



# The Divergent Effects of Remittance Transfers for Post-Disaster States

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## Abstract

This paper asks how remittances flows, the value of which has increased substantially in the last 20 years, moderate disruptions in state capacity generated by rapid-onset natural disasters. Focusing specifically on earthquakes, we consider how remittances affect social welfare and unrest. We propose two causal pathways that reflect the complex effects both natural disasters and remittances have on states and societies. First, we argue that remittances can mitigate political instability by smoothing disruptions in individual consumption, which are most salient during times when states are struggling to supply public goods, as in the aftermath of natural disasters. Second, we argue that remittance flows can supply financial resources that empower dissident groups to mobilize protests and other anti-state action. Although these pathways appear conflicting, we contend that they stem from the same causal mechanism—income smoothing—which is an important refinement in existing research that reports contradictory findings. Our results are supportive of our theoretical argument and show that remittances can paradoxically improve social welfare while also heightening the conditions for social unrest.

**Keywords** Remittances · Earthquakes · Social stability · Income smoothing

**JEL Classification** F24 · O57 · Q54

## Introduction

In January 2010, a 7.0 magnitude earthquake hit the island country of Haiti, killing over 300,000 people, injuring another 300,000, and devastating administrative and economic infrastructure (DesRosches et al. 2011). In the aftermath, Haiti received over \$13 billion in post-disaster assistance from international agencies (CNN Editorial Research 2020) to recover from the initial devastation. But Haiti also received nearly \$1500 million in remittances from Haitians living abroad that year (World Bank 2017). Whereas disaster aid from international organizations were used for shelter, resettlement, and managing

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damaged critical infrastructure (DesRosches et al. 2011), these remittances provided direct cash-in-hand to people whose lives and livelihoods were destroyed by the disaster.

Many countries see an increase in remittance inflows in the aftermath of a disaster (Yang 2008). Given the significance these funds can have on the lives of those affected by natural disasters, this paper asks how remittances may affect disaster-impacted countries more broadly. We focus on earthquakes due to their rapid-onset characteristics, and illustrate how remittances magnify two forms of social stability that are affected by disasters: social welfare and political conflict. First, we argue that remittances improve public welfare by providing supplemental financial resources that individuals can draw on at a time when their governments are struggling to provide public goods and services. Second, we contend that remittances empower dissident groups to protest during the windows of opportunity created by natural disasters by reducing barriers to group action and financing collective mobilization. We posit that, because both natural disasters and remittances impact social and political stability (albeit in opposing ways) and because remittances tend to increase in the aftermath of a natural disaster, the two phenomena intersect in such a way as to magnify their disparate effects on social stability. In other words, because they increase after a natural disaster, remittances influence the conditions created by a natural disaster and thus its effects on social welfare and group mobilization.

In this paper, we show that remittances can be both beneficial to states by improving social welfare, and potentially harmful by agitating the political atmosphere in disaster-affected societies. We find that increases in logged remittances per capita reduces the levels of infant mortality in an earthquake-affected country, and that this effect persists through time. We also find that increasing levels of remittances per capita raises the risk of a protest or riot in democratic countries, whereas autocratic countries see no significant effect.

Our contribution is twofold. First, we posit income smoothing as the causal mechanism driving the effects of remittances on disaster-affected societies. This mechanism explains the apparently conflicting findings that remittances both enhance social welfare and increase discontent, and is an important refinement of existing research that reports contradictory findings. Second, we test our hypotheses on a global sample of countries, which distinguishes our approach from previous research that relies on single-case, regional, or subregional analyses or focuses on developing countries. Overall, and in light of growing concerns about the human security implications of climate change, the results of our analyses indicate complex short- and long-term relationships between remittances, natural disasters, and their effects on social stability, which would benefit from further research.

In sections one and two of this paper, we discuss the previous literature on how natural disasters and remittances affect state capacity and political instability and present a set of hypotheses on how remittances can moderate the impacts of natural disasters to affect aggregate measures of social welfare. Section three explains our research design. Section four presents our empirical results, highlights important findings, and discusses their substantive interpretations. Finally, we conclude with a summary of the study and possible directions for future research.

## Rapid-Onset Disasters and Their Effects on State Stability

Rapid-onset natural disasters, such as earthquakes, hurricanes, and floods, are destructive and often create significant vulnerabilities for economic development and individual well-being, including displacement, hunger, and disease (Nels and Righarts 2008). Thus,

rapid-onset events have garnered particular focus in the climate security literature.<sup>1</sup> The suddenness of these events typically defies the possibility of adaptation or advance planning. Consequently, they offer useful scope conditions to evaluate the effects of remittances, because it is this type of unplanned disruption in incomes we expect remittances to supplement (Yang and Choi 2007; Yang 2008).

