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Corruption, homelessness and disasters

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Abstract

Corruption is widely believed to contribute to homelessness following a disaster triggered by natural hazards, as it is known to weaken resilience, deplete resources and stifle recovery. We test the association between corruption and post-disaster homelessness using data from the Emergency Events Database and data on corruption in the construction sector from the World Bank's Enterprise Surveys. Using instrumental variables and other estimation techniques, we find that corruption is associated with significantly more people left homeless following disasters. Corruption in the construction sector appears to be driving this result. These findings underline the importance of tackling corruption and poor construction practices in vulnerable communities.

KEYWORDS
corruption, disasters, homelessness, natural hazards, post-disaster recovery

1 | INTRODUCTION

Though there is much research on corruption and disasters triggered by natural hazards, we lack statistical evidence linking corruption with homelessness following disasters. Yet, episodes from history suggest that corruption may play a significant role in exacerbating the problem. In Nicaragua, for example, approximately two-thirds of Managua's one million residents were left homeless following an earthquake. We do not know if corruption was responsible for the collapse of some of the buildings and how many people were left homeless as a consequence, but we do know that the highly corrupt government distributed scarcely any of the foreign aid it received, leaving much of the city centre

in ruins 20 years later.[i] We also know that the costs of homelessness are severe, with many studies finding that it exposes individuals to a greater risk of dying prematurely and suffering from serious health problems, along with many other social and personal costs (Fazel et al., 2014; Hwang, 2001).

Further attention should be given to understanding the potential role of corruption, even if partial, in contributing to the scale of such tragedies. For one, it can help us to understand whether the relationship is systematic or merely occasional. It can also help us to design better, more targeted interventions to limit the harm of corruption, especially in disaster-prone regions. Previous studies come very close to showing that corruption is responsible for homelessness. Ambraseys and Bilham (2011), for example, found that from 1990 to 2010, 83% of all deaths from building collapses in earthquakes occurred in especially corrupt countries. While their focus is on mortality, the potential for greater homelessness is implicit. This potential is also evident in an extensive literature that shows that corruption delays post-disaster recovery. Studies in this literature show that corrupt officials use disasters as opportunities to siphon off recovery funds (Leeson & Sobel, 2008; Nguyen, 2017; Nikolova & Marinov, 2017; Yamamura, 2014). When taken together with studies that show corruption degrades infrastructure and the built environment (Gillanders, 2014; Lehne et al., 2018), the balance of evidence suggests that corruption could be responsible for greater homelessness because it weakens resilience to disasters, drains resources and stifles recovery.

Despite the balance of evidence, we cannot find any research that tests the relationship between corruption and post-disaster homelessness, leaving a significant gap in our understanding of the scale of the problem. To test this relationship, we use data on homelessness from the Emergency Events Database (EM-DAT) and data on corruption from the World Bank's Enterprise Surveys, a series of representative surveys of private firms. The Enterprise Surveys contain broad aggregates of corruption perceptions and experiences, as well as more specific measures of corruption in the construction industry. This level of detail allows us to draw more reliable conclusions from our data, as it allows us to examine the correlation of post-disaster homelessness with both general corruption and corruption in the construction industry.

Using instrumental variable and other estimation techniques, we show that corruption in the construction sector is associated with homelessness following disasters across 42 countries between 2006 and 2016. Once we control for corruption in construction, our proxy for the general level of business corruption is statistically insignificant. Moreover, the scale of this association is substantial—a 1% increase in the share of firms who have paid a bribe in relation to construction is associated with a 15% increase in the number of homeless people following a disaster. These findings underline the importance of fighting corruption to prevent needless harm and displacement, particularly in the construction sector, where failures in planning, policy and building inspections can put lives at risk.

Our research design is sensitive to how corruption is measured. Many studies use Transparency International's Corruption Perceptions Index, which is based on expert perceptions of corruption, while others point to the limitations of this indicator, arguing that it is prone to perception biases (Fan et al., 2009; Reinikka & Svensson, 2006; Svensson, 2003 and Treisman, 2007) and is slow to keep up with recent developments (Kenny, 2009; Knack, 2007). The Enterprise Surveys redress some of these concerns, as they are based on firm-level experiences of corruption rather than perceptions. A further contribution is that our data include most types of disasters linked to natural hazards, while existing studies tend to focus on earthquakes, which make up only 8% of our sample.

