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Abstract

In this paper we investigate the long- and short-run relationships between disasters and societal trust. A growing body research suggests that factors such as income inequality, ethnic fractionalization, and religious heritage are important determinants of social capital in general, and trust in particular. We present new cross-country and panel data evidence of another important determinant of trust—the frequency of natural disasters. Frequent naturally occurring events such as storms require (and provide opportunity for) societies to work closely together to meet their challenges. While natural disasters can have devastating human and economic impacts, a potential spillover benefit of greater disaster exposure may be a more tightly knit society.

JEL-Code: O100, Q540.

Keywords: natural disasters, economic development, social capital, trust.

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I. INTRODUCTION

Beginning in the 1990s economists began to more carefully consider the potential implications of "social capital" for economic activity. As researchers sought to define and measure social capital, and then estimate its impact on economic growth, another related strand of research emerged. In this research, rather than examining the impacts of social capital on economic activity, researchers wanted to better explain the underlying factors that determined social capital. Researchers sought to understand why some countries (or communities) exhibited high levels of social capital, whereas others lack this important though difficult to quantify input to economic activity. There are now a number of published studies that quantify the role of social capital in economic development, as well as examine the underlying determinants of social capital.

One now widely accepted proxy for social capital, the level of societal trust, is typically measured using surveys and is now available for many countries. As noted by Bjørnskov (2006), measures of trust tend to be stable over time. For example, the work of Uslaner (2004) shows that the descendants of immigrants to the United States tend to exhibit the same level of trust as the current inhabitants of countries from which their ancestors came several generations earlier. These observations suggest that the level of trust within a given society/community is deeply embedded in its culture. Major disruptions such as the dismantling of communist societies (Bjørnskov, 2004) can have a significant effect on societal trust, but generally trust levels are stable over time. What then are the underlying determinants of societal trust? Bjørnskov (2004) offers an excellent summary of the empirical research on this topic, which points to factors such income inequality, ethnic diversity, and religion as important factors.

In this paper we offer an examination of another possible factor--the natural environment.

In particular, we consider whether the propensities for different types of natural disasters are determinants of societal trust. As a prelude to the full analysis, controlling for other factors found to be important determinants of trust, we find that countries with higher frequencies of storms exhibit higher levels of trust. We conjecture that preparations for and responses to storms require (and provide opportunity for) societies to engage in activities that lead to an appreciation of social capital; Ostrom (1999) suggests that social capital tends to appreciate with use.

There is a growing body of research on the economic implications of natural disasters. Of greatest relevance to the present study is the work that focuses on how disasters influence decision making. For example the work of Skidmore and Toya (2002) show that countries with higher levels of climatic disasters tend to have greater human capital accumulation, greater improvements in total factor productivity, and higher rates of economic growth. The recent work of Bjørnskov and Méon (2010) shows in a cross-country analysis that trust and factor productivity are positively correlated. Could the positive relationship between disasters and factor productivity observed by Skidmore and Toya (2002) be the result of increased societal trust induced by disaster events? We attempt to shed light on this question.

Specifically, using data from many countries we conduct both cross-sectional and panel data analysis of the relationship between societal trust levels and the frequency of natural disasters. Since nearly all of the existing research on country to country differences in trust levels uses cross-sectional analysis, we begin here. However, cross-sectional analysis is hindered by the potential for omitted variable bias and spurious correlations. We therefore extend this line of work by examining the relationship between disaster activity and trust over time using panel data methods. As a prelude to the full analysis, we find in both approaches that natural disasters, particularly storms, are positively correlated with societal trust.

The remainder of this paper is organized as follows. The next section offers a review of the most relevant literature. Section III presents data on natural disaster activity, trust, and other socio-political-economic information. In section IV, we present both the cross-country and panel data analyses, and section V offers concluding remarks.

II. LITERATURE REVIEW

The literature review is organized into two parts. The first portion of the review offers a discussion of the most relevant literature on the economics of natural disasters. As will become apparent, there are potential linkages between disaster propensities and long-run socio-economic activity, and thus a potential link to the formation of culture, social capital, and more specifically levels of trust. We then turn our attention to a discussion of the most relevant research on the determinants and impacts of social capital/trust.

Economics of Natural Disasters

Generally, the research on the economics of natural disasters can be divided into three categories: 1) the examination of factors the determine the degree to which natural disasters will lead to human casualties and economic losses; 2) the short-run impacts of disaster events on economic activity; and 3) the long-run societal implications of living in disaster-prone regions. Consider first the studies that consider the determinants of disaster vulnerability.

The degree to which disasters lead to human and economic losses when they strike depends on a variety of economic, social, and political factors. In his classic work, Wildavsky (1988) makes the case that increased income translates to a general increase in societal safety. According to Wildavsky (1988), the degree of safety citizens enjoy is a natural outcome of a growing market economy. In the context of natural disasters, a number of researchers document a general reduction in vulnerability as income increases. For example, Burton, *et al* (1993) show a modest inverse relationship between disaster-induced deaths and income. Tol and Leek (1999) suggest that there is a rapid transition between vulnerable and invulnerable that occurs in the development process. More recently, using detail information on disasters from OFDA/CRED, Kahn (2005) demonstrates that income and institutional quality reduce vulnerability to disasters. Using a similar framework to that of Kahn (2005), Anbarci, Escaleras, and Register (2005) find that greater income inequality increases earthquake fatalities. Toya and Skidmore (2007) add to this line of research by showing that higher levels of human capital, trade openness, and a more developed financial sector also reduce disaster vulnerability.

In a study of the 1995 Kobe, Japan earthquake, Horwich (2000) documents the importance of social institutions in providing disaster assistance. In particular, he noted the Japanese Mafia was particularly effective at providing assistance and distributing resources even as units of government suffered from paralysis immediately following the quake. Very recent studies by Escaleras and Register (2012), Toya and Skidmore (2010), and Skidmore and Toya (2013) show that decentralized government systems are more effective at limiting disaster-induced human casualties. Generally, these studies document the importance economic development, human capital, and the quality and nature of institutions in reducing societal vulnerability to natural disasters.

Another related literature has examined the short- and medium-run impacts of natural disasters on various aspects of economy activity. Tol and Leek (1999) offer an excellent review of the early studies that assess the immediate economic repercussions of natural disasters. The empirical findings in this literature (Albala-Bertrand, 1993; Otero and Marti, 1995; Dacy and Kunreuther, 1969) generally report that gross domestic product (GDP) increases in the periods immediately following natural disaster events. This increase is due to the fact that most of the damages caused by disasters are reflected in the loss of capital and durable goods; since stocks of capital are not measured in GDP and replacing them is, GDP tends to increase in periods immediately following a natural disaster. In recent years, economists again have taken an interest in natural disasters and there are now many studies that examine the short-run economic repercussions of natural disasters. Using panel and/or times series approaches, Raddatz (2007), Noy (2009), Raddatz (2009) Loayza, *et al* (2009), Fomby *et a* (2009) and Hochchrainer (2009) all find, in varying degrees, that natural disasters reduce economic growth, and this is particularly true for larger disasters.[2] Recent research by Cassar, Healy, and von Kessler (2011) shows how preferences for risk, time, and trust can change in the wake of extreme events. In particular, they use experimental methods to examine how preferences changed in Thailand following the 2004 Asian tsunami; their work shows that individuals affected by the disaster are more trusting, more trustworthy, and more risk-averse than subjects in similar communities not affected by the tsunami.

There are at least two studies that consider the medium-run impacts of natural disasters on economic activity, using cross-country panel data. Cavallo, *et al* (2009) offer an excellent analysis of how a large natural disaster event ripples through an economy in the short- and medium-run, showing that when a significant disaster strikes, negative impacts can be felt for years. Similarly, McDermott (2011) shows that disaster events can have lasting negative effects on human capital.