Research shows that rapid-onset disasters are economically destructive (Oh and Reuveny 2010; Bergholt and Lujala 2012; Hsiang and Jina 2014), and their consequences are borne disproportionately by poorer countries and households (Hsiang et al. 2019; Lima and Barbosa 2019; Noy and Vu 2010; Cuaresma et al. 2008; Jakobsen 2012; De Haen and Hemrich 2007). Natural disasters also take major human tolls on countries that often extend for many years and even into subsequent generations (e.g., Hayward 2013; Abdul Mottaleb et al. 2013). Multiple studies have found that the trauma of exposure to such disasters by expectant mothers can exert effects on unborn babies, including lower birth weight (Torche 2011; Menclova and Stillman 2020; de Oliveira et al. 2021). This, in turn, has long-term effects on the babies' health and development that continue into adulthood (Mathews and MacDorman 2008; Pallotto and Kilbride 2006; Paneth 1995; Barker et al. 1993; Hales et al. 1991),<sup>2</sup> and have long-term implications for the economic performance of the country as a whole.<sup>3</sup> Evidently, the effects of natural disasters generally, and earthquakes specifically, on one's quality of life and economic wellbeing are quite severe and can continue to be felt long after the disaster has ended and the assistance exhausted.

These negative effects also manifest at the state-level. A country's capacity—including the quality of its public services, civil service, and policy implementation—to meet the challenges of a natural disaster, including management of post-disaster relief, is an important determinant of how long the effects of the disaster persist, even in highly vulnerable areas (Lin 2015; Pierre-Louis 2011; Sjöstedt and Povitkina 2017).<sup>4</sup> Moreover, natural disasters can expose the fragility and inadequacy of the state. Olson and Gawronski (2010), for example, find that poor government response to disasters lowers perceptions of the state's credibility and competence among citizens. The erosion of state capacity and legitimacy exposes governments to greater public scrutiny (Berrebi and Ostwald 2011) and creates focal points by which citizens can critically evaluate government competence (Wood and Wright 2015), thus increasing the risk of intrastate conflict and political violence. Flores and Smith (2013) find that poor management of a disaster increases the likelihood of protests and leader removal in democracies, while in autocracies, this effect is seen even in the absence of major damage and death.

Further, natural disasters offer disgruntled groups the chance to overcome their collective action problems as reconstructive efforts create spaces for people to organize (Apodaca 2017). Regarding earthquakes particularly, Brancati (2007) shows that they increase the risk of civil conflict in poor countries. She contends that this is due to an increase in disaster-driven scarcities, which generate competition among groups for satisfying first-order needs.

<sup>1</sup> See Beardsley and McQuinn (2009), Bergholt and Lujala (2012), Berrebi and Ostwald (2011), Brancati (2007), Nels and Righarts (2008), Slettebak (2012), Wood and Wright (2015).

<sup>2</sup> These include increased risk of diabetes and cardiovascular problems.

<sup>3</sup> See Caruso and Miller's (2015) study of the effects of the 1970 Ancash earthquake in Peru for an illuminating example on the long-term effects of earthquakes on fetuses and babies.

<sup>4</sup> For example, Cavallo and Noy (2009) note that Hurricane Ike killed just 7 people in Cuba but over 700 in Haiti, despite landing in a larger and more populated part of the former country. They attribute this to differences in policies and institutions between these countries.

However, these effects are disputed by some scholars, who argue that the effect of natural disasters on political instability is conditional on other factors (Omelicheva 2011; Nardulli et al. 2015; Slettebak 2012; Bergholt and Lujala 2012). Understanding what conditions mitigate the effects of natural disasters on conflict is thus a critical question in the field of environmental security. Until recently, existing research struggled to detail pathways by which natural disasters are transmitted into state-level political and economic outcomes (see Reinhardt and Lutmar 2022). In the next section, we offer one pathway by which these effects are transmitted by demonstrating the wide applicability of remittances as an income smoothing mechanism in disaster management.

## Remittances as Disaster Response

Remittances are person-to-person cash transfers that are typically used to smooth consumption in response to disruptions in personal income (Beaton et al. 2017). Research has shown that they are responsive to different kinds of income shocks across multiple contexts, being inversely correlated with household income and external shocks affecting recipients. This demonstrates their use to offset the family's economic downturns (Yang and Choi 2007; Gubert 2002). Other studies have shown that remittances are responsive to macroeconomic conditions like inflation (El-Sakka and McNabb 1999) and declines in GDP (Bouhga-Hagbe 2004; Gupta 2005), as well as political instability (Ajide and Alimi 2019).

During periods of acute financial and social instability brought about by exogenous circumstances—such as a natural disaster—remittances can serve as a vital lifeline, and their relative value is enhanced as economic conditions deteriorate. Gupta (2005), for example, finds tentative evidence that remittances to India increase during drought years, while Yang (2008) finds that in poor countries, hurricanes lead to an increase in remittances. Amuedo-Dorantes et al. (2010) find that in SIDS, remittances to disaster-affected countries continue to rise for six years in response to the disaster. Clarke and Wallsten (2003) find that in Jamaica, remittances to households increased in tandem with the damage inflicted in the aftermath of Hurricane Gilbert.

Further, as in the Haiti example, remittances differ from disaster aid in that the latter is often directed at broad services and infrastructure reconstruction, as well as those people most extremely affected by the disaster. Yet, there may be many others who are less affected but still require financial assistance due to the related income disruption and the reduction in available goods. Remittances thus represent direct aid that can be critical in smoothing consumption for families that will not be targeted by foreign aid organizations.

