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Do Natural Disasters Enhance Societal Trust?

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Do Natural Disasters Enhance Societal Trust?

Abstract

In this paper we investigate the long-run relationship 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 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 severe storms can have devastating human and economic impacts, a potential spillover benefit of greater storm 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 examine 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 communities (or countries) exhibit 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 are quite stable over time. As one illustration, 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 trust levels are generally very stable over time. What then are the determinants of societal trust? Bjørnskov (2004) offers an excellent summary of the empirical research on this topic, which points to factors such as 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 the whether the propensities for different types of natural disasters are

determinants of trust. As a prelude to the full analysis, controlling for other factors found to be important determinants of trust, we find that counties with higher frequencies of storms exhibit higher levels of trust. We conjecture that *ex ante* preparations and *ex post* response 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. Our examination offers an indirect test of this hypothesis.

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 the empirical analysis, and section V offers concluding remarks.

II. LITERATURE REVIEW

The literature review is organized into two distinct parts. The first portion of this discussion offers a brief review 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 formation 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 that 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 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. Skidmore and Toya (2007) add to this line of research by showing that higher levels of human capital, trade openness, and a stronger financial sector also reduce disaster vulnerability.

In a study of the 1994 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 (forthcoming) 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-run 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 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) Loaya, *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 large disasters.² Last, 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 tools to examine how preferences changed in Thailand following the 2001 Asian tsunami; their work shows that individuals affected by the disaster are more trusting, more trustworthy, and more risk-averse than subjects in the same communities prior to 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

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.

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 tend to have negative short- and medium-run impacts on economic growth. 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 long-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? To our knowledge, there are two studies in the economics literature that begin to address this question.

The first work in this line of research is Skidmore and Toya (2002) who use a long-run empirical economic growth framework to examine the implications 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, the propensity for the adoption of new technology, and social interactions.”

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 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 new 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 a strong positive relationship between natural disaster propensity 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 long-run framework. We hope to shed new light that might 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 conjecture further, it is necessary to 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 (Bourdieu, 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 obtained from surveys. 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 ambiguous and therefore makes it somewhat difficult for respondents to answer. However, for purposes of capturing culturally specific perceptions, it turns out to be a very effective measure. 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,

³ The respondent must choose between: “1-Most people can be trusted”; and “2-Can’t be too careful”.

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 Keefer, 1997). While income inequality is found to be a robust determinant of trust, care must be taken with estimation and interpretation as income inequality is potentially endogenously determined.⁵

To our knowledge, no studies to date consider the degree to which societal trust levels are influenced by external forces such as natural disasters. Is society influenced by the prevalence of natural disasters, and if so how? Intuitively, it seems reasonable that the forces of nature could influence cultural identity and psyche. On the one hand, a higher frequency of extreme events might overwhelm to a given society and thus social capital could erode.⁶ On the other hand, Ostrom (1999) suggests that social capital appreciates 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). In contrast, regular flooding may serve to divide social classes as it is often the case that floods most affect the poorest members of society. Those with limited resources are more likely to live in the riskier flood zone areas, whereas those with higher

⁴ See for example La Porta, *et al* (1997) and Berggren and Jordahl (2007), Knack and Keefer (1997), Zak and Knack (2001), Knack and Zak (2002), Uslaner (2002), and Bjørnskov (2006).

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

⁶ For example, there was considerable looting that occurred in New Orleans following hurricane Katrina. See for example http://www.msnbc.msn.com/id/9063708/ns/us_news-katrina_the_long_road_back/t/new-orleans-mayor-orders-looting-crackdown/.

incomes are better able to live in areas well above flood zones.

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 test this notion that there is an observable relationship between natural disasters and trust using cross-country data for many nations.⁷ Before presenting the empirical analysis, next 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 86 to 105 countries depending on the specification.

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 analysis we use the total number of significant events occurring in a country over the 1970-2000 period as our measure of exposure to natural disasters; the number of events is probably the best exogenous measures of disaster risk available. As a further precaution, the trust data we use are for the 2000-2010 period. Therefore, the measures of disaster propensities we use are for years prior to the trust score, our dependent variable. 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 number of natural events yields qualitatively similar results. Summary statistics for these and all other variables used in our analysis are presented in the Appendix A. Appendix B provides definitions and sources for all

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.

variables used in the analysis.

