0.087)*	(0.237)	(0.120)
GDP per Capita	-0.398	-0.335	-0.288	-0.032	-1.107	-0.260	-0.557	-0.099
	(0.089)**	(0.205)	(0.150)+	(0.267)	(0.241)**	(0.117)*	(0.347)	(0.172)
Ln(Population)	0.245	0.902	0.432	1.561	-0.408	0.122	-0.769	-0.076
	(0.092)**	(0.348)**	(0.132)**	(0.392)**	(0.263)	(0.138)	(0.326)*	(0.166)
Number of Disaster	0.992	0.280	0.844	0.229	2.034	0.234	1.877	0.258
	(0.045)**	(0.030)**	(0.062)**	(0.028)**	(0.111)**	(0.024)**	(0.138)**	(0.030)**
Democracy			-0.015	0.012			-0.053	-0.026
			(0.029)	(0.024)			(0.072)	(0.026)
Ethno-Linguistic Fractionalization			0.034	1.875			2.363	0.870
			(0.527)	(1.397)			(1.188)*	(0.638)
Constant	0.096	-12.153	-3.786	-26.187	20.067	-15.096	19.117	-0.079
	(1.611)	(5.220)*	(2.363)	(5.854)**	(4.559)**	(746.030)	(5.833)**	(3.076)
Observations	546	541	375	375	547	542	375	375
Number of group(country)	29	28	22	22	29	28	22	22

Standard errors in parentheses

+ significant at 10%; * significant at 5%; ** significant at 1%

Table 3: Effect of fiscal decentralization on total dead and affected

	Dependent variable: Total Dead						Dependent variable: Total Affected					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	GLS	NB	ZINB	GLS	NB	ZINB	GLS	NB	ZINB	GLS	NB	ZINB
Sub National Revenue	0.001	-0.004	-0.002	-0.025	-0.021	-0.008	-0.054	-0.009	0.000	-0.107	-0.024	-0.000
	(0.017)	(0.006)	(0.003)	(0.024)	(0.007)**	(0.007)	(0.033)+	(0.007)	(0.002)	(0.059)+	(0.009)**	(0.004)
Population Density	0.061	-0.113	-0.042	-0.169	-0.147	-0.062	-0.423	-0.210	0.022	-0.547	-0.207	0.022
	(0.196)	(0.054)*	(0.038)	(0.276)	(0.086)+	(0.087)	(0.333)	(0.063)**	(0.022)	(0.867)	(0.109)+	(0.048)
GDP per capita	-0.071	-0.038	-0.132	0.111	0.138	-0.055	-1.030	-0.261	-0.081	-0.601	-0.046	-0.085
	(0.227)	(0.084)	(0.055)*	(0.322)	(0.098)	(0.085)	(0.492)*	(0.086)**	(0.030)**	(0.872)	(0.111)	(0.045)+
Ln(population)	0.248	0.201	0.104	0.515	0.299	0.168	0.596	0.090	0.047	1.041	0.188	0.056
	(0.188)	(0.052)**	(0.031)**	(0.212)*	(0.069)**	(0.059)**	(0.339)+	(0.054)+	(0.018)*	(0.531)*	(0.071)**	(0.031)+
Number of disaster	0.607	0.199	0.047	0.498	0.117	0.048	1.380	0.295	0.018	1.097	0.166	0.013
	(0.061)**	(0.029)**	(0.011)**	(0.061)**	(0.026)**	(0.016)**	(0.125)**	(0.042)**	(0.007)*	(0.153)**	(0.030)**	(0.009)
Democracy				-0.025	0.010	0.005				-0.066	0.012	0.003
				(0.040)	(0.014)	(0.012)				(0.103)	(0.017)	(0.007)
Ethno-Linguistic Fractionalization				0.199	-0.063	-0.181				-3.238	-0.385	-0.108
				(1.145)	(0.368)	(0.320)				(3.247)	(0.395)	(0.169)
Latitude				-0.002	0.003	0.000				-0.015	0.001	-0.000
				(0.014)	(0.003)	(0.003)				(0.036)	(0.004)	(0.002)
Elevation				-0.001	-0.000	0.000				-0.001	-0.000	0.000
				(0.000)	(0.000)	(0.000)				(0.001)	(0.000)+	(0.000)
Constant	-2.382	-2.302	0.779	-6.557	-4.769	-0.818	3.901	2.483	2.131	-1.643	-0.012	2.075
	(3.745)	(1.231)+	(0.732)	(4.076)	(1.432)**	(1.116)	(6.917)	(1.116)*	(0.406)**	(10.271)	(1.272)	(0.553)**
Observations	500	500	500	276	276	276	501	501	501	276	276	276
Number of group(country)	37			23			37			23		