Many studies have established the positive impacts remittances have economically at both the individual- and state-level,<sup>5</sup> and some studies have also shown that remittances improve various human development indicators in receiving households, including children's education (Koska et al. 2013; Bredl 2011; Amuedo-Dorantes and Pozo 2010; Go 2009) and health outcomes (Azizi 2018). Additionally, remittances may be used to make up for deficiencies in public goods provision, such as drainage and sanitation (Adida and

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<sup>5</sup> Along with their positive impacts on individuals and households, remittances *prima facie* appear to have net positive impacts at the state-level, with many studies showing a positive link between receiving remittances and economic growth (Giuliano and Ruiz-Arranz 2009; Yang and Martinez 2006; Adida and Girod 2011).

Girod 2011). Given these effects of remittances on social welfare, we argue that there is an intersection between the effects of natural disasters and remittances on social stability. Natural disasters decrease human welfare, but remittances have an opposing effect. If remittances increase systematically in response to a natural disaster, they may mitigate the effects of that disaster. Thus, we posit that remittances are likely to have their most substantive impact shielding individuals from impacts of disaster on social welfare, mitigating its effects:

**HYP 1a:** Current remittance inflows improve social welfare in the immediate aftermath of rapid-onset natural disasters.

At the same time, some research shows that remittances may exert a negative effect on state capacity in the long-term. Governments in developing countries often rely on remittances as a method for shoring up and even funding public investment (Yang 2011). An overreliance on these external funds can cause chronic underinvestment in public services (Doyle 2015) or even directly substitute for public goods provision by the state (Ambrosius 2019), which erodes state capacity (Easton and Montinola 2016). This, in turn, may lead to persistent changes in a country's economy such as "Dutch Disease" (Acosta et al. 2009; Makhoul and Mughal 2013). Therefore, over the long-term, remittances may reduce the pressure on governments to provide public goods, leading to an atrophy of their capability to respond in times of crisis. Remittances may therefore generate outcomes analogous in their effects on governance to that of windfalls from foreign aid: perverting incentives to provide public goods more broadly. Therefore, we hypothesize that:

**HYP1b:** Past remittance inflows do not improve social welfare in the immediate aftermath of rapid-onset natural disasters.

Remittances may also affect public evaluations of a government's disaster management more broadly. Disasters can create focal points for collective mobilization, and the narrative surrounding the circumstances and management of natural disasters make them subject to capture by political entrepreneurs, which can exacerbate social unrest (Chaney 2013). This can be intensified when we consider that remittances may redefine citizens' relationships to the state by either crowding out or replacing its role in the social contract, which, in turn, can lead to a reevaluation of longstanding systems of political patronage (Pfütze 2014; Escribà-Folch et al. 2015, 2018). This is particular likely in countries where public spending is underprovided (Deonanan and Williams 2016).

Simultaneously, remittances help solve barriers to collection action by funding political organizers, whether through recruitment (Collier and Hoefler 2004), vigilantism and arms procurement (Ley et al. 2021), public messaging, intrastate travel, or other pecuniary inducements (Brinkerhoff 2011). Remittances may lower the costs of engaging in political expression for its recipients by attenuating their dependence on conventional income streams, thus altering their calculated opportunity costs (Weinstein 2005) and freeing them to engage in anti-state actions. At the same time, natural disasters expose government incompetence and generate windows of opportunity for civil disobedience by reducing state capacity (Wood and Wright 205). Thus, a natural disaster can motivate not only anti-government sentiment but also contentious political action, even as people attempt to recoup and rebuild from the disaster. For example, Flores and Smith (2013) find that poor management of a disaster increases the likelihood of protests and leader removal in democracies, while in autocracies, this effect is seen even in the absence of major damage and

death. Thus, in the context of natural disasters, we contend that the socially-enabling properties of remittances heighten the preexisting conditions for social unrest:

HYP 2: Current remittance inflows increase social unrest in the immediate aftermath of rapid-onset natural disasters.

## Research Design

We use country-year panel data from 1980–2019 to test our hypotheses on the conditionalized relationships between rapid-onset disasters, remittances, and their impacts on a country's aggregate levels social welfare and social unrest. We use two dependent variables to capture these outcomes. The first is the annual change in a country's *infant mortality rate* per 1,000 live births, derived from the World Bank's Development Indicators (World Bank 2021). Research shows that changes in infant mortality are a strong indicator of a country's ability to supply economic, social, and political stability (Abouharb and Kimball 2007; Preston 1975; Urdal 2005), and the overall health of the population (Reidpath and Allotey 2003).<sup>67</sup> Our second variable is the annual count of *riots and protests* from the Armed Conflict Location & Event Data Project (ACLED) 1997–2019 (Raleigh et al. 2010) to measure aggregate changes in social unrest.

There are three main explanatory variables for this analysis. The first is the *frequency* of an earthquake of 4.5 magnitude or higher as derived from the US Geological Survey's Earthquake Hazards Program (USGS 2019).<sup>8</sup> We also utilize the maximum reported earthquake *magnitude* in a given country-year as our second explanatory variable, since we assume that earthquakes with higher magnitudes will pose greater challenges to state capacity on average, but because we also assume that since their effects are cumulative, it is necessary to distinguish between their destructiveness and their frequency.