This article is organised as follows. We first describe the literature on corruption and its impact on disasters, identifying key lessons and motivating our argument on the link between corruption, construction and homelessness. Next, we explain our methodological approach and present our estimates of the association between corruption and homelessness. We conclude with some implications for the literature and suggestions for targeted interventions to strengthen disaster relief efforts.

2 | CORRUPTION AND DISASTERS

Many studies show that corruption, the abuse of public power for private gain, worsens the effects of disasters. For one, it delays recovery, as relief funds are a prime target for corrupt officials. Leeson and Sobel (2008), for example, showed that for each additional $100 per capita in the United States' federal relief, state-level corruption increases by nearly 102%, on average. The same pattern is evident in other contexts too, with increased corruption in local government (Nguyen, 2017; Nikolova & Marinov, 2017), the public sector (Yamamura, 2014; Escaleras & Register, 2016),[ii] emergency relief distribution chains (Rahman et al., 2017) and among elites in general (Takasaki, 2011). The findings of this impressive literature hold across a range of data sources and time periods, as well as experimental and quasi-experimental settings. Moreover, scholars have deepened our understanding of the different pathways at work: Wenzel (2020), for example, showed that after severe droughts, corruption preys on larger aid inflows in the developing world, while corrupt officials tend to target governmental relief payments in the developed world. In summary, there is good evidence that corruption is a direct and immediate threat to relief efforts.

While corruption poses an immediate threat, some research suggests that disasters help to bring people together, engendering selfless behaviour and greater cooperation (Fisman & Miguel, 2007; Seppala, 2012).[iii] It is possible, therefore, that previously corrupt officials may temper their demands for relief funds. However, researchers in the field of corruption studies are skeptical of this claim, emphasising that incentives do not go away, even after catastrophic events that tear at the fabric of society. For example, while there was a reduction in the propensity of UN diplomats to accumulate (but not pay) fines for parking violations following the terrorist attacks of 9/11, this was a short-term response (Fisman & Miguel, 2007). Corruption, by contrast, is often a long-term and endemic problem, which is notoriously difficult to eradicate. Backsliding is easy, and the long-term effects may outweigh any possible short-term reprieve from pro-social behaviour following a disaster.

As we already mentioned, many studies show that corruption has a severe impact on resilience to disasters. Escaleras et al. (2007) found that corrupt countries suffer more after major earthquakes, and Ambraseys and Bilham (2011) showed that there are more deaths from building collapses in earthquakes in corrupt countries.[iv] Yet more studies found that there is a strong link between corruption and the quality of the built environment (Gillanders, 2014; Lehne et al., 2018). Like us, most of the studies in this literature define corruption as the abuse of entrusted power for private gain (Mungiu-Pippidi, 2020, p. 99). Alternative definitions often focus on structural and systemic types of corruption. These alternatives are not to be dismissed—there is no single universally accepted definition of corruption. Nevertheless, our preferred definition is particularly useful in this context because it allows us to identify potentially corrupt business-state interactions that may undermine the integrity of the built environment.

With corruption causing weaknesses in basic physical structures and facilities, more individuals are likely to suffer homelessness following a disaster. Of course, corruption is just one of a range of factors that may contribute to homeless, which is a complex and multifaceted problem, but there is nevertheless a significant gap in our understanding of the scale of the problem. In the next section, we consider some of the mechanisms at work, focusing specifically on how corruption in the construction sector may give rise to homelessness following disasters.

3 | CORRUPTION, CONSTRUCTION AND DISASTERS: THE MECHANISMS

As the previous section suggests, corruption worsens the impact of disasters by weakening resilience, draining resources and stifling recovery. There are several channels through which it might increase homelessness. When a disaster strikes, corruption weakens state capacity to provide shelter and protect the victims of disaster, as a greater portion of the relief funds are effectively stolen. Individuals who experience a disaster will need support. Hunt (2007) noted that individuals who experience misfortune, such as a disaster, have a greater demand for public services such as emergency accommodation. As a consequence, disasters may trigger a vicious circle, increasing corruption as more people seek help and must pay bribes to receive it. To extract maximum bribes,

corrupt officials will under-provide public services, by delaying provision or restricting access in order to increase the number of payment opportunities.