We separate natural disasters into different types because the relative effects of each on 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, some types of disasters effect social classes 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.¹⁰ If the current generation has not yet experienced a significant natural disaster event, previous generations pass on their values, which have been in turned influenced by yet earlier generations.

Over the 1970-2000 period, 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 were 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 result from storm activity far upstream; regular flooding in Bangladesh where 80 percent of the land area lies on a huge flood plain much of which is only one meter above sea level is one such illustration. In

¹⁰ 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 \$4650 (in 1978). This study provides evidence that home buyers in California use well-publicized information on earthquake hazards to ascertain property values, and they do so in a way that is consistent with the expected utility framework

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). The correlation coefficient between severe storms and flooding is 0.677. 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, Syrian Arb Rep, Qatar, and Singapore).

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; Heston, *et al*, 2011; Indices of Social Development; 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 105 countries over the 1970-2000 period. Our measure of disaster exposure is the number of disasters over this period for each of the 105 countries. Using this merged data set, we conduct empirical analyses to determine the relationship between disaster propensities and trust in a cross-country analysis, while controlling for a range of other factors considered in previous studies.

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. Information on generalized trust is obtained from this World Values Survey question: “In general, do you think that most people can be trusted, or can’t you be too careful in dealing with people?” As described earlier, 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) very 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 in a cross-country framework. In particular, we include: religious composition (Protestant, Catholic, Muslim¹¹); legal origin of government (English, French, German, Socialist¹²), initial levels of GDP per capita, income inequality, total years of schooling, ethnic fractionalization, and degree of democracy.

As described earlier, relative to the omitted religion (eastern religions), countries with more hierarchical religions such as Catholicism tend to be less trusting (La Porta, 1997; Bergren and Jordahl, 2000). We also include the historical 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 in 2000; previous studies show that trust tends to be higher in higher income countries, though caution 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 control for educational attainment. We expect countries with more unequal income distributions and less human capital to have lower levels of trust. Finally, we 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

¹¹ The omitted category includes the eastern religions like Hinduism, Buddhism, Confucianism, and so on.

¹² The omitted category is Scandinavian.

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.

III. EMPIRICAL EVIDENCE

In this section, we present estimation results that identify the factors that explain the variation in 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)¹³, 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, and the degree of democracy), and e is the error term. 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. In column 2 we report results for a regression in which we include the different types of disasters. Recall, that depending on the characteristics of the disaster, 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

¹³ For some types of disasters in some countries, there were zero events. We therefore add one to all observations to avoid arithmetic error.

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, we see that 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 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 affect 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 differences in the ways 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 possible 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 differences in the effects of storms and floods on trust levels.

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, the regression with the most explanatory variables. We also report in Figures 1 and 2 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. Figure 2 also offers a reasonably compelling image of the negative correlation between flooding and trust. According to the regression results reported in column 3, a one standard deviation higher level of storm

activity (about a 120 percent greater level of storm activity than the average in the sample) would increase trust levels 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 a one standard deviation higher level of 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.¹⁴ Relative to Scandinavian, countries with legal origins in the 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 and the degree of democracy as explanatory variables, but the coefficients on these variables are not statistically significant. 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 quite high for a cross-sectional analysis; the regression explains more than 60 percent of the variation in trust levels.

¹⁴ 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.

Robustness

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 results are very similar to the full sample in that the coefficient on storms is positive and statistically significant, and the coefficient on floods is negative statistically significant. Of the control variables, only the coefficient on proportion of the population that is Protestant and the gini coefficient of income inequality are statistically significant; a greater proportion of the population that is Protestant and greater income inequality lead to lower levels of 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 lower levels of trust. Other than the positive and significant coefficient on the Protestant variable, 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 storm and flood activity 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.