We focus on earthquakes as our primary measure of rapid-onset disaster for three reasons. First, while other rapid-onset disasters, such as storms and hurricanes, can be predicted and thus mitigated in different ways, for example by evacuating residents or preparing storm shelters, earthquakes are inherently unpredictable both in their timing and intensity. Thus, they represent a true test of a state's ability to manage disaster relief of the proximate effects of a rapid-onset event. Second, earthquakes occur both along fault lines and inter-plate, which makes their geographic coverage wide-ranging and more randomly distributed across countries, whereas hurricanes and storms cluster primarily along coastlines and small island nations where state capacity tends to be low and reliance on remittances is high (World Bank 2021). Finally, we choose earthquakes as reported from the USGS because these events best represent our scope conditions without the risk of

<sup>6</sup> In our Appendix, we also evaluate the robustness of our social welfare measure by substituting the annual change in *infant mortality rate* with a measure of annual change in *caloric intake* from the UN's Food and Agricultural Organizations Food Balance Sheets (FAO 2021).

<sup>7</sup> See Blaydes and Kayser (2011) on why caloric intake is a reasonable alternative measure of social welfare in the developing world.

<sup>8</sup> From a substantive perspective there are many places throughout the world that experience earthquakes on a daily basis that often go unnoticed and are relatively minor. In addition, from a methodological standpoint, the inclusion of frequent, irrelevant, low-level events runs the risk of generating misleading, statistically significant results by artificially improving the precision of our p-values. Thus, we do not consider low-level events in our *frequency* count measure and opt for a more rigorous test of our argument.

endogeneity created by a disaster declaration that is endemic in the coding criteria of datasets such as the Centre for Research On the Epidemiology of Disasters (EM-DAT) (2020). Given that our intentions are to avoid systematic bias in case selection and endogeneity with our dependent variables, we prefer earthquakes as our measure of rapid-onset events.<sup>9</sup>

We condition the effects of these disasters based on changes in our third explanatory variable, which is annual *remittances* from the World Bank's Development Indicators (2017) from 1980–2019, which are linearly interpolated to account for missingness gaps within panels. Because the size of remittance inflows varies quite substantially country-to-country, we normalize this measure by a country's population for cross-sectional comparability. We use the logged values of *remittances* per capita to account for the significant right skew in the distribution of the variable, as most remittance transfers are incrementally small on an annualized basis.

We also include a battery of controls to better account for the unobserved factors that may explain the relationships posited by our hypotheses. From Penn World Tables, we control for the logged *population* and logged *GDP per capita* (Feenstra et al. 2015), and from the World Bank we also control for *land area* in square kilometers. Research suggests that larger countries with lower-than-average economic development are more susceptible to the negative effects of natural disasters (Brancati 2007) and that these countries also are the recipients of more frequent remittance transfers due to lower levels of public investment and larger diaspora communities (Yang 2008). Because regime type has important effects on how disasters are managed (Wood and Wright 2015) as well as how remittances are transformed into collective mobilization (Escribà-Folch et al. 2015, 2018), we also control for a country's level of executive constraints based on Vreeland's (2008) coding of regime type, *xpolity*, using data from the Polity Project's Polity5 Annual Time Series 1946–2018 (Marshall and Jaggers 2009), which we employ as a measure of democratic governance. We choose this variable, which isolates executive constraints, because of arguments linking public demand for improved leader competency and accountability following natural disasters (see Wood and Wright 2015). Using the more traditional *polity2* measure in our models reveals roughly the same results.

We also control for the logged annual levels of humanitarian aid via the World Bank's (2017) *official developmental assistance (ODA)*, and logged *foreign direct investment*. In their study of SIDS, Amuedo-Dorantes et al. (2010) find that remittances decrease when foreign aid increases, suggesting that emigrants are strategic in their altruism. Moreover, because our theory posits a separate channel by which remittances can condition outcomes, it is important to isolate their effects from more aggregated and conventional methods of disaster assistance. We also control for the presence of *civil war* using data from UCDP/PRIO's 20.1 Armed Conflict Database (ACD) 1946–2019 (Gleditsch et al. 2002; Pettersson and Öberg 2020). Finally, as we have noted, the effects of remittances can be countercyclical, which may make them partially endogenous to socioeconomic conditions in the receiving country. Therefore, we lag our control variables by one year to better capture the temporal progression advanced in our theoretical arguments. Summary statistics and codebook for the variables used in our estimations are presented in Table A1 in the Appendix.

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<sup>9</sup> It is likely that our argument is most salient in the rarer instances where earthquakes cause significant numbers of fatalities, injuries, and economic damage. However, our scope conditions are focused specifically on the effects of remittances and we want to avoid any conflation with international disaster aid, which is likely to track with these high-profile events. This is important because the coding criteria of EM-DAT uses official disaster declarations for inclusion into the dataset. Because states have an incentive to overstate the negative effects of a natural disaster in order to receive international aid via a disaster declaration, we prefer USGS, which does not use this coding criteria.