Even before disaster strikes, more corrupt places suffer from weaknesses in basic infrastructure, including buildings, roads and power supplies. Kenny (2007, p. 1) noted that corruption in the construction sector can be particularly harmful, leading to low-quality planning, construction methods, building maintenance and inadequate health and safety. Gardiner (1985, cited in Chiodelli & Moroni, 2015, p. 438), explored the weak points in planning systems, arguing that the potential for corruption is greatest in land-use and building regulatory systems. He suggests that the public officials who are responsible for planning and zoning are critical, as they must decide which projects can be built in which locations. Gardiner also emphasised the importance of building inspectors, who must decide whether to enforce compliance with building code violations. If these officials become corrupted, whole neighbours might be built in unsafe areas such as flood plains, and building inspectors may systematically turn a blind eye to unsafe structures.

More generally, corruption tends to misallocate society's resources in different ways, as well as distort the framework within which decisions are taken. For example, Apergis et al. (2010) argued that a strong association between corruption and inequality at state-level in the United States exists because corruption is responsible for misallocating society's resources away from education, health and other pro-poor redistributive efforts (Apergis et al., 2010). If corruption affects homelessness following a disaster, a key question is whether the effect is driven by the broad societal impact of corruption on a range of outcomes, or more specifically by corruption in the sector responsible for providing houses. Within this sector, corruption affects the speed, quality and fairness of rebuilding and rehousing, which are mediating factors in the relationship between corruption and post-disaster homelessness. Corruption may prolong homelessness because houses will not be built. It may undermine the quality of the housing stock through poor-quality construction techniques, poor-quality material and poor-quality design. As we have argued, we expect corruption in the construction sector to dominate other modes of corruption because it is more likely to yield structures that are vulnerable to disaster. We have catalogued several ways in which corruption might affect the built environment and the quality of the housing stock. Above all, a single corrupt official with the powers to control land use has the potential to cause a major disaster, such as granting permission for a large number of houses to be built on a flood plain. This hypothetical example illustrates the potentially extreme cost of corruption in a single economic sector.

In summary, the literature suggests that corruption is likely to increase homelessness following a disaster. More precisely, it presents strong evidence that corruption will have an immediate impact on recovery efforts, with corrupt officials targeting funds earmarked for recovery. But, it also suggests a pernicious effect on homelessness, with corruption weakening resilience and draining societal resources long before a disaster has taken hold. What remains is to test whether there is a systematic relationship between indicators of corruption and post-disaster homelessness and discern whether this relationship is strong or weak.

4 | DATA AND APPROACH

In this section, we describe the data we use to examine the association between corruption and post-disaster homelessness and our statistical approach.

4.1 | Dependent variable

As explained above, while others have studied the effect of corruption or institutional quality on metrics such as the death toll or total damage from disasters, we are interested in the idea that corruption is associated with increased homelessness in the wake of a disaster. Our measure of post-disaster homelessness comes from the Emergency

Events Database (EM-DAT) compiled by the Centre for Research on the Epidemiology of Disasters (CRED). Our variable of interest is defined by EM-DAT as the 'number of people whose house is destroyed or heavily damaged and therefore need shelter after an event'.[v] EM-DAT is based on reports from UN agencies, NGOs, insurers, research institutions and press agencies, and the data are subjected to a rigorous process of review and updated at the end of each year as necessary.

EM-DAT covers disasters from 1900 onwards in which at least 10 people were killed, and or 100 people were affected, and or a state of emergency was declared, and or a call was issued for assistance from the international community. There are methodological differences between EM-DAT and other leading data sources. In particular, EM-DAT uses a higher threshold for identifying disasters than the United Nation's DesInventar database, which defines a disaster as having occurred if there was 1 or more human losses or $1 or more in economic loss. As such, both sources can give a different picture of the scale of disaster or losses in a country (Osuteye et al., 2017). However, EM-DAT's collection of data related specifically to people made homeless following a disaster makes it our preferred source. DesInventar contains data on the number of houses destroyed but not specifically on the number of individuals made homeless. Other databases on building performance such as the Cambridge Earthquake Impact Database (CEQID) also lack information on the number of people made homeless.

