European Commission

JRC TECHNICAL REPORTS

Culture and Resilience

Frank Neher and Apollonia Miola

October 2016

Joint Research Centre

EUR 28314 EN

Contact information
Name: Frank Neher
Address: Joint Research Centre, TP 124, Via E. Fermi 2749, 21027 Ispra (VA), Italy
E-mail: frank.neher@jrc.ec.europa.eu
Tel.: +390332785841

JRC Science Hub
https://ec.europa.eu/jrc

JRC103748

EUR 28314 EN

PDF	ISBN 978-92-79-64531-0	ISSN 1831-9424	doi:10.2788/937554
Print	ISBN 978-92-79-64530-3	ISSN 1018-5593	doi:10.2788/7750

Luxembourg: Publications Office of the European Union, 2016

How to cite this report: Frank Neher, Apollonia Miola*; Culture and Resilience*; EUR 28314 EN; doi:10.2788/937554

Table of contents

Abstract

Under the basic assumption that national climate change risk and vulnerability are closely linked with a country's resilience to climate change, we analysed how some aspects of culture are related to risk and vulnerability. Individualism/collectivism, religiousness and cultural heterogeneity are the cultural aspects analysed. Variables quantifying those aspects of culture were consistently correlated with standard risk and vulnerability measures. Further inquiry revealed that religiousness, and to a lesser extent cultural heterogeneity, can contribute to explaining national differences in resilience. We discuss the hypothesis that culture influences trust and a society's propensity to cooperate, which are important inputs for resilience.

Abbreviations

CC	Climate change
CRI	Climate Risk Index
EVS	European Values Study
GCCA+	Global Climate Change Alliance
HDI	Human Development Index
INFORM	Index of Risk Management
IPCC	Intergovernmental Panel on Climate Change
ND-GAIN	Notre Dame Global Adaptation Index
WRI	World Risk Index
WVS	World Values Survey

1 Introduction

The problems associated with mitigating climate change (CC), coupled with the fact that some consequences of a changing climate are already inevitable, make it ever more urgent to answer the question of how to foster adaptation and resilience (IPCC, 2014). It is generally understood that the susceptibility of an entity to be negatively affected depends on its vulnerability and exposure. The resilience of a system, i.e. its ability to maintain its basic function, depends on, among other things, the system's vulnerability and its adaptive capacity (e.g. Carpenter et al., 2001). Vulnerability and the capacity of a society to adapt depend on its social aspects, as well as its fundamental biological, chemical and physical properties. The level of socio-economic development can be seen as a major determinant of vulnerability. While the debate as to what determines development is still open, there is some agreement that, next to resource endowments, historical contingencies and path dependency, institutions, social norms and culture are important drivers of development (e.g. Alesina and Giuliano, 2015).

This paper focuses on the importance of cultural aspects in the context of risk from and resilience to CC. First, we briefly review some evidence for the importance of culture in economics and for the role of culture as a facilitator or a hindrance in the adaptation to climate change (Section 2). We will then ask how culture can be conceptualised and measured and will discuss three aspects of culture that can be subject to a quantitative analysis (Section 3). In Section 4, available measures of CC risk and resilience are discussed. The analysis of how these measures of resilience and risk are related to the measures of culture is presented in Section 5. Sections 6 and 7 will further investigate the quantitative analysis for the Index of Risk Management (INFORM). Section 8 discusses checks of robustness and restricts the analysis to the EU-28 sample. Potential explanations for the observed phenomena are discussed in Section 9 and conclusions are drawn in Section 10.

2 Culture in the economic literature

2.1 The relevance of culture for economic outcomes

While Adam Smith was already concerned with culture (Fleischacker, 2013), the modern economic profession had for a long time, by and large, ignored the effects of culture on economic outcomes (Guiso et al., 2006). This changed when experiments in the laboratory and in the field in different societies convincingly demonstrated cultural differences in economically relevant behaviour across societies (Roth et al., 1991; Croson and Buchan, 1999; Henrich et al., 2001, 2004; Brandts et al., 2004;, Gurven et al., 2008).