Data limitations on these covariates constrain our sample size for testing Hypothesis 1a to approximately 3,700 observations from 124 countries, and approximately 1,000 from 75 countries for testing Hypothesis 2.<sup>10</sup> We use ordinary least squares regression for testing Hypotheses 1a due to the continuous nature of the dependent variable. For Hypothesis 2, we use a negative binomial estimation strategy because the data generating process approximates a count-process that has significant overdispersion (King 1998).<sup>11</sup> We first illustrate the effects of remittances and disasters absent the interaction terms, and then in sequential models we display the results of each tested hypothesis when using country and year fixed effects.<sup>12</sup> Due to concerns that earthquakes may nevertheless cluster in specific countries or locations, and because we recognize the real possibility of time-invariant, omitted variable bias, we prefer this estimation strategy because it isolates the effects of natural disasters separate from other geographic or climatic characteristics of countries. All estimations are conducted using STATA 16 SE.

## Results and Discussion

There results of testing each Hypothesis are displayed in Tables 1 and 2. However, because we are interested in evaluating how *remittances* condition the effects of earthquake *frequency* and *magnitude* on the dependent variables, we must investigate their relationships visually, as scholars have demonstrated that statistical significance in the coefficient of the interaction term does not mean the existence or absence of the interactive effect (Berry et al. 2010). Therefore, we illustrate the average marginal effects of the conditionalized relationships presented in the Tables in their respective Figure Sets.

Figure 1 displays the change in predicted probability of *infant mortality rate* based on a simulated one-unit change in *remittances* while holding earthquake *frequency* constant across a range from 0 to 100, with the remaining covariates fixed at their observed values. The results show that the effect of increasing *remittances* reduces the annual change in a country's *infant mortality rate* by approximately 3% when moving from 0 earthquakes in a given year to 70. It is important to note that although this annual frequency of earthquakes may appear large at first glance, we must remember that many earthquakes occur in regions that are sparsely inhabited and have no immediate effect or measurable impact on society. It is quite common for a country to experience hundreds of earthquakes in a year depending on its geographic circumstances<sup>13</sup> with few doing real damage. Because of this, we also examine the conditional relationship between earthquake *magnitude* and *remittances*,

<sup>10</sup> To address this issue, we explored three additional model specifications including: Huber-White robust standard errors, jackknife resampling, and bootstrap resampling using 500 iterations. In each instance these results are comparable to those reported here.

<sup>11</sup> We also run models using zero-inflated negative binomial regressions to account for the large number of nonevents year-to-year with regards to protests and riots and find no substantial differences in the results. A table and figure are available in the Appendix.

<sup>12</sup> For comparison across model specifications and to address concerns over heteroskedasticity, omitted variable bias, and measurement sensitivity (Hastie et al. 2009), we estimate these same models when clustering the standard errors of the estimates on the country and using only yearly fixed effects. We also test the robustness of our results by using alternative variable specifications. The results of these analyses are presented in the Appendix.

<sup>13</sup> The BBC (2021) reports the recent eruption of Iceland's Fagradalsfjall volcano on March 19, 2021 followed more than 40,000 earthquakes in the preceding three weeks.



**Table 1** Hypothesis lab empirical results

Variable	Current year			Three-year lag			Five-year lag		
	Native model (t)	Frequency interaction (t)	Magnitude interaction (t)	Native model (t-3)	Frequency interaction (t-3)	Magnitude interaction (t-3)	Native model (t-5)	Frequency interaction (t-5)	Magnitude interaction (t-5)
		(t)	(t)		(t-3)	(t-3)		(t-5)	(t-5)
Logged remittances pc	.11** (.033)	.11** (.034)	.179*** (.045)						
Logged remittances pc (t-3)				.095*** (.025)	.095*** (.026)	.117*** (.035)			
Logged remittances pc (t-5)							.118*** (.026)	.118*** (.026)	.147*** (.036)
Remittances pc* Frequency	0 (0)								
Remittances pc* Magnitude									
Remittances pc* Frequency (t-3)					0 (0)				
Remittances pc* Magnitude (t-3)									
Remittances pc* Frequency (t-5)								0 (0)	
Remittances pc* Magnitude (t-5)									
Earthquakes	.001 (.001)	-.003 (.004)	.001 (.001)	.001 (.001)	0 (.003)	.001 (.001)	.001 (.001)	.001 (.003)	-.008 (.007)
Magnitude	-.014 (.035)	-.015 (.035)	-.264* (.105)	.018 (.028)	.018 (.028)	-.052 (.082)	.021 (.03)	.021 (.03)	-.068 (.0085)