In practice, our sample is constrained by the corruption data, as discussed in the next sub-section. The maximum sample size available to us is 73 disasters that occurred in 42 countries between 2006 and 2016. As we can see in Table A1 in the appendix, slightly under half of the disasters in our usable sample are floods, with storms accounting for another 22%. Earthquakes, the focus of much of the existing literature on corruption and damage/fatalities, make up only 8% of our sample. This difference should be borne in mind when making comparisons between the current study and the findings of others. Table A2 in the appendix shows the distribution of the 73 disasters across the 42 countries for which we have corruption data.

Table 1 reports summary statistics for the variables used in our analysis. The average disaster in our sample left 41 482 people homeless, though the standard deviation and the range are large. In light of this skew, and to facilitate interpretation, we estimate our models using the natural logarithm of the homeless variable as our dependent variable.

4.2 | Measuring corruption

To measure corruption, we employ two variables from the World Bank's Enterprise Surveys database. The Enterprise Surveys are representative firm-level surveys that have been conducted in countries around the world since the early 2000s. The surveys ask about firm operations and expectations and, of particular relevance to our study, about the likelihood of paying bribes in certain circumstances.

Firms are asked to indicate if they applied for a construction-related permit in the past 2 years and are asked if an 'informal gift or payment' was expected or requested. The percentage of firms that replied that such gifts were

TABLE 1 Summary statistics.

	Observations	Mean	Standard deviation	Min	Max
Bribery depth	73	21.1274	15.75026	0.8	65.2
Construction corruption	73	31.63973	19.0542	0	78.1
Number homeless	73	41 481.56	170 240.7	10	1 060 273
GDP per capita	73	3280.115	3496.601	225.6222	13 413.01
Rule of law	73	−0.69734	0.574016	−1.86438	1.33554

expected serves as our primary explanatory variable of interest. However, it is important to note that the surveys capture the interactions of the private sector with government rather than providing information on government embezzlement of funds. While some of the firms are in the construction sector, the majority of surveyed firms are in the manufacturing and services sectors. Their construction permits are unlikely to be related to residential property. The question also asks about construction permits and does not capture corruption in zoning and planning, both of which can lead to increased risk for future residents. Our measure of corruption construction is thus an imperfect proxy, but we believe that it offers advantages over other measures. As noted above, a common limitation of quantitative corruption studies is their reliance on metrics of corruption perceptions. It is plausible that the experts who feed into the Corruption Perceptions Index are biased in different ways. For example, they may be influenced by the outcomes of disasters, associating disaster-prone regions with greater corruption irrespective of the evidence on the ground. We would also argue that public officials who take bribes in relation to commercial construction are also likely to act corruptly in relation to residential construction. Given the nature of corruption and its corrosive effects on norms and behaviours (Fisman & Miguel, 2007), a culture of corruption is unlikely to be contained in one specific area of responsibility, or modality, of construction regulation for long.

To more precisely examine the theoretical mechanisms suggested by the literature, we also include, separately and alongside the corruption in construction proxy, the depth of bribery in general. This is the percentage of public transactions where a gift or informal payment was requested. The transactions considered here include tax, licensing and utility connections. This approach to measuring corruption has some nuances and limitations. In particular, our corruption indicators represent corruption from the point of view of doing business in a country, as they come from business surveys. There is also the problem of how to illicit truthful responses from these businesses. Why should a business respond to a question about whether an 'informal gift or payment' was expected or requested, particularly if they have some legal liability? To deal with this problem, the survey asks questions in the following form: 'We've heard that establishments are sometimes required to make gifts or informal payments to public officials to "get things done" …' The phrase 'get things done' and 'establishments' help to reduce the respondents' concerns about whether they are implicated in any wrongdoing. In sum, no existing method or indicator on its own can capture all aspects or forms of corruption. But despite their limitations, well-designed surveys can capture valuable information about corruption in specific areas such as the business environment.

4.3 | Basic model

To investigate the hypotheses developed above, we estimate models of the form:

$$\ln Homeless_{ijt} = \alpha_0 + \beta_1 Corruption_{it} + \beta_2 \ln GDPPC_{it} + \beta_3 RL_{it} + \gamma_j + \delta_i + \varepsilon_{ijt}$$

where the subscripts *i*, *j* and *t* denote country, disaster and year, respectively. *Homeless* is the EM-DAT measure of post-disaster homelessness. *Corruption* is either the Enterprise Surveys bribery depth variable, the corruption in construction variable, or both. *GDPPC* is real GDP per capita, and *RL* is the World Banks' Rule of Law index, which takes values between −2.5 and 2.5. Both of these latter variables were obtained from the World Development Indicators database.