VI. CONCLUSIONS

In this paper, we use cross-country data to examine the long-run relationships between disaster propensities and trust. Our analysis reveals a robust relationship between past storm and flood activity and current trust levels. While this analysis offer a general evaluation, it is plausible that the natural environment in general and natural disasters in particular influence 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 recent work of Strauss and Orlove, 2003), economists may have something new to offer in the discussion. 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 the evidence for climate change mounts, it will be increasingly important to consider the long-run implications for society and culture.

In this study, we offer a new perspective, at least for economists, on the formation of societal trust. In particular, we offer evidence showing that the frequency of severe storms and flooding activity are 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 break down 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.¹⁵

¹⁵ The only work we are aware of along these lines is Cassar, Healy, and von Kessler (2011), who examination how preferences with regard to risk, time, and trust were altered in the wake of the devastating Asian tsunami in 2001.

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Table 1
Natural Disasters and Trust Regressions

	1	2	3	4	5
Constant	0.497 (29.480)	0.511 (34.629)	0.220 (2.928)	0.392 (3.743)	0.491 (4.180)
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 (4.913)	0.051 (3.086)	0.042 (2.765)	0.042 (3.009)
Log(1+Number of floods adjusted by land area)		-0.104 (-3.966)	-0.037 (-1.586)	-0.031 (-1.513)	-0.038 (-1.933)
Log(1+Number of earthquakes adjusted by land area)		0.016 (0.479)	-0.013 (-0.448)	-0.014 (-0.490)	-0.008 (-0.275)
Log(1+Number of mass movements adjusted by land area)		0.032 (0.646)	-0.010 (-0.213)	-0.010 (-0.245)	-0.018 (-0.440)
Log(1+Number of volcano Eruption adjusted by land area)		-0.033 (-0.404)	0.039 (0.667)	0.041 (0.879)	0.053 (0.996)
Protestant population / total population			-0.129 (-2.814)	-0.128 (-2.381)	-0.115 (-1.905)
Roman Catholic population / total population			-0.067 (-2.575)	-0.053 (-2.093)	-0.037 (-1.529)
Muslim population / total population			0.071 (2.525)	0.047 (1.196)	0.020 (0.470)
Legal origin, English			-0.136 (-3.140)	-0.117 (-2.258)	-0.104 (-1.711)
Legal origin, French			-0.140 (-2.963)	-0.128 (-2.366)	-0.101 (-1.681)
Legal origin, German			-0.089 (-2.019)	-0.085 (-1.701)	-0.070 (-1.246)
Legal origin, Socialist			-0.115 (-2.555)	-0.117 (-2.325)	-0.121 (-2.113)
Log (GDP per capita)			0.048 (8.700)	0.038 (4.711)	0.025 (1.814)
Gini coefficient				-0.240 (-2.778)	-0.336 (-4.081)
Total Schooling Years					0.008 (1.272)
Ethnic Fractionalization					-0.026 (-0.630)
Degree of Democracy					-0.003 (-1.087)
Number of Observations	105	105	104	97	86
Adjusted R-squared	-0.010	0.133	0.577	0.587	0.605