**Table 1** (continued)

Variable	Current year		Three-year lag		Five-year lag		
	Native model (t)	Frequency interaction (t)	Native model (t-3)	Frequency interaction (t-3)	Native model (t-5)	Frequency interaction (t-5)	Magnitude interaction (t-5)
IMR (t-1)	-1.15** (.005)	-1.15** (.005)	-0.73** (.005)	-0.73** (.005)	-0.81** (.005)	-0.81** (.005)	-0.81** (.005)
Logged population (t-1)	-6.041** (.587)	-6.111** (.59)	-3.643** (.499)	-3.648** (.501)	-4.082** (.545)	-4.083** (.547)	-4.107** (.545)
Logged GDP pc (t-1)	-7.74** (.227)	-7.35** (.227)	-1.08 (.19)	-1.08 (.19)	-1.89 (.203)	-1.88 (.203)	-1.71 (.204)
Logged FDI (t-1)	-2.37** (.078)	-2.34** (.078)	-0.19 (.064)	-0.19 (.064)	.005 (.067)	.005 (.067)	0 (.067)
Logged Aid (t-1)	-3.23** (.086)	-3.31** (.087)	-2.5** (.073)	-2.51** (.073)	-2.17** (.08)	-2.17** (.08)	-2.2** (.08)
XPolity (t-1)	-0.92** (.02)	-0.91** (.02)	-0.62** (.016)	-0.62** (.016)	-0.62** (.017)	-0.62** (.017)	-0.64** (.017)
Civil war onset (t-1)	-1.01 (.237)	-0.97 (.237)	-0.22 (.192)	-0.21 (.192)	-0.47 (.2)	-0.47 (.2)	-0.46 (.2)
Land area							
Constant	113.063** (10.313)	114.176** (10.349)	64.276** (8.794)	64.372** (8.821)	74.227** (9.579)	74.252** (9.612)	74.788** (9.592)
Observations	3709	3709	3546	3546	3368	3368	3368
R-squared	.146	.146	.103	.103	.105	.105	.105

Standard errors are in parentheses  
 \*\*  $p < 0.01$ , \*  $p < 0.05$ , +  $p < 0.1$

**Table 2** Hypothesis 2 empirical results

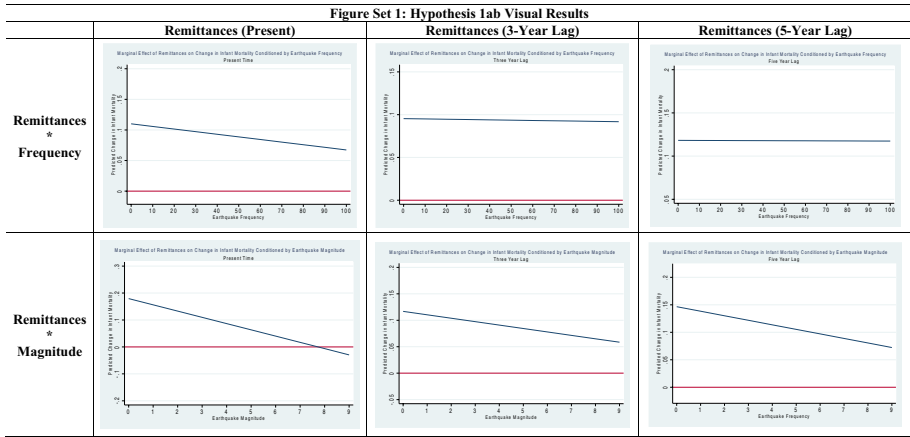
Variable	All countries				Democracies only				Autocracies only					
	Naïve model		Magnitude interaction		Naïve model		Frequency interaction		Naïve model		Frequency interaction		Magnitude interaction	
		Frequency interaction		Magnitude interaction		Frequency interaction		Magnitude interaction		Frequency interaction		Magnitude interaction		Magnitude interaction
Logged remittances pc	.002 (.021)	-.007 (.021)	-.016 (.023)		.074+ (.042)	0.668*** (0.049)	.585** (.045)		-.056 (.099)	-.016 (.443)	.079 (.138)			
Earthquakes	.002+ (.001)	.026** (.01)	.002 (.001)		-.001 (.002)	0.011 (0.014)	.004* (.002)		.205 (.879)	1.721 (148.234)	.244 (2.064)			
Magnitude	-.008 (.014)	-.005 (.014)	.091 (.064)		-.02 (.021)	0.028+ (0.015)	.562** (.095)		.185 (.271)	-.308 (14.315)	-.032 (1.421)			
Remittances pc*		.002* (.001)				0.001 (0.001)				.129 (9.046)				
Earthquakes			.009 (.006)				.068** (.01)							
Remittances pc*														
Magnitude														
Logged population (t-1)	-.153* (.068)	-.155* (.068)	-.157* (.068)		.225+ (.13)	-1.99*** (0.075)	1.311** (.116)		.304 (.339)	.013 (.964)	.042 (.802)			
Logged GDP pc (t-1)	.039 (.024)	.04 (.024)	.039 (.024)		.114* (.046)	0.091 (0.06)	-1.29** (.213)		.391 (.297)	.066 (.456)	.353 (.275)			
Logged FDI (t-1)	.123** (.037)	.117** (.036)	.123** (.036)		.138* (.063)	0.063 (0.059)	.34** (.048)		-.144 (.409)	-.254 (1.008)	-.267 (1.27)			
Logged Aid (t-1)	.103+ (.054)	.115* (.054)	.115* (.055)		-.268* (.13)	-0.063 (0.116)	-266 (.219)		-.299 (.301)	-.08 (.73)	-.354 (.856)			
XPolity (t-1)	.014 (.01)	.012 (.01)	.013 (.01)		-.014 (.02)	-0.064** (0.021)	.171** (.018)		-.166+ (.087)	.079 (.141)	-.137 (.128)			
Civil war onset (t-1)	.14+ (.085)	.149+ (.083)	.141+ (.084)		.147 (.119)	0.087 (0.098)	.383** (.081)		4.591 (235.323)	3.174 (8367.623)	4.772 (189.254)			
Land area	0+	0*	0*		0	0***	0**		0	0*	0			