We control for GDP per capita in line with work that has argued that economic development brings with it greater disaster readiness and response capability (Kahn, 2005; Toya & Skidmore, 2007). Kahn (2005) showed that institutional quality is a significant predictor of the death toll from so-called 'natural' disasters. To allow for government accountability and responsiveness, we also control for institutional quality, as measured by the World Bank's Rule of Law index. We also allow for unobserved country-specific effects, δ_i, and disaster type fixed effects, γ_j.

4.4 | Endogeneity of corruption and disasters

The extent of corruption and the fallout from disasters are likely to be endogenous. While we can allow for unobserved time-invariant common causes of both with our country fixed effects, it remains possible that the intensity of the disasters suffered by a country will give rise to corruption. The aftermath of a disaster often features large sums of discretionary spending that must be decided and acted upon quickly with little opportunity for oversight. Discretion and a lack of accountability have long been argued to be key contributors to the emergence and escalation of corruption (Klitgaard, 1988). Barone and Mocetti (2014) argued that disaster-induced corruption can serve as a mechanism through which earthquakes can lower economic growth. Moreover, while Hunt (2007) found only weak evidence that Peruvian disaster victims are more likely to face bribery demands, she does find that people who suffer misfortune in other contexts are more likely to be targeted. Similar targeting of the vulnerable is evident in relation to poverty (Justesen & Bjørnskov, 2014). Thus, a significant association in our OLS model may simply reflect that disasters render more people homeless and thus vulnerable to predation by corrupt officials, rather than a causal effect of corruption on homelessness.

Therefore, we also estimate two-stage least squares models in which we utilise first-stage instruments that have been shown to influence corruption. Our first instrument draws on the seminal work of Brunetti and Weder (2003). These authors demonstrate that countries with more press freedom are also generally countries that are less corrupt. This is motivated by the idea that a free press has an economic incentive and opportunity to expose corrupt behaviour. To operationalise this, we make use of the Reporters without Borders index, which is created from expert assessments and data on acts of violence and repression. In our context, the assumption is that whatever effect press freedom has on the extent of post-disaster homelessness manifests itself only through an effect on corruption. We acknowledge that this is quite a strong assumption as a free press may influence government spending on reconstruction.

As an alternative, we draw on the literature that examines gender differences in the willingness and opportunity to engage in corruption. Several studies have found that women are less likely to be involved in corruption. For example, Dollar et al. (2001) found that countries with more women in positions of power are less corrupt while Breen et al. (2017) made use of the Enterprise Surveys data and found that firms with female owners or managers are less likely to pay bribes. While this is far from a universal finding and cultural context is important, it is explicable by different levels of risk aversion in men relative to women (Croson & Gneezy, 2009) and the fact that, in many countries, women tend not to have access to the 'old boys' networks that potentially corrupt men can leverage. The results of Breen et al. (2017) suggest that the extent to which women participate in business ownership—measured in the Enterprise Surveys by the question 'are any of the owners female?'—will have explanatory power for the Enterprise Surveys corruption variables. The assumption we require for this to serve as a valid instrumental variable in our context is that the effect of female involvement in the ownership of small and medium firms on post-disaster homelessness occurs entirely through an effect on corruption. Again, this is arguably a strong assumption to make as female business leaders may be more willing to donate to charity and reconstruction in the wake of a disaster (Williams, 2003). While both instruments yield very similar results, our instrumental variable results should be interpreted with caution and we refrain from making causal claims.

5 | RESULTS

As we argue above, two broad sets of theories link corruption to an increased vulnerability to disaster-induced homelessness. Firstly, the distortionary effect of corruption on policy and income distribution could generate a larger number of vulnerable people. Secondly, corruption in the construction sector could generate poorly planned, built and maintained housing stock. In this section, we present evidence that points to the latter of these mechanisms as being the dominant force linking corruption to increased homelessness in the wake of a disaster.