Taken together, the more recent analyses suggest that individual disaster events, particularly large disasters, tend to have negative short- and medium-run impacts on economic growth.

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[2] Fomby *et al* (2009) find that small disasters have a small positive effect. See Cavallo, *et al* (2009) for a more detailed review of this line of research.

While these studies are very useful, the use of panel data means that they examine effects of disaster *events* on various aspects of economic activity and not necessarily the longer-run social and economic implications of living in regions with higher *exposure* to natural disasters. Is there a difference between the impacts of disaster events vs. the impacts of greater disaster risk exposure? What are the implications of living in regions that regularly experience significant storms relative to regions where storms are rare? How might such exposure affect society/culture? The research that focuses on these longer-run implications is more limited.

One of the earlier studies that addresses the longer-run implications of living in disaster-prone regions is that of Skidmore and Toya (2002) who use a long-run empirical economic growth framework to examine the effects of higher levels of disaster propensity on economic growth. They suggest that natural disasters could have a positive effect on economic growth, stating:

> "We interpret past events as affecting the cultural mindset such that these experiences affect capital accumulation decisions as well as the propensity for the adoption of new technology."

In the framework they use, if natural disasters destroy physical capital more so than human capital, and if human capital externalities are present (Azariadis and Drazen, 1990), then disasters tend to raise the relative return to human capital. This in turn leads to greater human capital investment and thus a higher rate of long-run economic growth. They show empirically that places with higher levels of climatic disasters have greater human capital accumulation, total factor productivity, and economic growth. Skidmore and Toya (2002) also suggest that the disaster-growth connection might be the result of the Schumpeter's "creative destruction" process. The human capital accumulation effect was further pursued by Toya, Skidmore, Robertson (2010) who used natural disaster propensities as an instrument for human capital, thereby addressing the endogenous relationship between human capital accumulation and economic growth. The Toya, Skidmore, and Robertson (2010) article offered additional evidence of positive human capital externalities.

It is important to note, however, that even when controlling for human capital accumulation, Skidmore and Toya (2002) document and strong positive relationship between natural disaster propensities and total factor productivity. This relationship suggests that there are other possible routes by which natural disasters have a positive effect on economic growth that have yet to be identified. Further, there is a need to reconcile the observed negative effects of natural disaster *events* on growth observed in panel data with the observed positive effects of disaster *exposure* in a longer-run framework. In the present work we offer an evaluation that may help to reconcile these seemingly conflicting empirical results.

As a transition to the review of the research on social capital and trust, the recent work of Bjørnskov and Méon (2010) shows a strong positive relationship between trust and factor productivity. Skidmore and Toya (2002) document a strong positive relationship between climatic disasters and factor productivity. Taken together, these findings suggest a possible link between natural disasters and trust. Before we explore this possible link further, we offer a review of the most relevant literature on social capital and trust.

Social Capital and Trust

Over the last twenty years, a number of development and regional economists have focused their attention on the formation and importance of social capital in economic systems. Generally, social capital refers to the nature of social obligations, connections, and networks available to an individual in a given society (Bourdeiu, 1986). The review article by Sobel (2002) offers an excellent summary of the research on the various aspects of social capital. Of particular relevance to the present study is the work that examines differences across countries in social capital. While there are several measures of social capital such as membership in clubs, civic organizations, and other group activities that have been considered in this literature, a particularly useful measure that is highly correlated with other measures social capital is the degree of societal trust. The most commonly accepted measure of generalized societal trust in cross-country comparisons is obtained from this question on the World Values Survey: "In general, do you think that most people can be trusted, or can't you be too careful in dealing with people?"[3] The question is somewhat ambiguous and therefore makes it difficult for respondents to answer. However, for purposes of capturing culturally specific perceptions, it turns out to be a very effective measure of trust. For example, trust scores obtained from this question were good predictors of the number of wallets in each country that would be returned with its contents intact (Knack, 2001). According to the work of Lederman, *et al* (2002) and Uslaner (2002), trust scores are also an important determinant of corruption and violent crime. In addition, trust scores tend to be stable over time (Bjørnskov, 2006). In this context, the degree of trust exhibited within a society is deeply rooted within its culture.

There are now a number of studies that have sought to explain the variation in trust levels across countries. Broadly speaking, these studies point to income inequality, ethnic diversity, and religious composition as core determinants of societal trust.[4] For example, La Porta, *et al* (1997) and Berggren and Jordahl (2006) find societies with hierarchical religions (Catholicism, Orthodox Christianity, and Islam) are less trusting. Similarly, countries with greater ethnic diversity are sometimes found to exhibit less trust (Knack and Keifer, 1997). While income inequality is generally a robust determinant of trust, care must be taken with estimation and

[3] The respondent must choose between: "1-Most people can be trusted"; and "2-Can't be too careful".
[4] See for example La Porta, *et al* (1997) and Berggren and Jordahl (2007), Knack and Keefer (1997), Zak and Knack (2001), Uslaner (2002), and Bjørnskov (2006).

interpretation as income inequality is potentially endogenously determined.[5]

To date, none of the published studies within the economics literature have considered the role that the natural environment may play in determining societal trust. Is society influenced by the prevalence of natural disasters, and if so how? Intuitively, it seems reasonable to think that the forces of nature could influence cultural identity and mindset. On the one hand, a higher frequency of extreme events might overwhelm a given society and thus social capital could erode. On the other hand, Ostrom (1999) suggests that social capital tends to appreciate with use. In this sense, some types of natural disasters may provide an opportunity for individuals to work together to address their collective challenges. For example, consider a case where societies experience a high frequency of storms that affect entire regions and broad cross-section of society, regardless of social status. Addressing the challenges associated with regularly occurring storms in terms of *ex ante* preparations and *ex post* responses requires a collective effort, or the building of "bridging" capital (Putnam, 2000). As one anecdotal illustration, consider the significant changes in public education that occurred in New Orleans following Hurricane Katrina. For many years, leaders in New Orleans had been in conflict about how to improve the very troubled New Orleans school system. In the wake of Katrina leaders put aside their differences and came together and agreed to replace the school system with an entirely new structure.[6] As a result, educational outcomes have substantially improved. In a different context, using experimental methods Cassar, Heally, and von Kessler (2011) observed higher trust levels in Thai villages affected by the 2004 tsunami, relative to villages that were not affected by the

[5] For example, higher levels of trust could generate a sense of solidarity across income groups and thus create support of redistributive policies.

[6] In a Newsweek article, Recovery School District Superintendent Paul Vallas said "we used Katrina as an opportunity to build — not rebuild, but build — a new school system", http://news.yahoo.com/blogs/upshot/orleans-public-schools-stage-impressive.html.

tsunami.

The recent work of Bjørnskov and Méon (2010) shows in a cross-country analysis that trust and factor productivity are positively correlated. As highlighted earlier, Skidmore and Toya (2002) document a strong positive relationship between climatic disasters and total factor productivity. In this paper, we examine whether there is an observable relationship between natural disasters and trust using both cross-country and panel data analysis for many nations.[7] Before presenting the empirical results, we offer a detailed description of natural disasters and other data that we use in our analysis.