The literature on social capital, as initiated by Putnam et al. (1994), Putnam (1995) and Knack and Keefer (1997), raised the awareness of the importance of idiosyncratic social aspects of a given society for its economic performance. Social capital is often approximated with measures of civic attitudes, participation in social groups and trust. Social capital and trust, in particular, are shown to have a positive effect on economic growth (Knack and Keefer, 1997; Bjørnskov, 2012; Serritzlew et al., 2014). Trust is also considered a central cultural ingredient, at both a social and communal level, to overcome collective action problems associated with public goods and the tragedy of the commons (Pretty, 2003; Brondizio et al., 2009; Ostrom, 2010).[1]

The influence of culture on development is now widely accepted (Lopez-Claros and Perotti, 2014). The literature discusses both aspects, culture facilitating and inhibiting development (e.g. Arrow, 1971). A nice overview of the debate and the importance of culture for a plethora of outcomes, such as female labour force participation, fertility, political engagement, redistribution, migration and others, is provided by Fernández (2011). A more recent survey of the economic effects of culture is provided by Marini (2016).

Guiso et al. (2006) saw the circular causality between economics and culture as one reason why economics for a long time did not consider cultural factors to explain differences in economic outcomes (see also Bowles, 1998).[2] The observation that certain cultural aspects are exogenous from an individual point of view motivated the generation of large, and constantly increasing, body of literature analysing cultural effects on economic outcomes.

2.2 The relevance of culture for vulnerability and adaptation

The importance of culture in many contexts is also discussed in the CC literature. The Intergovernmental Panel on Climate Change (IPCC), in its latest assessment report, acknowledged that risk perception and security needs, which constitute an important determinant of the demand for adaptive measures, are at least partly culture specific

[1] We will elaborate on this relation of trust and public good provision in the discussion of our empirical findings in Section 9.

[2] These two opposite directions of causation are nicely captured in the hypotheses of Marx and Weber: for Marx, the material conditions determined the social structure and a society's value system while, for Weber, some very specific values created the economic structure of capitalism.

(IPCC, 2014). This is closely related to the values-based approach to vulnerability and adaptation, which states that a proper definition of adaptation objectives and understanding of vulnerability necessitates an analysis of the values affected (O'Brien and Wolf, 2010; Adger et al., 2013). A broad framing of values that extend beyond market prices will open the perspective on symbolic, ethical and religious values in societies that might effectively constitute culture specific limits to adaptation (Adger et al., 2009). Finally, differences in the ability to overcome collective action problems across societies (Henrich et al., 2001; Hermann et al., 2008) are rooted in cultural differences. To the extent that adaptation and adaptive capacity depend on collective action, these cultural differences will have a direct effect on a country's resilience and adaptive capacity.[3]

The empirical analysis undertaken in this paper focuses on macro-level aspects of culture, i.e. cultural aggregates at the level of the nation state. This level was chosen because the resilience and risk measures (introduced in Section 4) are available only at the country level. In addition, structural aspects can be captured only at the macro level. It could, however, be argued that, for a thorough understanding of how culture affects human behaviour and how this feeds into resilience, a micro-level analysis would be warranted. Many economic analyses of culture, particularly in the fields of trust, social capital and social norms, look at beliefs and values held by individuals, which are measured by individual responses to survey questions. Albeit a widespread exercise, the measurement of cultural aspects with the help of individual survey responses has undergone serious critique; some scholars argue that culture results from the creation of intersubjective meaning, which emanates from relations between individuals and contexts in which these relations happen, and are thus supra-individual (Gauri et al., 2013; Woolcock, 2014). Schwartz (2014) also argues that culture, which he understands as a latent value system justifying and enabling the functioning of social institutions, is external to the individual.

3 Measures of culture

3.1 Measurement and concepts of culture

What is culture and how can it be measured? There are multiple different definitions of culture. The *Merriam Webster Dictionary* alone provides four different definitions:

> (1) 'the integrated pattern of human knowledge, belief, and behaviour that depends upon the capacity for learning and transmitting knowledge to succeeding generations';
>
> (2) 'the customary beliefs, social forms, and material traits of a racial, religious, or social group; also: the characteristic features of everyday existence (as diversions or a way of life) shared by people in a place or time';
>
> (3) 'the set of shared attitudes, values, goals, and practices that characterizes an institution or organization';

[3] We will elaborate on this hypothesis in Section 9.

(4) 'the set of values, conventions, or social practices associated with a particular field, activity, or societal characteristic'.