Robust standard errors in parentheses

+ significant at 10%; * significant at 5%; ** significant at 1%

Table 4: Effect of fiscal decentralization on total dead and affected with country and year fixed effect

	Dependent variable: total dead				Dependent variable: total affected			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	GLS	NB	GLS	NB	GLS	NB	GLS	NB
Sub National Revenue	-0.007	-0.006	-0.019	-0.023	-0.028	-0.018	-0.083	-0.014
	(0.009)	(0.010)	(0.013)	(0.023)	(0.020)	(0.012)	(0.035)*	(0.020)
Population Density	-0.130	0.013	0.032	-1.044	-0.701	-0.119	-0.286	0.192
	(0.077)+	(0.188)	(0.128)	(0.549)+	(0.184)**	(0.134)	(0.404)	(0.216)
GDP per capita	-0.031	0.326	0.251	-0.031	-1.215	-0.063	-0.946	-0.705
	(0.112)	(0.216)	(0.192)	(0.311)	(0.303)**	(0.161)	(0.541)+	(0.269)**
Ln(population)	0.361	1.010	0.538	2.104	0.532	0.707	1.373	0.968
	(0.068)**	(0.149)**	(0.103)**	(0.447)**	(0.188)**	(0.119)**	(0.305)**	(0.160)**
Number of disaster	0.670	0.120	0.505	0.094	1.388	0.144	0.742	0.077
	(0.035)**	(0.018)**	(0.046)**	(0.018)**	(0.082)**	(0.023)**	(0.106)**	(0.017)**
Democracy			0.015	-0.033			0.081	-0.033
			(0.028)	(0.023)			(0.076)	(0.022)
Ethno-Linguistic			0.445	-12.394			-3.407	-3.702
Fractionalization			(0.601)	(3.980)**			(1.731)*	(0.951)**
Constant	-4.187	-18.926	-9.764	-22.334	7.012	-11.518	-6.419	-8.908
	(1.519)**	(3.081)**	(2.283)**	(5.476)**	(4.234)+	(2.372)**	(6.459)	(3.325)**
Observations	500	481	276	272	501	484	276	275
Number of group(country)	37	32	23	21	37	33	23	22