II. DATA ON NATURAL DISASTERS, TRUST, AND SOCIO-ECONOMIC FACTORS

Natural Disasters

Data on natural disasters come from the OFDA/CRED International Database (2012). The OFDA/CRED database is a result of collaboration between the Office of U.S. Foreign Disaster Assistance and the Center for Research on the Epidemiology of Disasters. Efforts to establish better preparedness for and the prevention of disasters have been a primary concern for donor agencies, implementing agencies, and affected countries. Demand for complete and verified data on disasters and their human impacts, by country and type of disasters has been growing. The OFDA/CRED initiative to develop a validated database on disaster impacts is a response to this need. OFDA/CRED has compiled data on the occurrences and effects of mass disasters in the world from 1900 to the present. OFDA/CRED makes a concerted effort to validate the contents of the database by citing and cross-referencing sources. OFDA/CRED also uses specific criteria for determining whether an event is classified as a natural disaster.[8] The database includes

[7] We use 74 to 133 countries depending data availability and specification. See Appendix D for list of countries.
[8] The reasons for taking into account a disaster are: 1) 10 or more people were killed; 2) 100 or more people were

information on number of events, damages, numbers affected, and deaths. However, for purposes of our analysis we are reluctant to use data on damages, number affected, and deaths from natural disasters for three reasons. First, data on these factors are not always available. More importantly, since total economic damages tend to increase with income, the damages caused by disasters may be endogenously determined. Similarly, numbers of people affected fall with income so that low-income countries experience far more human casualties and losses (Toya and Skidmore, 2007). Wealthy countries clearly spend more money on safety in terms of building codes, engineering, and other safety precautions, reducing deaths.[9] Finally, as noted by Albala-Bertrand (1993), the impacts of disasters are sometimes exaggerated in developing countries in order to secure international assistance. Thus, data on damages and loss of life are to some degree unreliable.

For the reasons described above, in our cross-country analyses we use the total number of significant events occurring in a country over the 1970-2000 period as our indicator of exposure to natural disasters[10]; the number of events is probably the best exogenous measures of disaster risk available. As a further precaution, in the cross-country analysis our trust scores are from the 2000—2010 period so that the measures of disaster propensities we use are for years prior to the trust score, our dependent variable. Similarly, in our panel analysis we used lagged disaster activity to reduce concerns about reverse causality. In the remainder of this paper, we focus on the total number of natural events normalized by the natural logarithm of land area since larger countries generally experience more natural disasters. However, using the unadjusted total

affected/injured/homeless, 3) significant damages were incurred; or 4) a declaration of a state of emergency and/or an appeal for international assistance was made.

[9] See Toya and Skidmore (2007) for empirical evidence on the relationship between the level of development and the effects of natural events.

[10] As we describe in more detail later, in our panel data analysis we consider changes in trust and disaster activity in five-year intervals using data for years between 1990 and 2010.

number of natural events yields qualitatively similar results. Summary statistics for these and all other variables used in our analysis are presented in Appendices A and B. Appendix C provides definitions and sources for all variables used in the analysis. Appendix D presents the list of countries used in our analysis.

We separate natural disasters into different types because the relative effects of each may differ. Some disasters may serve to divide and break down social networks, whereas others might provide opportunity to build social capital. Generally, we expect disasters that tend to have differential effects on sub-populations such as flooding (some social groups are highly exposed, whereas others are less exposed) would erode social networks and trust. On the other hand, other types of disasters effect different social groups more uniformly and thus may engender cooperation across social classes to address their challenges. Finally, we assume that embedded in culture is a general sense of the inherent risks associated with location.[11]

Countries experienced an average of about 21.8 disasters as recorded in the OFDA/CRED database over the 1970-2000 period. In our analysis, we consider storms, floods, earthquakes, mass movements such as landslides, and volcanic eruptions. In our sample, the most common types of disasters are floods and storms (extreme winds), accounting for 37 and 40 percent of the total number of disaster events, respectively. Earthquakes, slides, and volcanic activity account for the remainder. It may seem that storms and flooding tend to go together, but this is not necessarily the case. Flooding in one region can be the result of storm activity upstream; regular flooding in Bangladesh where 80 percent of the land area lies on a huge flood

[11] Some studies show that risk from natural disasters can have a substantial effect on economic activity. For example, Brookshire, Thayer, Tschirhart, and Schulze (1985) use data on home sales in Los Angeles and San Francisco areas to estimate the effects of home proximity to plate tectonic fault lines on home prices. Holding other factors constant, their results indicate that close proximity to a fault hazard zone reduces home values in the Los Angeles area by $4,650 (in 1978). This study provides evidence that home buyers in California use information on earthquake hazards to ascertain property values.

plain, much of which is only one meter above sea level. is one such illustration. In fact, many countries such as United States, Japan, Taiwan, Madagascar, and Fiji experience numerous severe storms but relatively little flooding, and vice versa (Indonesia, Brazil, Iran, Columbia, and Sri Lanka). However, the correlation coefficient between severe storms and flooding is 0.677, which is relatively high. Over the period of analysis, there is considerable variation in the frequency of natural disasters, with several countries experiencing more than 200 disasters over the period (United States, China, Philippines, and India) to countries with very few disaster events (Kuwait, Syria, Qatar, and Singapore). There may also be a concern that disaster propensities might be related to the level of development and thus indirectly related to trust levels. If disaster occur more frequently in poor nations where trust levels tends to be low, then any relationship between trust and disaster observed in the analysis could be spurious. Including measures of development as control variables may help in this regard, but it may not fully address this concern. However, in a recent study which use the same disaster data used in the present study, Kahn (2005) shows that probability of disaster occurrence is unrelated to the level of development. Thus, it seems that disasters are equally likely across the development spectrum, though clearly disasters have much larger impacts in developing countries.

We merge the disaster data with socio-economic and government data, which are available from several sources (Alesina, *et al*, 2003; Barro and Lee, 2010; Global Terrorism Database; Heston, *et al*, 2011; Indices of Social Development; La Porta, *et al*, 1999; Polity IV Project; and the World Income Inequality Database). The unit of analysis we use in our study is the country level, where we consider 3,799 disaster events from 86 to 105 countries (depending on data availability) over the 1970-2000 period in our cross-country analysis. Our measure of disaster exposure is the number of disasters over this period. Using this merged data set, we conduct empirical analyses to determine the relationship between disaster propensities and trust, while controlling for a range of other factors considered in previous studies. In the panel data analysis, we use data on trust, disaster activity and other socio-economic variable for 74 to 133 countries (depending on data availability) in four five-year intervals for years between 1990 and 2010.

Trust

Cross-country data on trust come from survey data reported in "Indices of Social Development". As described earlier, a commonly accepted measure of trust in cross-country comparisons is an indicator of generalized trust, which is available for numerous countries over a number of years.[12] This measure of trust is: 1) a good predictor of the number of wallets in each country that would be returned with its contents intact (Knack, 2001); 2) an important determinant of corruption and violent crime (Lederman, *et al*, 2002; Uslaner, 2002); and 3) tends to be stable over time (Bjørnskov, 2006).

Other Variables

In order to isolate the effects of natural disasters on societal trust levels, we include a number of other variables in our analysis that have been shown to be important in previous studies that examine the determinants of trust across countries. In particular, we include: religious composition (Protestant, Catholic, Muslim[13]); legal origin of government (English, French, German, Socialist[14]), initial levels of GDP per capita, income inequality, total years of schooling, ethnic fractionalization, degree of democracy, and the number of terrorist incidents.

As described earlier, relative to the omitted religion (eastern religions), countries with more

[12] Trust data from ISD is made from various sources See http://www.indsocdev.org/interpersonal-safety-and-trust.html for details.
[13] The omitted category includes the eastern religions like Hinduism, Buddhism, Confucianism, and so on.
[14] The omitted category is Scandinavian.

hierarchical religions such as Catholicism tend to be less trusting (La Porta, 1997; Bergren and Jordahl, 2000). We also include the legal origin of government using series of indicator variables for English, French, German, and Socialist origins. Relative to the omitted category (Scandinavian), we expect countries with these origins to be less trusting (Bjørnskov, 2006). As a control, we also include the initial GDP per capita (or the previous period's GDP growth in panel data estimates); previous studies show that trust tends to be higher in higher income countries, though caution in interpretation is in order as this relationship is likely endogenous. We also include the gini coefficient, a measure of income inequality, and total schooling years as a control for educational attainment. We expect countries with more unequal income distributions and less human capital to have lower levels of trust. We also control for the degree of ethnic fractionalization and the degree of democracy; in accordance with Knack and Keefer (1997); we expect greater fractionalization to result in lower levels of trust, whereas the effect of democracy on trust is expected to be positive, though again we must interpret the empirical estimates with some caution due to concerns about endogeneity. Finally, other shocks can have affect trust as well; we therefore include the number of terrorist incidents as another control variable. Our primary interest in this paper is to examine the effects of disasters on trust. We consider this broad set of control variables to determine the robustness of the coefficient on disasters.