**Table 2** (continued)

Variable	All countries			Democracies only			Autocracies only		
	Naïve model	Frequency interaction	Magnitude interaction	Naïve model	Frequency interaction	Magnitude interaction	Naïve model	Frequency interaction	Magnitude interaction
Constant	.697 (.991)	.542 (.987)	.471 (.994)	(0) -2.081 (1.796)	(0) 40.361	(0) 1.5 (3.557)	(0) -48.964** (5.265)	(0) -46.158 (6172.423)	(0) -47.922 (59.348)
Observations	1004	1004	1004	422	422	422	141	141	141

Standard errors are in parentheses

\*\*  $p < 0.01$ , \*  $p < 0.05$ , +  $p < 0.1$



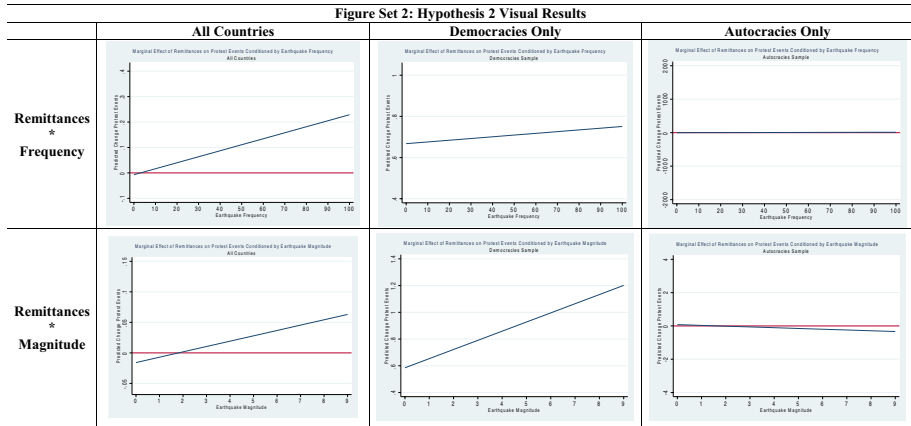
**Fig. 1** Hypothesis 1a visual results

which is also displayed in Fig. 1. Here we see that the substantive impact of increasing remittances is meaningful for reducing the *infant mortality rate* only at earthquake magnitudes of less than 5, losing statistical significance at larger values. However, the size of the effect is larger, reducing change in *infant mortality rate* by about 10%.

Figure 1 also shows the results from testing Hypothesis 1b, where we interact both three and five-year lags of *remittances* with earthquake *frequency* and *magnitude*. Recall that Hypothesis 1b considers the substantive effect of *remittances* over the long-term, which we theorized leads to the sustained erosion of public goods provision as governments increasingly replace them with private financing. However, this expectation is not supported by our results. Instead, the effect of *remittances* in reducing impacts of earthquakes only strengthens over time and is more effective at high *magnitude* (i.e., severity) rather than *frequency*. A one-unit change in the 3-year lag of *remittances* reduces a country’s annual change in its *infant mortality rate* by approximately 4% when moving from no earthquake to a magnitude of about 6. Similarly, when using the year 5-lag of *remittances*, we can expect an approximate 7% reduction in a country’s annual change in its *infant mortality rate* moving from no earthquake to a magnitude of about 7.

Substantively, results shown in Table 1 and Fig. 1 demonstrate that that increasing levels of *remittances* help offset the negative impacts of earthquakes. Simply put, the longer individuals receive remittances, the better positioned they will be to withstand the negative impacts of a natural disaster. We suspect that this occurs because the sustained inflow of remittances over time enables recipients to accumulate the kinds of capital which would enable them to withstand the negative impacts brought about by a natural disaster. This includes investment in larger savings accounts, structural improvements to the home, and improved access to healthcare and proper nutrition (see Yang and Martinez 2006; Yang 2011; Adida and Girod 2011).

Interestingly, there appears to be an upper limit on the ability of *remittances* to protect recipients against severe events, because the results consistently show a loss of statistical significance at high values of both earthquake *frequency* and *magnitude*. This should not surprise us—we know that individual remittance transfers are often modest in their amounts, and there often exists a point at which the damage induced by a natural disaster is simply too much for any amount of cash transfers to overcome. It is also likely that severe



**Fig. 2** Hypothesis 2 visual results

events make it harder for recipients to access these transfers, for example by disrupting money transfer or banking operations.