Standard errors in parentheses

+ significant at 10%; * significant at 5%; ** significant at 1%

Table 5: Interaction between political and fiscal decentralization

	Dependent variable: total dead						Dependent variable: total affected					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	GLS	NB	ZINB	GLS	NB	ZINB	GLS	NB	ZINB	GLS	NB	ZINB
Sub National	-0.045	-0.026	0.021	0.232	0.150	0.070	0.041	0.001	-0.005	0.891	0.186	-0.002
Revenue (R)	(0.054)	(0.022)	(0.018)	(0.116)*	(0.064)*	(0.061)	(0.152)	(0.023)	(0.010)	(0.381)*	(0.078)*	(0.030)
State (S)	0.593	0.379	0.581				2.808	0.174	0.111			
	(0.507)	(0.183)*	(0.193)**				(1.586)+	(0.239)	(0.101)			
Municipality(M)				2.187	1.221	0.133				6.184	1.177	-0.001
				(0.865)*	(0.526)*	(0.560)				(2.955)*	(0.688)+	(0.281)
R x M				-0.223	-0.136	-0.023				-0.642	-0.130	-0.005
				(0.081)**	(0.046)**	(0.048)				(0.279)*	(0.054)*	(0.024)
R x S	-0.018	-0.016	-0.051				-0.261	-0.028	-0.003			
	(0.057)	(0.022)	(0.020)**				(0.175)	(0.024)	(0.010)			
Population Density	-0.599	-0.316	-0.172	-0.007	0.245	0.310	-1.163	-0.210	-0.033	-0.088	-0.053	-0.076
	(0.318)+	(0.100)**	(0.103)+	(0.760)	(0.500)	(0.404)	(1.266)	(0.139)	(0.061)	(2.013)	(0.403)	(0.196)
GDP per capita	-0.452	-0.112	-0.128	0.261	0.147	-0.412	-0.795	-0.084	-0.104	1.551	0.271	-0.096
	(0.341)	(0.105)	(0.098)	(1.090)	(0.544)	(0.419)	(1.147)	(0.140)	(0.060)+	(2.294)	(0.562)	(0.214)
Ln (population)	0.820	0.414	0.312	-0.043	-0.204	0.010	1.662	0.220	0.094	-0.103	-0.102	0.074
	(0.218)**	(0.072)**	(0.077)**	(0.590)	(0.439)	(0.332)	(0.778)*	(0.098)*	(0.042)*	(1.552)	(0.394)	(0.169)
Number of disaster	0.434	0.081	0.043	1.091	0.550	0.244	1.042	0.149	0.012	3.506	0.893	0.090
	(0.062)**	(0.015)**	(0.018)*	(0.127)**	(0.128)**	(0.088)**	(0.166)**	(0.032)**	(0.011)	(0.286)**	(0.186)**	(0.052)+
Democracy	-0.028	0.005	0.005	-0.285	-0.161	-0.072	-0.153	-0.004	0.009	-0.815	-0.167	-0.020
	(0.043)	(0.014)	(0.015)	(0.133)*	(0.075)*	(0.060)	(0.127)	(0.021)	(0.009)	(0.362)*	(0.098)+	(0.032)
Ethno-Linguistic	-0.855	-0.442	-0.307	-0.003	0.611	0.319	-5.925	-0.559	-0.195	-5.633	-1.179	-0.126
Fractionalization	(1.268)	(0.359)	(0.343)	(2.131)	(1.542)	(1.095)	(4.771)	(0.453)	(0.196)	(5.339)	(1.396)	(0.629)
Latitude	0.024	0.011	0.004	-0.004	-0.008	-0.003	0.032	0.005	0.001	0.031	-0.005	0.002
	(0.016)	(0.004)*	(0.004)	(0.022)	(0.010)	(0.008)	(0.062)	(0.006)	(0.002)	(0.052)	(0.013)	(0.005)
Elevation	0.000	0.000	0.000	-0.001	-0.000	0.000	-0.001	-0.000	0.000	-0.003	-0.001	-0.000
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.002)	(0.000)	(0.000)	(0.003)	(0.001)	(0.000)
Constant	-4.992	-3.781	-2.517	-0.205	0.711	2.332	-7.575	-0.179	1.821	-5.692	1.001	2.307
	(4.205)	(1.449)**	(1.346)+	(6.582)	(4.234)	(3.158)	(14.874)	(1.729)	(0.753)*	(16.379)	(4.053)	(1.726)
Observations	233	233	233	80	80	80	233	233	233	80	80	80
Number of group	19			10			19			10		

Robust standard errors in parentheses

+ significant at 10%; * significant at 5%; ** significant at 1%

Table 6: Interaction between political and fiscal decentralization with country and year fixed effect