Guiso et al. (2006) define culture as 'those customary beliefs and values that ethnic, religious, and social groups transmit fairly unchanged from generation to generation'. Fernández (2011) rejects this notion of culture as it excludes the possibility of cultural learning and change, which are arguably central aspects in human development. Since quantitative analysis exploits variation to identify causation (or at least correlation), Fernández provides a working definition for 'differences in culture as systematic variations in beliefs and preferences across time, space or social groups' (Fernández, 2011). [4] Given the opaque nature of the relation between individual beliefs and preferences on the one hand, and the social structure of society on the other, we also pay attention to variables capturing the social structure.

In the present paper we look at three aspects of culture: the individualism/collectivism distinction as provided by Hofstede (2001); the extent of religiosity in a country as expressed in the frequency of religious practices; and the level of ethnical, religious and linguistic fractionalisation in a country. While religiosity fits in the working definition of Fernández (2011), fractionalisation is a structural parameter measuring the difference of countries with respect to differences in beliefs and preferences within each country. Individualism/collectivism is an aggregate concept, derived from the aggregation of individual preferences and beliefs. We will now describe our measure in some detail.

3.2 Individualism and collectivism

Hofstede (2001) applied cluster analysis on surveys sampled in 50 countries to identify five cultural dimensions: (1) power distance, (2) uncertainty avoidance, (3) masculinity/femininity, (4) long-term/short-term orientation and (5) individualism/collectivism.[5] Hofstede's five dimensions are generally considered reliable and valid measures of culture (Schimmack et al., 2005; Yoo et al., 2011). Some dimensions can even be replicated from existing survey data collected for different purposes (Minkov and Hofstede, 2014a). The dimension of individualism/collectivism in particular has attracted a great deal of attention. Gorodnichenko and Roland (2011a, b) found that it is the most important cultural measure influencing long-term economic growth. They also provided an integrated review of individualism in economics and social psychology (Gorodnichenko and Roland, 2012). Some contributions from social psychology have pointed out the statistical relation between collectivism and pronoun drop, i.e. the characteristic of some languages to not use pronouns. There is a theoretical argument in linguistics and social psychology that states that language is the symbolic environment in which humans operate. As such, it shapes and is shaped by the interactive patterns and the specific form of social organisation prevailing in a language area. The statistical relation between Hofstede's measure of individualism and non-pronoun drop are seen as evidence for this theory (Kashima and Kashima, 1998, 2003,

[4] This definition follows methodological individualism and roots culture in the individual.

[5] It is the hypothesis of the authors that uncertainty avoidance should, in principle, be associated with the distribution of individual risk aversion in a country and short-term/long-term orientation with the distribution of individual discount rates. This question needs to be addressed in future research.

2005). The linguistic data are particularly interesting as the evolution of language is comparatively slow and thus exogenous to most economic outcomes. In addition, books provide access to the historic use of language in the last decades. Accordingly, these data have been used in the economic literature to assess culture (Licht et al., 2007; Tabellini, 2008). The summary statistics of the individualism and non-drop measures are shown in Table 3.1.

3.3 Religiosity

The second cultural category we looked at is the degree of religiosity, as expressed by religious practice in a country. While it could be argued that belief systems vary widely across different religions, there is some evidence that attitudes differ more between cultures than they do between people from different religions (Minkov and Hofstede, 2014b). Accordingly, we focused our attention on the degree of religiosity rather than looking at different religious practices. To measure religiosity we looked at a number of responses from the World Values Survey (WVS, 2015) and the European Values Study (EVS, 2015) [frequency of attendance at religious services (*religious_reg*, *religious_some*, *religious_never*), [6] the frequency of individual prayer (*pray_reg*, *pray_some*, *pray_never*), the belief in God (*believe_god*) and the importance of God in one's life (*god_important*)] and aggregated them at the country level. We focused on the respondents with regular attendance at religious service and higher frequency of prayer, and dropped the complementary variables. We were thus left with the proportion of respondents who regularly attend religious services (*religious_reg*), the proportion of respondents who regularly pray (*pray_reg*), the proportion of people who believe in God (*believe god*) and the mean value for the country of how important people feel that God is in their lives (*important_god*). The summary statistics and descriptions of the variables are presented in Table 3.1. The survey items and details on the construction of the variables are described in Table A1 in the appendix.

3.4 Ethnic, linguistic and religious fractionalisation

Higher levels of ethnic, linguistic and religious heterogeneity might impose a burden on communication and cooperation within a given society, which might result in negative effects on a society's coping capacity and its resilience. Arguments on the influence of ethnic heterogeneity on economic growth and cooperation have been put forward by a number of authors Easterly and Levine (1997), Arcand et al. (2000), Alesina et al. (2003), Fearon (2003) and, Desmet et al. (2016).