Next we present our empirical analysis. We first offer a cross-country examination because the past empirical research on the determinants of trust is typically conducted in this fashion. However, cross-country analysis may suffer from omitted variable bias and/or spurious correlations and is therefore much more tenuous in terms of identifying causal relationships. Therefore, in the second part of the empirical analysis we examine the determinants of trust with panel data using a first-difference approach.

III. EMPIRICAL EVIDENCE

Cross-country Analysis

In this section we present estimation results that identify factors that are correlated with trust levels across countries, with a focus on the role of natural disasters. Our regression analysis is based on the following equation:

$$Trust_i = \beta_m (Disaster_{ij}) + \beta_n (y_{ik}) + e_i$$

where $Trust_i$ is the average trust score in country i, Disaster is equal to the natural logarithm of 1 + the number of events per the natural logarithm of land area in country i for disaster type j (storms, floods, earthquakes, mass movement, volcanic activity)[15], y_{ik} represents a vector of k variables that may determine the trust levels (e.g., religious composition, legal origin of government, GDP per capita, income inequality, educational attainment, ethnic fractionalization, degree of democracy, terrorist activity), and e is the error term. Some researchers do not view ethnic fractionalization or degree of democracy as appropriate explanatory variables in this type of cross-country analysis. However, we include these as well as other variables to examine the robustness of the disaster variables, the primary interest of the present work. All regressions are estimated using an ordinary least squares procedure with White's (1980) correction to ensure heteroskedastic-consistent standard errors.

The primary regression results are reported in Table 1. In column 1, we report a regression in which only the total number of disasters is included as an explanatory variable, and in column 2 we report results for a regression in which we include the different types of disasters. Recall,

[15] For some types of disasters in some countries, there were zero events. We therefore add one to all observations to avoid arithmetic error.

that depending on the characteristics of the disaster type, the ways in which society is influenced may be different. In columns 3-5 we incrementally include more control variables to examine robustness of the disaster coefficients.

Consider first the results reported in columns 1 and 2. In column 1 we see that the coefficient on the total number of disasters is statistically insignificant, and the regression explains none of the variation in trust levels. However, as reported in column 2 when different disaster types are entered into the regression separately, the coefficient on the number of storms is positive and statistically significant, whereas the coefficient on floods is negative and significant. The coefficients on the other disaster types are statistically insignificant. Note also that the disaster variables alone (column 2) explain about 13 percent of the variation in trust. Why might storms have a positive effect on trust, but flooding a negative effect? One possible explanation is that storms effect a population more uniformly and may engender cooperation across social classes to prepare for and respond to storms. Storms can and do affect rich and poor alike. On the other hand, floods often occur in low lying areas, places the lowest income groups can most easily afford to live. Thus, there are significant differences in the degree to which a flood affects the various social classes. In this context, it may be that regular flooding can divide rather than unite different groups of people. While this explanation is conjecture on our part, our hope is that this initial empirical exploration will lead to further research to better understand the underlying reasons for the potential differences in the effects of storms and floods on trust. As we discuss below, when we include additional control variables the statistical significance of the floods variables falls considerably, proving not to be robust. The panel data analysis offered in the next subsection will offer a further evaluation of this issue. The coefficients on the other disaster types are statistically insignificant; perhaps this is not too surprising given that storms and floods account for 77 percent of disaster activity, earthquakes, slides, and volcanic activity account for the remaining 23 percent; there may not be enough observations from which to generate precise coefficient estimates.

Turning to columns 3-5, we see that the coefficient on storms is very robust, though the size of coefficient is reduced as more explanatory variables are added to the regressions. The coefficient on floods is negative in all estimates, but statistically significant only in column 5, which is the regression with the most explanatory variables. We also report in Figure 1 a graph of the partial relationship between storms and trust using the column 3 regression. Figure 1 illustrates the strong correlation between storm propensities and trust levels. According to the regression results reported in column 3, a one standard deviation higher level of storm activity during the 1970-2000 period (about a 120 percent greater level of storm activity than the average in the sample) would increase trust levels during the 2000-2010 period by 0.035, or about 6.4 percent using the sample average trust level as the base. For context, the magnitude of this effect is somewhat larger than the effect of one standard deviation higher income inequality (see column 4 results); income inequality has been considered an important determinant of societal trust in earlier studies.

Consistent with previous work, a number of the control variables have statistically significant effects on societal trust levels. In column 3, we see that Protestant and Catholic populations tend to have lower levels of trust, relative to the eastern religions. Countries with greater Muslim populations have a greater level of trust.[16] Relative to countries with

[16] A number of Muslim countries are monarchies. Bjørnskov (2006) shows that countries ruled by monarchy tend to exhibit greater levels of trust. Thus, in estimates that are not presented but available upon request, we include a variable to indicate whether a country is a monarchy. However, the coefficient on the monarchy variable is statistically insignificant and the sign and statistical significance of the coefficient on the Muslim variable is maintained. Also, the inclusion of the monarchy coefficient does not materially affect the coefficients on the other variables.

Scandinavian legal origins, countries with English, French, German, and Socialist traditions are less trusting. Last, countries with higher levels of initial GDP per capita are more trusting, though caution is warranted with regard to assigning causality. In column 4, we add income inequality as a covariate. Consistent with a number of previous studies, greater income inequality results in lower levels of trust. Finally, in column 5 we also add , total schooling years, ethnic fractionalization, the degree of democracy, and terrorist incidents as explanatory variables, but with the exception of terrorist activity the coefficients on these variables are not statistically significant. In the case of terrorism, not surprisingly countries with more terrorist incidents are less trusting. Note that in all regressions the coefficient on storms is positive and statistically significant even when we add a wide array of variables used in previous studies. Finally, the adjusted R^2 in our most comprehensive regression is high for a cross-sectional analysis; the regression explains about 62 percent of the variation in trust levels.

To further examine the relationships between disaster propensities and trust, we divide our sample of countries into developed and industrialized countries, and estimate a series of regressions similar to those presented in Table 2. In columns 1 and 2 of Table 2, we present a basic regression and a regression that includes the full range control variables for the developing country sample. Columns 3 and 4 report a set of results similar to columns 1 and 2 except the industrialized country sample is used. Also, given the limited sample size, the column 4 estimates include the disaster variables, religion variables, legal origin variables and the natural logarithm of GDP per capita. The developing country estimates are very similar to the full sample in that the coefficient on storms is positive and statistically significant, and the coefficient on floods in negative statistically significant. Of the control variables, only the coefficient on proportion of the population that is Protestant, the gini coefficient of income inequality, and terrorist activity are statistically significant; a greater proportion of the population that is Protestant, income inequality, and terrorist activity are inversely correlated with societal trust. For the industrialized country sample (columns 3 and 4), of the storm and flood variables, only the coefficient on floods is statistically significant, indicating that greater flood activity results in lower levels of trust. However, also note that in the industrialized country sample countries with more volcanic activity tend to have higher levels of trust. Other than the positive and significant coefficient on the Protestant, Roman Catholic, and German Legal Origin variables, none of the other control variables are significant in this sample. Despite a limited sample size of just 23 countries, the adjusted R^2 is high: 0.38 in the regression with just the disaster variables, and 0.48 in the regression with the full set of explanatory variables.