	Dependent variable: total dead				Dependent variable: total affected			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	GLS	NB	GLS	NB	GLS	NB	GLS	NB
Sub National Revenue (R)	-0.010	-0.034	0.248	0.070	0.038	0.048	1.193	0.168
	(0.035)	(0.063)	(0.118)*	(0.122)	(0.108)	(0.045)	(0.300)**	(0.084)*
State (S)	0.420	1.028			1.069	1.000		
	(0.381)	(0.864)			(1.041)	(0.489)*		
Municipality(M)			2.307	2.150			8.045	0.684
			(0.843)**	(1.344)			(2.266)**	(1.044)
R x M			-0.237	-0.197			-0.788	-0.142
			(0.089)**	(0.100)*			(0.245)**	(0.072)*
R x S	-0.029	0.039			-0.132	-0.115		
	(0.038)	(0.066)			(0.110)	(0.050)*		
Population Density	-0.205	4.322	0.248	1.223	-0.457	0.316	2.612	10.077
	(0.179)	(0.951)**	(0.331)	(1.118)	(0.531)	(0.269)	(0.749)**	(0.751)**
GDP per capita	-0.229	0.494	0.137	-1.884	-1.437	-1.173	1.120	4.287
	(0.265)	(0.366)	(0.890)	(1.315)	(0.712)*	(0.346)**	(1.666)	(1.076)**
Ln (population)	0.711	3.246	-0.287	0.049	1.476	1.072	-1.696	6.510
	(0.136)**	(0.319)**	(0.464)	(0.948)	(0.374)**	(0.164)**	(0.929)+	(0.600)**
Number of disaster	0.436	0.081	1.150	0.649	0.677	0.059	3.550	0.797
	(0.051)**	(0.019)**	(0.091)**	(0.130)**	(0.121)**	(0.017)**	(0.260)**	(0.107)**
Democracy	-0.018	-0.011	-0.301	-0.146	-0.042	-0.061	-1.016	-0.309
	(0.035)	(0.023)	(0.126)*	(0.114)	(0.095)	(0.023)**	(0.254)**	(0.078)**
Ethno-Linguistic	-0.945	12.623	0.719		-5.332	-3.475	-1.030	37.997
Fractionalization	(0.816)	(3.484)**	(1.660)		(2.065)**	(1.173)**	(3.394)	(2.559)**
Constant	-6.708	-74.204	2.655	-2.707	-2.171	-7.655	7.408	-192.560
	(3.055)*	(0.000)	(4.415)	(1,948.431)	(8.501)	(4.514)+	(9.768)	(0.000)
Observations	233	232	80	80	233	232	80	80
Number of group(country)	19	18	10	10	19	18	10	10

Standard errors in parentheses

+ significant at 10%; * significant at 5%; ** significant at 1%

Table 7: Test of Riker's hypotheses: Age of party and Government fractionalization with country and year fixed effect

Dependent variable: total dead					Dependent variable: total affected			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	GLS	NB	GLS	NB	GLS	NB	GLS	NB
Sub National Revenue (R)	-0.042	-0.021	-0.001	0.010	-0.007	-0.030	-0.046	-0.039
	(0.026)	(0.027)	(0.017)	(0.035)	(0.067)	(0.021)	(0.046)	(0.027)
R x A	0.001	0.000			-0.005	-0.001		
	(0.001)	(0.001)			(0.002)+	(0.001)		
Party Age (A)	-0.007	-0.001			0.070	0.005		
	(0.017)	(0.010)			(0.046)	(0.013)		
R x F			-0.081	-0.020			-0.026	-0.003
			(0.034)*	(0.019)			(0.095)	(0.020)
Parliamentary system			-0.401	0.057			0.195	0.304
			(0.322)	(0.380)			(0.877)	(0.305)
Proportional electoral system			0.347	9.282			0.013	0.928
			(0.276)	(2.023)**			(0.751)	(0.405)*
Government			1.321	0.388			-1.036	-0.472
Fractionalization (F)			(0.621)*	(0.436)			(1.768)	(0.550)
Population Density	-0.205	-0.825	0.126	1.713	-0.971	-0.556	-0.796	-0.130
	(0.180)	(0.692)	(0.180)	(0.851)*	(0.523)+	(0.320)+	(0.557)	(0.272)
GDP per capita	0.061	0.073	0.244	0.941	-1.117	-0.740	-1.074	-1.204
	(0.214)	(0.374)	(0.247)	(0.445)*	(0.583)+	(0.280)**	(0.666)	(0.349)**
Ln(population)	0.643	2.204	0.574	4.443	1.525	1.332	1.154	1.072
	(0.141)**	(0.600)**	(0.134)**	(0.250)**	(0.382)**	(0.225)**	(0.380)**	(0.188)**
Number of disaster	0.487	0.085	0.486	0.103	0.707	0.067	0.878	0.072
	(0.052)**	(0.019)**	(0.053)**	(0.022)**	(0.117)**	(0.016)**	(0.131)**	(0.020)**
Democracy	0.004	-0.019	-0.002	-0.005	0.007	-0.030	-0.001	-0.006
	(0.043)	(0.025)	(0.044)	(0.034)	(0.110)	(0.022)	(0.122)	(0.042)
Ethno-Linguistic	-1.119	-15.074	0.815	-5.626	-7.964	-8.050	-3.216	-3.321
Fractionalization	(0.927)	(5.061)**	(0.891)	(4.780)	(2.621)**	(1.544)**	(2.869)	(1.210)**
Constant	-7.881	-23.697	-11.034	-88.219	-2.859	-9.143	0.173	-5.678
	(2.553)**	(7.580)**	(3.268)**	(0.000)	(7.050)	(3.598)*	(8.966)	(4.151)
Observation	227	222	219	218	227	222	219	218
Number of group(country)	21	18	19	18	21	18	19	18