5.1 | OLS results

Table 2 presents our simple OLS results controlling for both country-specific and disaster-type effects. Column 1 tells us that overall corruption is associated with an increase in the number of people left homeless following a disaster though this relationship is only significant at the 10% level. Column 2 uses the proxy for corruption in the construction sector. As argued above, theory suggests that this sector is a particular source of risk in terms of a country's resilience to disaster-induced homelessness. Not only is this relationship statistically significant at more conventionally satisfactory levels, but the magnitude of the estimated association is appreciable. A 1% increase in the share of firms who have paid a bribe is associated with a roughly 15% increase in the number of homeless people following a disaster.

Finally, Column 3 includes both metrics of corruption in the same specification. While these variables are highly correlated ($r = 0.82$), it is a worthwhile exercise to attempt to disentangle their relative importance. The results point to construction corruption as the winner of this 'horse race' exercise. Once corruption in this sector is controlled for, the general level of corruption has no predictive power for our homeless variable. We conclude that the explanatory power of the overall depth of corruption is, in large part, driven by the incidence of construction-related corruption.[vi] In this final specification, the control variables are significant. As one might expect, stronger institutions are associated with lower levels of post-disaster homelessness. The finding that richer economies incur more homelessness in the wake of a disaster may at first seem spurious but is in line with the finding of Kellenberg and Mobarak (2008) that the disaster risk associated with flooding increases until a GDP per capita of approximately $5,000. This threshold level of economic development is, as can be seen in Table 1, well above the average in our sample.

Taken together, our OLS findings suggest that, in terms of the countries and disaster types covered by our sample at least, the second theoretical mechanism has more support. Corruption in the construction sector is associated with appreciably more homeless people in the wake of a disaster.

TABLE 2 Main results.

Dependent variable: Natural log of number homeless			
Model	**(1)**	**(2)**	**(3)**
Bribery depth	0.157*		−0.289
	(0.079)		(0.178)
Construction corruption		0.140***	0.311**
		(0.046)	(0.114)
Natural log of GDP per capita	2.245	12.493	27.234*
	(11.727)	(10.834)	(13.873)
Rule of law	1.274	−13.495	−32.708*
	(13.040)	(12.640)	(17.027)
Constant	−15.063	−104.288	−225.851*
	(92.493)	(87.181)	(112.836)
Country dummies	Yes	Yes	Yes
Disaster-type dummies	Yes	Yes	Yes
Number of observations	73	73	73
R squared	0.774	0.811	0.831

Note: Standard errors are in parentheses.
***Statistical significance at 1% level.
**Statistical significance at 5% level.
*Statistical significance at 10% level.

TABLE 3 Instrumental variables.

Panel A: Second stage results					
Dependent variable: Natural log of number homeless					
Model	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Bribery depth	0.456***		0.278***		−0.132
	(0.106)		(0.070)		(0.146)
Construction corruption		0.218***		0.211***	0.281***
		(0.039)		(0.049)	(0.075)
Natural log of GDP per capita	−9.478	18.283**	−0.545	15.868**	26.311**
	(12.012)	(7.799)	(7.064)	(6.705)	(11.551)
Rule of law	14.607	−24.786**	2.774	−20.011**	−36.177**
	(17.299)	(11.265)	(7.768)	(8.351)	(16.515)
Constant	72.044	−163.241**	0.808	−139.195**	−231.274**
	(102.116)	(66.979)	(55.331)	(55.347)	(98.351)
Country dummies	Yes	Yes	Yes	Yes	Yes
Disaster-type dummies	Yes	Yes	Yes	Yes	Yes
Number of observations	69	69	72	72	68

Panel B: First stage coefficients of interest						
Corresponding model in Panel A	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	
Dependent variable	Bribery depth	Construction corruption	Bribery depth	Construction corruption	Bribery depth	Construction corruption
Press freedom	1.597***	3.334***			0.853	3.763***
	(0.469)	(0.601)			(0.687)	(0.916)
Female ownership of business			0.664***	0.875***	0.435	−0.250
			(0.154)	(0.266)	(0.300)	(0.400)
Cragg–Donald *F* statistic	11.613	30.803	18.638	10.827	6.101	
GDP per capita and rule of law	Yes	Yes	Yes	Yes	Yes	Yes
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes
Disaster-type dummies	Yes	Yes	Yes	Yes	Yes	Yes

Note: Standard errors are in parentheses.
***Statistical significance at 1% level.
**Statistical significance at 5% level.
*Statistical significance at 10% level.