As a further examination of robustness, we also use a procedure outlined by Krasker, Kuh, and Welsch [1983] to identify any potential outliers. However, the test results failed to identify outliers. Thus, the presence of influential outliers does not appear to be affecting our results. Generally, the range of estimates indicates fairly robust relationships between storms and levels of trust. Further, the magnitude of the effects are not inconsequential; our estimates indicate that disasters are equally or more important than income inequality, religious composition, and legal origins in determining levels of societal trust. While the cross-country analysis offers an examination that can be compared with previous studies on societal trust, the analysis this far offer only suggestive evidence of a relationship between disasters and trust. We now turn to an evaluation using panel data approaches.

Panel Data Analysis

While the cross-country regressions offer an initial exploration, identifying causal relationships is difficult with cross-sectional data. In this section, we offer an examination of *changes* in trust levels using panel data. The primary reason for the focus on cross-country variation in previous studies is because trust levels tend to be stable; there is relatively little within-country variation over time in societal trust. However, in light of the recent work of Cassar, Heally, and von Kessler (2011) and the cross-country correlations presented above, it seems prudent to further explore whether disaster activity influences societal trust using panel data. While it is true that societal trust levels tend to be stable over time, there is still some within-country variation—in this portion of our analysis we seek to identify the determinants of *changes* in trust over time.

Our panel regression analysis is based on the following equation:

$$Trust_{it} - Trust_{it-1} = \beta_m (Disaster_{ijt-1} - Disaster_{ijt-2}) + \beta_n (z_{imt-1} - z_{imt-2}) + c_i + t_t + \varepsilon_{it}$$

where $Trust_{it}$ is the average trust score in country i in periods t and t-1, $Disaster_{ijt}$ is equal to the natural logarithm of 1 + the number of events in country i for disaster type j (storms, floods, earthquakes, mass movement, volcanic activity)[17] in periods t-1 and t-2, z_{im} represents a vector of m variables that may determine changes in trust over time (e.g., , per capita GDP growth, changes in the degree of democracy, changes in income inequality, changes in educational attainment, and changes terrorist activity), c_i represents country fixed effects, t_t is set of a time period indicator variables, and ε_{it} is the error term. All regressions are estimated using a cluster approach in which standard errors are clustered at the country level to address temporal autocorrelation.

The equation represents a first-difference specification in which we control for both country and time effects. The time period covers 1990 through 2010 in which we consider four five-year time periods: 1990-1995, 1995-2000, 2000-2005, and 2005-2010. Also note that

[17] For some types of disasters in some countries, there were zero events. We therefore add one to all observations to avoid arithmetic error.

factors such as religious composition, legal origin of government, and ethnic fractionalization—variables that are typically included in cross-sectional analyses of trust—fall out of the first-difference specification because they are fixed over this period. We are therefore not able to include them in the panel analysis.

As reported in Table 3, all dependent variables enter in as lags to reduce concerns about reverse causality. In Table 4, we consider both lagged and contemporaneous dependent variables. For reference, in Appendix B we report summary statistics for the first-differenced variables.

Consider first the results reported in Table 3. In columns 1, 3, and 5, we include a single comprehensive measure of disaster activity. This lagged measure of disaster activity is the sum of all the types of disasters we consider in our analysis. Column 1 includes just the disaster variable, whereas column 3 includes per capita GDP growth, the number of terrorism incidents and the degree of democracy. In column 5 we add a measure of income inequality and educational attainment. The regressions reported in columns 2, 4, and 6 are similar to those in columns 1, 3, and 5 except that disaster activity is divided into storms, floods, earthquakes, mass movements, and volcanic eruptions.

Columns 1, 3, and 5 show that that the coefficient on the change in natural disaster activity is positive and highly significant. Further, the single disaster variable explains 38 percent of the within country variation in the change in trust. Breaking out the disasters into the five types increases the adjusted R^2 to 43.4. Adding covariates also increases the within adjusted R^2, but only marginally. Also, the other explanatory variables are generally statistically insignificant. Democracy, however, is negatively correlated with changes in trust, but is only significant in column 5.

While the coefficients on the control variables are certainly of interest, our main focus is on disaster activity. Indeed changes in disaster activity appear to be the dominant factor in changing trust levels; increases disaster activity subsequently results increased in societal trust levels. Columns 2, 4, and 6 show that of the five disaster types, storms and volcanic activity are the disaster types that have the greatest influence on trust.

In Table 4 we report a series of regressions in which the both current and lagged dependent variables are considered. These estimates show that past disaster activity is the more dominant determinant of changes in trust, though both the coefficients on current and past storm activity are statistically significant. The coefficient on current per capita GDP growth is also positive and statistically significant, though caution in inferring causality is warranted. While the coefficients on the other control variables are sometimes significant, none are robust across the specifications. What is important to note is that the disaster result is robust across all specifications.

This analysis offers new evidence suggesting that natural disasters, particularly storms, lead to statistically significant and substantial positive changes in societal trust. Given that storm activity is expected to accompany global warming, this relationship may prove to be increasingly important. Further, there is now a growing body of empirical evidence showing trust plays a critical role in economic development and governance. Increasing our understanding of the determinants of societal trust may enhance development efforts as well as inform disaster mitigation policies.

VI. CONCLUSIONS

In this paper we use cross-country and panel data analyses to examine the relationship between disaster propensities and societal trust. Our examination reveals a robust relationship between past storm activity and current trust levels in both the cross-country and panel data analyses. Flooding is also negatively correlated with trust in the cross-country regressions, but this result is generally not robust, and not present in the panel analysis. The panel data analysis reveals a strong positive relationship between trust levels and an overall measure of the previous period's disaster activity. We have greatest confidence in terms of identifying causal relationships in the panel estimates. This initial exploration offers evidence that natural disasters have a significant influence on culture. While researchers in anthropology, psychology, and sociology have considered the role of weather and climate in the formation of culture (see for example the work of Strauss and Orlove, 2003), economists may have something new to offer. In particular, economists bring more formal theoretical and empirical modeling that may shed new light on relationships between climate and the formation of social capital and in turn economic development. As evidence for climate change mounts, it will be increasingly important to consider the implications for society and culture.

In this study we offer new evidence on the formation of societal trust. In particular, we offer evidence showing that the frequency of disasters, particularly storm activity, is positively correlated with societal trust levels. In so doing, this research makes a contribution to understanding the underlying factors that determine the formation of social capital in general and trust in particular. We anticipate that additional research along these lines will offer new insights regarding these observed relationships. For example, it may be that particular disaster events such as a very severe storm could serve to erode both human (McDermott, 2011) and social capital. Similarly, research that considers how specific natural disaster events affect our preferences for risk and degree of trust will also be important.

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Table 1
Natural Disasters and Trust: Cross-country Regressions

Dependent variable: Trust

	1	2	3	4	5
Constant	0.497	0.511	0.220	0.392	0.515
	(29.480)	(34.629)	(2.928)	(3.743)	(4.726)
Log(1+Number of Total disasters adjusted by land area)	-0.001				
	(-0.099)				
Log(1+Number of storms adjusted by land area)		0.081	0.051	0.042	0.042
		(4.913)	(3.086)	(2.765)	(3.137)
Log(1+Number of floods adjusted by land area)		-0.104	-0.037	-0.031	-0.033
		(-3.966)	(-1.586)	(-1.513)	(-1.721)
Log(1+Number of earthquakes adjusted by land area)		0.016	-0.013	-0.014	0.008
		(0.479)	(-0.448)	(-0.490)	(0.298)
Log(1+Number of mass movements adjusted by land area)		0.032	-0.010	-0.010	-0.007
		(0.646)	(-0.213)	(-0.245)	(-0.169)
Log(1+Number of volcano Eruption adjusted by land area)		-0.033	0.039	0.041	0.036
		(-0.404)	(0.667)	(0.879)	(0.728)
Protestant population / total population			-0.129	-0.128	-0.118
			(-2.814)	(-2.381)	(-1.937)
Roman Catholic population / total population			-0.067	-0.053	-0.029
			(-2.575)	(-2.093)	(-1.251)
Muslim population / total population			0.071	0.047	0.028
			(2.525)	(1.196)	(0.670)
Legal origin, English			-0.136	-0.117	-0.095
			(-3.140)	(-2.258)	(-1.498)
Legal origin, French			-0.140	-0.128	-0.093
			(-2.963)	(-2.366)	(-1.479)
Legal origin, German			-0.089	-0.085	-0.065
			(-2.019)	(-1.701)	(-1.158)
Legal origin, Socialist			-0.115	-0.117	-0.124
			(-2.555)	(-2.325)	(-2.139)
Log (GDP per capita)			0.048	0.038	0.024
			(8.700)	(4.711)	(1.832)
Gini coefficient				-0.240	-0.323
				(-2.778)	(-4.162)
Total Schooling Years					0.009
					(1.452)
Ethnic Fractionalization					-0.031
					(-0.740)
Degree of Democracy					-0.003
					(-0.849)
Log(1+Number of Terrorism Incidents)					-0.009
					(-2.252)
Number of Observations	105	105	104	97	86
Adjusted R-squared	-0.010	0.133	0.577	0.587	0.619

Numbers in parentheses are t-values.