Table 2 and Fig. 2 show the results from testing Hypothesis 2, which argues that the interaction of *remittances* on both earthquake *frequency* and *magnitude* should raise the incidence of riots and protests in affected countries. Existing research suggests divergent outcomes between democratic states and authoritarian states (Flores and Smith 2013). This finding is borne out in our analyses too as evidenced in the democracies-only graphs. Looking at values of earthquake *frequency* across the full sample of countries, we see that there is an increase in protest events of about 14% going from 40 earthquakes to the maximum for every increment increase in logged *remittances*. Once we split the sample, however, we find that there is an increase in these events only in democracies which begins at no earthquakes and increases minimally across the range of *frequency*. In autocracies, there is no effect. This result is stronger when looking at earthquake *magnitude*—here, we find no effect across the full sample of countries or the autocracies-only sample, but there is a strong positive effect of remittances in democracies. A one-unit increase in remittances increases the likelihood of protest events in democracies by almost double (~6% to ~12%) across the range of earthquake *magnitude*. That the conditioning effect of remittances is felt only in democracies goes against our expectations—Flores and Smith (2013), for example, argue that autocracies are more vulnerable to any shift in the status quo brought about by an exogenous shock regardless of its strength (magnitude). Thus, we should expect a stronger effect in autocracies rather than democracies, which offer formal channels to express grievances and affect political change. We suggest that this is because democracies offer greater opportunities for political expression, and an incumbent government may be less willing to deploy coercive force in the aftermath of a natural disaster in order to preserve its chances for retaining power/winning reelection. Autocratic countries, on the other hand, may have a stronger coercive force and be more likely to deploy it, discouraging protest more generally and particularly in the aftermath of a natural disaster, when people are already vulnerable.

Overall, the results for testing Hypothesis 2 are particularly notable because they suggest that the interaction between *remittances* and exposure to natural disasters creates a synergistic outcome in two dimensions. First, natural disasters provide opportunity for contentious political mobilization that did not exist prior to the event. Second, remittances

provide the additional resources for that mobilization by reducing the opportunity cost for political action.

## Conclusion

In this paper, we examined how remittances condition the effects of earthquakes on social welfare and political unrest. Our analyses show that remittances improve social welfare both in the immediate aftermath of the earthquake and over the long-term. It is important to recall that remittances are typically not saved, but consumed as they are received. These expenditures include not only satisfying immediate needs such as food, shelter, and energy, but also can serve as bridges to capital investments such as improvements to property structures and physical relocation to safer environments. We also showed that remittances increase the likelihood of social unrest, but only in democratic countries—autocracies do not see the same effects.<sup>14</sup>

Although these findings may appear conflicting, we contend that they stem from the same causal mechanism—income smoothing. First, remittances serve immediate needs to stave off the harmful effects of a natural disaster. Simultaneously, they agitate the existing political atmosphere in disaster-affected societies by enabling collective organization. Status quo we would expect people and governments to go about their business, but the suddenness of a rapid-onset disaster disrupts the normal order at the individual, community, and country level, creating the need for the infusion of outside monies to rebuild and recover while concurrently providing the opportunity, at least in the short-term, for agitators to agitate and for people to vent long-standing grievances in response.

These findings are important for several reasons. First, the effects of climate change are raising the value of remittances transfers because of their ability to hedge against the uncertainties and insecurities to personal welfare and employment. Thus, as the socioeconomic consequences of climate change accelerate, the importance of remittances as a tool for disaster management, particularly in poor and vulnerable countries, grows. Second, this study better clarifies the conditions under which scholars and policymakers can expect natural disasters to shape societal-level changes in public welfare and social instability. Current research has just begun to demonstrate the causal mechanisms that translate the effects of a natural disaster to state-level political and economic outcomes (see Reinhardt and Lutmar 2022). Our findings help demonstrate income smoothing as one mechanism, and that mechanism itself is a product not only of a country's institutional features but also its international socioeconomic linkages. Finally, these findings demonstrate the continuing need to explore the generalizability of this research to other sources of environmental insecurity, because the expected changes in the global climate will be uncertain and variegated (IPCC 2012). This requires scholars to test the veracity of established knowledge under as many scenarios and research designs as possible.

We recognize that there are some limitations to this study. First, we are using country-level measures based on data availability, but the posited effects of remittances at the state-level are difficult to observe in practice and may pale in comparison to broader macro-level characteristics such as regime type, competent governance, and favorable economic

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<sup>14</sup> The nature of our models does not allow us to capture variation across the range of regime types. Future research could explore this in greater depth.



conditions. We attempt to account for some of these issues via our included statistical controls; however, we concede that the process we identify also occurs at lower levels of aggregation. Unfortunately, because the data on cross-national remittances do not offer that finer level of measurement, we cannot directly observe the subnational processes we presume, but future research could gather this data.

From a policy perspective, our takeaway is that effects of natural disasters are not independent of the context within which they occur. While previous research has rightly identified the institutional setting as a critical factor, we demonstrate the importance of the international socio-economic framework in a highly interconnected world. Given that the economic impact of such disasters is increasing, our results suggest that the importance of remittances as source of income smoothing will rise in the future. Remittances now constitute a non-trivial source of foreign investment worldwide, and this paper's findings suggest that they are vital for blunting the consequences of exogenous economic disruptions from non-traditional security threats, including not only environmental disasters but also financial meltdowns and global pandemics. This makes them critical to our understanding of political science phenomena.

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**Author Contributions** Both authors contributed to the study conception and design, including material preparation, data collection, analysis, and drafting of the manuscript.

**Data Availability** The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request, and will be deposited in Harvard Dataverse within three months of the paper's publication.

## Declarations

**Competing Interests** The authors have no relevant financial or non-financial interests to disclose.

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