5.2 | Instrumental variables results

While as noted above, our instrumental variable strategy makes strong assumptions, Table 3 presents the results of our two-stage least squares models. Panel A reports the second-stage estimates of the relationship between corruption and homelessness, and Panel B presents the corresponding first-stage coefficients of interest. The first two

columns make use of the press freedom instrument. For both corruption variables, the instrument has satisfactory first-stage explanatory power, and the first-stage Cragg–Donald *F* statistic is greater than 10. Recall that larger numbers in the press freedom index indicate less press freedom. Therefore, our first stage regressions for models 1 and 2 tell us that press freedom reduces the depth of bribery in general and the occurrence of construction-related corruption, respectively. The second stage of these models supports our OLS results and our conclusion that higher levels of corruption are associated with a greater level of homelessness in the aftermath of a disaster. Our second instrumental variable, the share of businesses with female participation in ownership, also supports this conclusion. Once again, in both models 3 and 4, the instrument is significant in the first stage with high *t*-statistics. Interestingly, in our sample, greater female participation in ownership is associated with more corruption. This is likely due to differences between our sample and those used in other studies.

Finally, Model 5 repeats the 'horse race' specification from above and includes both corruption metrics simultaneously as endogenous regressors. As was the case with our OLS results, construction corruption emerges as a significant correlate of extra homelessness in the aftermath of a disaster, while the overall bribery depth variable is unimportant. A caveat to this conclusion is that in this specification, we cannot rule out the possibility that our model suffers from a weak instrument problem. Nevertheless, our instrumental variables approach supports the argument that corruption in construction is associated with a greater number of people left homeless in the wake of a disaster. We discuss the implications of this conclusion in the next section.

6 | CONCLUSION

Our research confirms that corruption in construction is associated with greater homelessness following disasters. This is consistent with a corrupt construction sector weakening resilience, depleting resources and stifling recovery. Our results suggest that the scale of the problem is large and that relatively small increases in corruption are associated with a large increase in the number of people made homeless following a range of disasters caused by natural hazards. The findings of our work are of particular significance in two key domains. From a policy perspective, it underlines the need to tackle corruption and poor construction practices in what are already vulnerable communities. Furthermore, from a disaster management stance, it highlights the need to mitigate the impact of corruption pre-disaster, plan for building collapse during the initial disaster response and factor significant levels of homelessness and displacement into long-term disaster recovery plans.

If we are to protect already vulnerable communities, housing and construction must be increasingly insulated from corruption. Mitigation measures such as stronger building codes, increased planning controls and the vesting of control in official, public-facing bodies are essential. These measures, coupled with increased visibility regarding planning decision criteria, and the criteria for the award of contracts should help to reduce the level of corruption which exists and reduce the impact of a disaster on the host community. These changes may also decrease the likelihood of a disaster in a given area. Poor planning and construction practices that result in inadequate drainage, interference with the natural waterways and so on may actually bring the disaster into the heart of these vulnerable communities.

However, such mitigation is slow to make a difference, must be considered within the overall context and is not meant as a substitute for other political and economic reforms. Until robust housing policy is in place, our findings support research that suggests that more effective disaster mitigation and disaster management is essential (Bullock et al., 2017. Pre-disaster planning should focus on educating vulnerable communities so they can identify early warning signals and evacuate while there is still time to move to safer ground. Planning for the immediate response should focus on urban search and rescue and the resources needed to underpin an effective response where the risk of failure in housing structures and critical infrastructure such as roads and power supply are likely. Finally, disaster response agencies, including the mechanisms in place under the UN and the EU, should be aware of the need to have housing modules in place in the most vulnerable countries or regions—which can be predicted using the methods outlined in this paper.