Table 2
Natural Disasters and Trust: Cross-country Regressions
Dependent variable: Trust

	Developing Countries		Industrialized Countries	
	1	2	3	4
Constant	0.486	0.460	0.599	0.558
	(27.50)	(3.902)	(63.09)	(1.543)
Log(1+Number of Total disasters adjusted by land area)				
Log(1+Number of storms adjusted by land area)	0.060	0.037	0.018	-0.003
	(2.694)	(2.101)	(1.313)	(-0.229)
Log(1+Number of floods adjusted by land area)	-0.071	-0.033	-0.059	-0.040
	(-2.514)	(-1.378)	(-2.547)	(-1.621)
Log(1+Number of earthquakes adjusted by land area)	0.030	0.013	-0.024	0.015
	(0.678)	(0.346)	(-1.156)	(0.675)
Log(1+Number of mass movements adjusted by land area)	0.006	0.008	0.015	-0.074
	(0.104)	(0.139)	(0.351)	(-0.939)
Log(1+Number of volcano Eruption adjusted by land area)	-0.058	0.068	0.122	0.191
	(-0.652)	(1.285)	(1.943)	(1.843)
Protestant population / total population		-0.171		0.074
		(-1.785)		(1.962)
Roman Catholic population / total population		-0.039		0.047
		(-1.141)		(1.431)
Muslim population / total population		0.040		2.081
		(0.725)		(1.598)
Legal origin, English		-0.011		0.012
		(-0.268)		(0.298)
Legal origin, French		-0.023		-0.011
		(-0.473)		(-0.286)
Legal origin, German				0.055
				(1.710)
Legal origin, Socialist		-0.039		
		(-1.123)		
Log (GDP per capita)		0.018		-0.001
		(1.319)		(-0.034)
Gini coefficient		-0.235		
		(-2.161)		
Total Schooling Years		0.009		
		(1.341)		
Ethnic Fractionalization		-0.064		
		(-1.173)		
Degree of Democracy		-0.002		
		(-0.626)		
Log(1+Number of Terrorism Incidents)		-0.010		
		(-1.995)		
Number of Observations	82	65	23	23
Adjusted R-squared	0.030	0.475	0.377	0.484

Numbers in parentheses are t-values

Table 3
Natural Disasters and Trust: Panel Regressions
Dependent variable: Change in Trust

	1	2	3	4	5	6
Log(1+Number of Total Disasters adjusted by land area) $_{t-1}$	0.084		0.091		0.084	
	(4.222)		(3.762)		(3.486)	
Log(1+Number of Storms adjusted by land area) $_{t-1}$		0.158		0.157		0.167
		(5.583)		(5.161)		(5.448)
Log(1+Number of Floods adjusted by land area) $_{t-1}$		-0.001		0.009		0.008
		(-0.033)		(0.379)		(0.301)
Log(1+Number of Earthquakes adjusted by land area) $_{t-1}$		-0.011		-0.011		-0.006
		(-0.407)		(-0.403)		(-0.217)
Log(1+Number of Mass Movements adjusted by land area) $_{t-1}$		-0.049		-0.020		-0.033
		(-1.084)		(-0.373)		(-0.594)
Log(1+Number of Volcanic Eruptions adjusted by land area) $_{t-1}$		0.216		0.231		0.187
		(1.974)		(2.023)		(1.704)
Per capita GDP Growth $_{t-1}$			-0.027	-0.046	-0.026	-0.050
			(-0.878)	(-1.589)	(-0.722)	(-1.407)
Log(1+Number of Terrorism Incident) $_{t-1}$			-0.005	-0.004	-0.006	-0.006
			(-1.289)	(-1.099)	(-1.478)	(-1.349)
Change in Degree of Democracy $_{t-1}$			-0.002	-0.001	-0.003	-0.002
			(-1.611)	(-1.110)	(-2.150)	(-1.439)
Change in Gini Coefficient $_{t-1}$					0.000	0.000
					(-0.631)	(-0.144)
Change in Total Schooling Years $_{t-1}$					-0.005	-0.008
					(-0.256)	(-0.398)
Number of Observations	322	322	295	295	235	235
Number of Countries	133	133	120	120	87	87
R-squared : within	0.382	0.434	0.441	0.486	0.482	0.530

Numbers in parentheses are t-values. Time indicator variables for each of the 5 year periods and country indicator variables are included, but not reported here.

Table 4

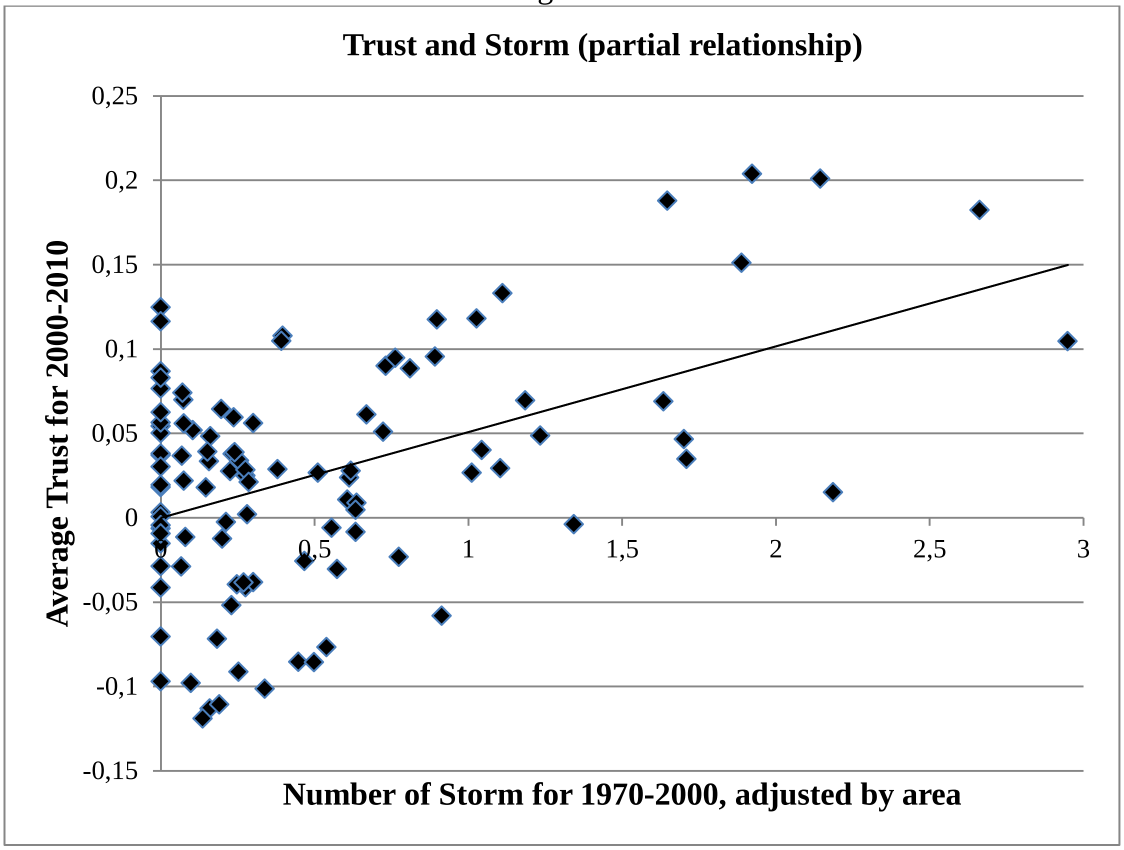
Current and Past Natural Disasters and Trust: Panel Regressions