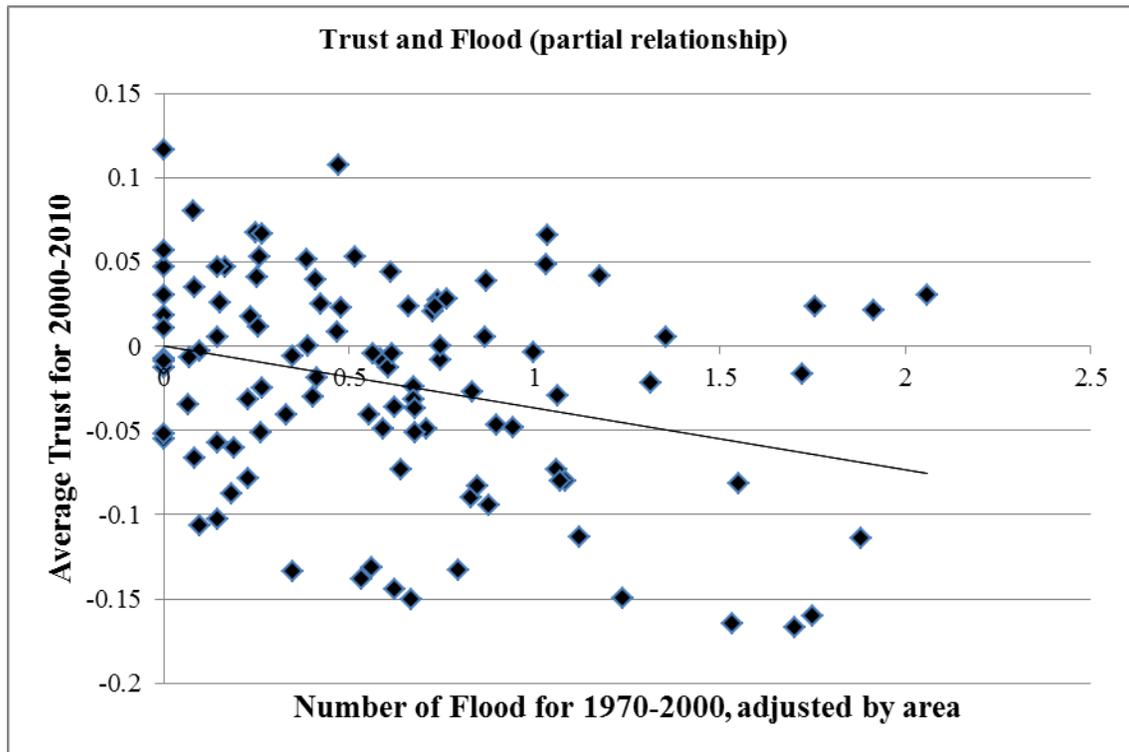
Numbers in parentheses are t-values

Table 2
Natural Disasters and Trust Regressions

	Developing Countries		Industrialized Countries	
	1	2	3	4
Constant	0.486 (27.50)	0.437 (3.350)	0.599 (63.09)	0.558 (1.543)
Log(1+Number of Total disasters adjusted by land area)				
Log(1+Number of storms adjusted by land area)	0.060 (2.694)	0.041 (2.249)	0.018 (1.313)	-0.003 (-0.229)
Log(1+Number of floods adjusted by land area)	-0.071 (-2.514)	-0.042 (-1.755)	-0.059 (-2.547)	-0.040 (-1.621)
Log(1+Number of earthquakes adjusted by land area)	0.030 (0.678)	-0.003 (-0.068)	-0.024 (-1.156)	0.015 (0.675)
Log(1+Number of mass movements adjusted by land area)	0.006 (0.104)	-0.009 (-0.161)	0.015 (0.351)	-0.074 (-0.939)
Log(1+Number of volcano Eruption adjusted by land area)	-0.058 (-0.652)	0.079 (1.325)	0.122 (1.943)	0.191 (1.843)
Protestant population / total population		-0.165 (-1.865)		0.074 (1.962)
Roman Catholic population / total population		-0.050 (-1.413)		0.047 (1.431)
Muslim population / total population		0.025 (0.459)		2.081 (1.598)
Legal origin, English		-0.030 (-0.727)		0.012 (0.298)
Legal origin, French		-0.036 (-0.758)		-0.011 (-0.286)
Legal origin, German				0.055 (1.710)
Legal origin, Socialist		-0.043 (-1.231)		
Log (GDP per capita)		0.022 (1.429)		-0.001 (-0.034)
Gini coefficient		-0.262 (-2.379)		
Total Schooling Years		0.007 (1.078)		
Ethnic Fractionalization		-0.057 (-1.059)		
Degree of Democracy		-0.003 (-0.933)		
Number of Observations	82	65	23	23
Adjusted R-squared	0.030	0.455	0.377	0.484

Numbers in parentheses are t-values

Figure 2



Appendix A
Summary of Statistics of all Variables Used in the 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

Appendix B
Definitions and Sources of Variables

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 ethnolinguistic group	ADEKW
Degree of Democracy	Degree of Democracy (range from 10(good) to -10(bad)) in 2000	POLITY

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, April 2010, "A New Data Set of Educational Attainment in the World, 1950-2010." NBER Working Paper No. 15902, taken from Barro-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/>

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/