This research establishes a foundation on which future work can build. The link between corruption and disaster aid distribution needs further investigation, particularly with the trend towards aid in the form of cash. Due to data limitations, we cannot establish whether the longest lasting effect of corruption is the disappearance of relief and rebuilding funds, or the weakening of the built environment before a disaster strikes or sub-national variation in corruption and homelessness. In addition, further research on the role of networks of influence, particularly among construction companies and public officials, would be valuable. Also, our findings can only tell us about the event of being made homeless directly by a disaster and not how long people are homeless for, or homelessness more holistically conceived. Homelessness often persists through time and can be for shorter or long periods; it depends on aid and households' mobilisation of their social networks for recovery. Further research into these questions would also be valuable. Finally, there is a need to delve more fully into the impact of various types of corruption on community resilience and to apply research techniques that will allow for a more comprehensive analysis of the link between corruption indicators and the EM-DAT disaster data. For example, future research could investigate the impact of novel corruption indicators drawn from public procurement data or new techniques such as machine learning.

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DATA AVAILABILITY STATEMENT

Data and replications files are available from the authors on request.

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ENDNOTES

[i] This example is related to an earthquake that happened near Managua on the 23 December 1972. The social and political impact of this event is described in several sources, including Person, W.J., 1973. Earthquakes: September–October 1973. Earthquake Information Bulletin (USGS) 5, 23–24; New York Times, 1977. Nicaraguans Accused of Profiteering on Help the U. S. Sent After Quake, and The Los Angeles Times, 1992. 20 Years After Quake, Poor Still Live in Managua's Ruins [WWW Document], URL https://www.latimes.com/archives/la-xpm-1992-12-27-mn-5120-story.html (accessed 3.10.22).

[ii] Escaleras and Register (2016) found a strong relationship between predetermined natural hazards and public sector corruption in a sample of 75 countries between 1984 and 2009.

[iii] This research does not negate the reappearance of dissent and conflict in societies affected by disaster.

[iv] Studies that do not examine corruption specifically but examine the effects of general political and economic variables on disaster outcomes are also important and suggest the need to control for context. These studies find that richer nations suffer less (Kahn, 2005) and the poor disproportionately (Sakai et al., 2017).

[v] EM-DAT Glossary [WWW Document], n.d. URL https://www.emdat.be/Glossary (accessed 3.10.22).

[vi] Conceptually, both of these variables are measures of the same phenomenon. But empirically, we know that no measure of corruption is perfect and that including both variables in our regressions does not lead to econometric problems such as multicollinearity.

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APPENDIX

TABLE A1 Disasters by type.

Disaster type	Number	Percent	Cumulative percent
Earthquake	6	8.22	8.22
Flood	34	46.58	54.79
Landslide	7	9.59	64.38
Miscellaneous accident	4	5.48	69.86
Storm	16	21.92	91.78
Wildfire	6	8.22	100
Total	73	100	

TABLE A2 Disasters by country.

Country	Number	Percent	Cumulative percent
Afghanistan	2	2.74	2.74
Albania	1	1.37	4.11
Angola	3	4.11	8.22
Bangladesh	1	1.37	9.59
Bolivia	1	1.37	10.96
Brazil	3	4.11	15.07
Burundi	6	8.22	23.29
Chad	2	2.74	26.03
Chile	1	1.37	27.4
China	2	2.74	30.14
Congo (Democratic Republic of the)	4	5.48	35.62
Côte d'Ivoire	1	1.37	36.99
Ecuador	1	1.37	38.36
El Salvador	1	1.37	39.73
Gabon	1	1.37	41.1
Guatemala	1	1.37	42.47
Honduras	1	1.37	43.84
India	2	2.74	46.58
Indonesia	3	4.11	50.68
Iraq	1	1.37	52.05
Madagascar	2	2.74	54.79
Malawi	2	2.74	57.53
Mali	2	2.74	60.27
Mauritania	2	2.74	63.01
Myanmar	1	1.37	64.38
Nepal	1	1.37	65.75
Panama	1	1.37	67.12
Peru	2	2.74	69.86
Philippines	5	6.85	76.71
Russian Federation	2	2.74	79.45
Saint Vincent and the Grenadines	1	1.37	80.82
Solomon Islands	1	1.37	82.19
South Africa	2	2.74	84.93
Sri Lanka	1	1.37	86.3
Tanzania	2	2.74	89.04
Timor-Leste	1	1.37	90.41
Turkey	1	1.37	91.78
Ukraine	1	1.37	93.15
Uzbekistan	1	1.37	94.52
Venezuela	1	1.37	95.89
Viet Nam	2	2.74	98.63
Yemen	1	1.37	100
Total	73	100	