Dependent variable: Change in Trust

	1	2	3	4	5	6
Log(1+Number of Total Disasters adjusted by land area) $_t$	-0.019		-0.019		-0.008	
	(-0.870)		(-0.949)		(-0.203)	
Log(1+Number of Total Disasters adjusted by land area) $_{t-1}$	0.089		0.077		0.106	
	(4.421)		(3.497)		(2.434)	
Log(1+Number of Storms adjusted by land area) $_t$		0.064		0.040		0.091
		(1.756)		(1.171)		(2.110)
Log(1+Number of Storms adjusted by land area) $_{t-1}$		0.181		0.144		0.245
		(5.343)		(3.945)		(4.447)
Log(1+Number of Floods adjusted by land area) $_t$		-0.034		-0.009		-0.013
		(-1.255)		(-0.362)		(-0.226)
Log(1+Number of Floods adjusted by land area) $_{t-1}$		-0.011		0.005		-0.010
		(-0.440)		(0.235)		(-0.196)
Log(1+Number of Earthquakes adjusted by land area) $_t$		-0.092		-0.087		-0.023
		(-2.005)		(-2.004)		(-0.428)
Log(1+Number of Earthquakes adjusted by land area) $_{t-1}$		-0.011		-0.021		-0.004
		(-0.302)		(-0.614)		(-0.106)
Log(1+Number of Mass Movements adjusted by land area) $_t$		-0.036		-0.023		-0.095
		(-0.630)		(-0.382)		(-1.228)
Log(1+Number of Mass Movements adjusted by land area) $_{t-1}$		-0.024		-0.015		-0.113
		(-0.499)		(-0.297)		(-0.829)
Log(1+Number of Volcanic Eruptions adjusted by land area) $_t$		0.049		0.016		-0.140
		(0.653)		(0.186)		(-1.052)
Log(1+Number of Volcanic Eruptions adjusted by land area) $_{t-1}$		0.194		0.183		0.084
		(2.151)		(1.889)		(0.568)
Per capita GDP Growth $_t$			0.150	0.131	0.259	0.252
			(3.313)	(3.339)	(2.453)	(2.677)
Per capita GDP Growth $_{t-1}$			-0.020	-0.045	-0.058	-0.071
			(-0.655)	(-1.363)	(-0.946)	(-1.243)
Log(1+Number of Terrorism Incidents) $_t$			-0.011	-0.010	-0.009	-0.005
			(-2.299)	(-1.907)	(-0.995)	(-0.629)
Log(1+Number of Terrorism Incidents) $_{t-1}$			-0.004	-0.002	-0.007	-0.005
			(-1.117)	(-0.462)	(-0.852)	(-0.540)
Change in Degree of Democracy $_t$			0.000	0.000	0.005	0.004
			(-0.021)	(-0.085)	(1.183)	(1.011)
Change in Degree of Democracy $_{t-1}$			-0.002	-0.001	0.000	0.001
			(-1.961)	(-0.972)	(-0.160)	(0.307)
Change in Gini Coefficient $_t$					-0.002	0.000
					(-1.144)	(-0.217)
Change in Gini Coefficient $_{t-1}$					0.000	0.002
					(0.049)	(1.062)
Change in Total Schooling Years $_t$					0.011	0.024
					(0.438)	(0.860)
Change in Total Schooling Years $_{t-1}$					0.042	0.041
					(1.515)	(1.408)
Number of Observations	307	307	283	283	146	146
Number of Countries	127	127	114	114	74	74
R-squared : within	0.377	0.447	0.498	0.543	0.568	0.647

Numbers in parentheses are t-values. Time indicator variables for each of the 5 year periods and country indicator variables are included, but not reported here.

Figure 1



Trust and Storm (partial relationship)
0,25
0,2
0,15
0,1
0,05
0
-0,05
-0,1
-0,15
0
0,5
1
1,5
2
2,5
3
Average Trust for 2000-2010
Number of Storm for 1970-2000, adjusted by area

Appendix A

Summary of Statistics of all Variables Used in the Cross-country Analysis

	Mean	Standard Deviation	No. of Observations
Trust	0.496	0.099	105
Log(1+Number of Total disasters per land area)	1.036	0.744	105
Log(1+Number of Storm per land area)	0.502	0.618	105
Log(1+Number of Flood per land area)	0.602	0.502	105
Log(1+Number of Earthquake per land area)	0.226	0.341	105
Log(1+Number of Mass movement per land area)	0.167	0.269	105
Log(1+Number of Volcano eruption per land area)	0.055	0.160	105
Protestant population / Total Population	0.130	0.232	104
Roman Catholic population / Total Population	0.350	0.385	104
Muslim population / Total Population	0.157	0.297	104
Legal origin, English	0.269	0.446	104
Legal origin, French	0.385	0.489	104
Legal origin, German	0.048	0.215	104
Legal origin, Socialist	0.250	0.435	104
Legal origin, Scandinavian	0.048	0.215	104
Log (GDP per capita)	8.885	1.240	104
Gini coefficient	0.389	0.111	97
Total Schooling Years	8.277	2.393	86
Ethnic Fractionalization	0.363	0.231	86
Degree of Democracy	6.209	5.090	86
Log(1+Number of Terrorism Incidents)	4.957	1.994	86

Appendix B

Summary of Statistics of all Variables Used in the Panel Analysis

	Mean	Standard Deviation	No. of Observations
Change in Trust	-0.027	0.059	322
Past variables			
Log(1+Number of Total Disasters adjusted by land area) $_{t-1}$	0.483	0.412	322
Log(1+Number of Storms adjusted by land area) $_{t-1}$	0.210	0.306	322
Log(1+Number of Floods adjusted by land area) $_{t-1}$	0.250	0.243	322
Log(1+Number of Earthquakes adjusted by land area) $_{t-1}$	0.073	0.145	322
Log(1+Number of Mass Movement adjusted by land area) $_{t-1}$	0.052	0.106	322
Log(1+Number of Volcano Eruption adjusted by land area) $_{t-1}$	0.015	0.053	322
Per Capita GDP Growth $_{t-1}$	0.129	0.130	295
Log(1+Number of Terrorism Incidents)$_{t-1}$	2.899	2.027	295
Change in Degree of Democracy $_{t-1}$	0.698	2.844	295
Change in Gini Coefficient $_{t-1}$	0.514	5.562	235
Change in Total Schooling Years $_{t-1}$	0.434	0.344	235
Current variables			
Log(1+Number of Total Disasters adjusted by land area) $_{t}$	0.559	0.427	307
Log(1+Number of Storms adjusted by land area) $_{t}$	0.235	0.319	307
Log(1+Number of Floods adjusted by land area) $_{t}$	0.320	0.280	307
Log(1+Number of Earthquakes adjusted by land area) $_{t}$	0.074	0.153	307
Log(1+Number of Mass Movement adjusted by land area) $_{t}$	0.051	0.112	307
Log(1+Number of Volcano Eruption adjusted by land area) $_{t}$	0.018	0.060	307
Per Capita GDP Growth $_{t}$	0.138	0.124	283
Log(1+Number of Terrorism Incidents)$_{t}$	2.617	2.045	283
Change in Degree of Democracy $_{t}$	0.265	1.929	283
Change in Gini Coefficient $_{t}$	0.017	5.157	146
Change in Total Schooling Years $_{t}$	0.442	0.349	146