Standard errors in parentheses
+ significant at 10%; * significant at 5%; ** significant at 1%

List of Countries

Algeria	Guatemala	Nicaragua
Bangladesh	Honduras	Nigeria
Bolivia	Hungary	Pakistan
Brazil	India	Panama
Cambodia	Indonesia	Papua New Guinea
Chile	Iran, Islam Rep	Peru
China	Kenya	Philippines
Colombia	S. Korea	Romania
Costa Rica	Madagascar	Russia
Cuba	Malawi	South Africa
Dominican Republic	Malaysia	Sri Lanka
Ecuador	Mexico	Tajikistan
Egypt	Morocco	Thailand
El Salvador	Mozambique	Turkey
Ethiopia	Nepal	Venezuela
		Vietnam

Correlation

	MUNICIPALITY	STATE	Sub National Revenue	Sub National Expenditure	Total dead	Total affected
MUNICIPALITY	1					
STATE	0.345	1				
Sub National Revenue	0.141	0.076	1			
Sub National Expenditure	0.007	0.361	0.80	1		
Total dead	0.025	-0.025	-0.053	0.039	1	
Total affected	-0.021	-0.040	-0.104	-0.040	0.279	1

Descriptive Statistics

Variable	Obs	Mean	Standard Deviation	Minimum	Maximum
Total Dead	547	471.96	6145.81	0	139469
Total Affected	547	599407.50	3212655	0	53600000
Number of Disaster	547	1.50	1.80	0	11
Sub National Revenue	500	7.69	5.90	0.47	23.71
Sub National Expenditure	500	12.63	9.92	1.60	37.45
STATE	547	0.36	0.48	0	1
MUNICIPALITY	547	0.76	0.42	0	1
Population (000)	547	27069.89	32366.50	1991.58	153699.20
Real GDP per capita	547	3791.73	2677.51	346.65	13637.80
Population density (person/km2)	547	150.04	235.11	5.40	1176.29
Elevation (meter above sea level)	547	724.17	605.15	85.46	2565.38
Absolute value of Latitude (degrees)	547	21.00	11.59	3.88	47.20
Democracy	375	4.87	3.57	0	10
Ethno linguistic Fractionalization	547	0.47	0.23	0.05	0.88
Parliamentary System	547	0.31	0.46	0	1
Proportional electoral rule	380	0.72	0.44	0	1
Government Fractionalization	509	0.17	0.28	0	1
Party age	471	32.47	30.36	1.5	188
Legal Origin (UK)	125	0.40	0.49	0	1
Legal Origin (France)	125	0.60	0.49	0	1

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