Appendix C1
Definitions and Sources of Variables Used in the Cross-country Analysis

Variables	Definition	Source
Trust	The extent that individuals in a society feel they can rely on those whom they have not met before, average for 2000-2010	ISD
Log(1+Number of Total disasters per land area)	Logarithm of 1 + number of total disaster events (Storm, Flood, Earthquake, Volcanic Eruption, and Mass Movement) per logarithm of land area	EM-DAT
Log(1+Number of Storm per land area)	Logarithm of 1 + number of Storm per logarithm of land area	EM-DAT
Log(1+Number of Flood per land area)	Logarithm of 1 + number of Flood per logarithm of land area	EM-DAT
Log(1+Number of Earthquake per land area)	Logarithm of 1 + number of Earthquake per logarithm of land area	EM-DAT
Log(1+Number of Mass movement per land area)	Logarithm of 1 + number of Mass Movement per logarithm of land area	EM-DAT
Log(1+Number of Volcano eruption per land area)	Logarithm of 1 + number of Volcanic Eruption per logarithm of land area	EM-DAT
Protestant population / Total Population	Ratio of Protestant population to total population in 1980	LLSV
Roman Catholic population / Total Population	Ratio of Roman Catholic population to total population in 1980	LLSV
Muslim population / Total Population	Ratio of Muslim population to total population in 1980	LLSV
Legal origin, English	Legal origin British	LLSV
Legal origin, French	Legal origin French	LLSV
Legal origin, German	Legal origin socialist	LLSV
Legal origin, Socialist	Legal origin German	LLSV
Legal origin, Scandinavian	Legal origin Scandinavian	LLSV
Log (GDP per capita)	Logarithm of real GDP per capita in 2000	HAS
Gini coefficient	Gini coefficient	WIID
Total Schooling Years	Total schooling years in the total population aged 15 and over in 2000	BL
Ethnic Fractionalization	Probability that two randomly selected persons from a given country will not belong to the same ethno-linguistic group	ADEKW
Degree of Democracy	Degree of Democracy (range from 10(good) to -10(bad)) in 2000	POLITY
Log(1+Number of Terrorism Incidents)	Logarithm of 1 + number of terrorism incident for 1970-2000	GTD

Appendix C2
Definitions and Sources of Variables Used in the Panel Analysis

Variables	Definition	Source
Change in Trust	Change in Trust for 5 years (1990-1995, 1995-2000, 2000-2005, 2005-2010)	ISD
Log(1+Number of Total disasters per land area)	Logarithm of 1 + number of total disaster events (Storm, Flood, Earthquake, Volcanic Eruption, and Mass Movement) per logarithm of land area	EM-DAT
Log(1+Number of Storm per	Logarithm of 1 + number of Storm per logarithm of	EM-DAT

land area)	land area	
Log(1+Number of Flood per land area)	Logarithm of 1 + number of Flood per logarithm of land area	EM-DAT
Log(1+Number of Earthquake per land area)	Logarithm of 1 + number of Earthquake per logarithm of land area	EM-DAT
Log(1+Number of Mass movement per land area)	Logarithm of 1 + number of Mass Movement per logarithm of land area	EM-DAT
Log(1+Number of Volcano eruption per land area)	Logarithm of 1 + number of Volcanic Eruption per logarithm of land area	EM-DAT
Per Capita GDP Growth	Per Capita GDP Growth for each 5 years	HSA
Log(1+Number of Terrorism Incidents)	Logarithm of 1 + number of terrorism incident for each 5 years	GTD
Change in Degree of Democracy	Change in Degree of Democracy for each 5 years	POLITY
Change in Gini Coefficient	Change in Gini Coefficient for each 5 years	WIID
Change in Total Schooling Years	Change in Total Schooling Years for each 5 years	BL

Sources:

ADEKW: Alesina,A., A. Devleeschauwer, W. Easterly, S. Kurlat, and R. Wacziarg (2003). "Fractionalization." *Journal of Economic Growth, 8*, 155–194.

BL: Barro, Robert and Jong-Wha Lee (2010). "A New Data Set of Educational Attainment in the World, 1950-2010." NBER Working Paper No. 15902, taken from Baroo-Lee Educational Attainment Dataset, taken from the web page, http://www.barrolee.com/

EM-DAT:The OFDA/CRED International Disaster Database –www.emdat.be – Université Catholique de Louvain – Brussels – Belgium.

HSA: Alan Heston, Robert Summers and Bettina Aten, Penn World Table Version 7.0, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania, May 2011, taken from the Web page, http://pwt.econ.upenn.edu/.

GTD: "National Consortium for the Study of Terrorism and Responses to Terrorism (START)”. (2011). Global Terrorism Database [Data file]. Retrieved from http://www.start.umd.edu/gtd.

ISD: Indices of Social Development, URL: http://www.IndSocDev.org/.

LLSV: La Porta, R., F. Lopez-de-Silanes, A. Shleifer, and R. Vishny. 1999. "The quality of government." *Journal of Law Economics and Organization,* 15(1): 222-79.

POLITY: Polity IV Project: Political Regime Characteristics and Transitions, 1800-2010, taken from the web page, http://www.systemicpeace.org/polity/polity4.htm.

WIID: World Income Inequality Database, taken from the UNU-WIDER Web page, http://www.wider.unu.edu/research/Database/en_GB/wiid/.

Appendix D
List of Countries

Albania	Ecuador	Lebanon*	Russia
Algeria *	Egypt	Lesotho	Rwanda*
Argentina	El Salvador	Lithuania	Saudi Arabia
Armenia	Estonia+	Luxembourg	Singapore+
Australia	Ethiopia	Macedonia FRY	Senegal*
Austria	Fiji	Madagascar*	Serbia Montenegro*
Azerbaijan	Finland	Malawi*	Seychelles*
Bahamas*	France	Malaysia	Slovakia
Bangladesh	Georgia	Malta+	Slovenia
Barbados*	Germany	Mali*	South Africa
Belarus	Ghana*	Mauritius	Spain
Belgium	Greece	Mexico	Sri Lanka
Bhutan*	Guatemala	Moldova Rep	St Vincent and The Grenadines*
Bolivia	Guyana*	Mongolia	Sudan*
Bosnia-Hercegovenia	Honduras	Morocco	Swaziland
Botswana	Hong Kong	Mozambique	Sweden
Brazil	Hungary	Myanmar*	Switzerland
Bulgaria	Iceland	Namibia	Syrian Arab Rep
Burkina Faso*	India	Netherlands	Tajikistan*
Cambodia	Indonesia	New Zealand	Tanzania Uni Rep
Cameroon*	Iran Islam Rep*	Nicaragua	Thailand*
Canada	Iraq*	Nigeria	Tonga*
Chile	Ireland	Norway	Trinidad and Tobago*
China P Rep	Israel	Oman*	Tunisia*
Colombia	Italy	Pakistan	Turkey
Costa Rica	Jamaica	Panama	Uganda
Cote d'Ivoire	Japan	Papua New Guinea*	Ukraine
Croatia	Jordan	Paraguay	United Kingdom
Cuba*	Kazakhstan	Peru	United States
Cyprus	Kenya*	Philippines	Uruguay
Czech Rep	Korea Rep	Poland	Venezuela
Denmark	Kuwait	Portugal	Viet Nam
Dominica*	Kyrgyzstan	Qatar+	Yemen*
Dominican Rep	Latvia	Romania	Zambia
			Zimbabwe

* and + denote a country only available in panel analysis or only available in cross-country analysis, respectively.