To determine if cultural heterogeneity is an important factor for resilience to CC, we considered a number of available measures of fractionalisation. Fractionalisation in general measures the probability that two randomly selected people from a given country will not belong to the same group, when the group can be defined by either ethnicity, language or religion. Two secondary data sources were employed in this analysis. Alesina et al. (2003) provide data on ethnic fractionalisation (*al_ethnic*), ethnolinguistic fractionalisation (*al_language*) and religious fractionalisation (*al_religion*). Fearon (2003) provide an alternative measure of ethnic fractionalisation (*fe_etfra*) and an elaborated measure of cultural diversity (*fe_cultdiv*), as well as a measure of

[6] Variables names are always set in italics.

ethnolinguistic fractionalisation (*elf*) and the number of groups in a country (*numgrps*). Summary statistics are provided in Table 3.1, variable descriptions and data sources are detailed in Table A2 in the appendix. Alternative measures of fractionalisation and heterogeneity are being employed to assure the robustness of any findings.

Table 3.1 Description and descriptive statistics of cultural variables

Variable	No of observations	Mean	SD	Minimum	Maximum	Description
individualism	67	43.716	24.052	6	91	Hofstede's measure of individualism
nondrop	73	0.301	0.462	0	1	Linguistic category of pronoun drop
religion_reg	101	0.443	0.252	0.094	0.912	Percentage of respondents regularly participating in religious service
pray_reg	68	0.503	0.248	0.008	0.940	Percentage of respondents regularly praying
belief_god	92	0.847	0.185	0.188	1.000	Percentage of respondents believing in God
Important_god	103	7.590	1.891	2.900	9.874	Mean importance of God (1–10)
al_ethnic	97	0.392	0.239	0.002	0.930	Ethnic fractionalisation
al_language	94	0.359	0.272	0.002	0.923	Language fractionalisation
al_religion	96	0.426	0.229	0.003	0.860	Religious fractionalisation
fe_cultdiv	158	0.309	0.208	0.000	0.733	Cultural diversity
fe_etfra	159	0.475	0.260	0.002	1.000	Ethnic fractionalisation
elf	129	0.428	0.288	0.004	0.925	Ethno-linguistic fractionalisation
numgrps	160	5.138	3.506	0	22	Number of ethnic groups

SD, standard deviation.

4 Measuring climate change risk and resilience

It is generally understood that the susceptibility of an entity to be negatively affected depends on its vulnerability and exposure. The resilience of a system, i.e. its ability to maintain its basic functioning, depends on the system's vulnerability and adaptive capacity.[7] The very general definition of resilience as a system's ability to maintain its basic functioning goes back to Holling (1973). It has been modified with differing, more specific and context-dependent definitions. For example, Hallegatte (2014) defined macroeconomic resilience as the ability of an economy to minimise aggregate consumption losses for a given capital loss resulting from an external shock. Microeconomic resilience in this context is the ability of a household to minimise welfare losses for a given consumption loss.

Both resilience and the related concept of vulnerability are multifaceted, multidimensional and complex concepts, which are inherently difficult to measure. One approach to empirically conceptualise them is via composite indicators. Different authors follow a number of approaches in constructing such indices of resilience or vulnerability. Overview and discussion on this topic is provided by Füssel (2010), Miola and Simonet (2014) and Miola et al. (2015).

In our analysis we looked at a number of different composite indicators which are constructed with the aim of capturing vulnerability or risks from CC. The implicit assumption is that resilience and vulnerability or risk are strongly inversely related concepts, i.e. less vulnerability implies more resilience and vice versa. We are interested in knowing if vulnerability, risk or resilience, as measured by these indicators, are statistically related with aspects of culture, and, where such a relation exists, whether or not it is meaningful and can provide additional insights into the dynamics of adaptation and vulnerability.

In the first step, we used six different indices to assure that observed correlations are not driven by the idiosyncratic construction of any one index. The six indices employed were INFORM (De Groeve et al., 2015), the World Risk Index (WRI) 2015 (Birkmann et al., 2011; Welle and Birkmann, 2015), the Notre Dame Global Adaptation Index (ND-GAIN) 2014 (Chen et al., 2015), the DARA Risk Reduction Index 2010 (DARA, 2013), the Climate Risk Index (CRI) 2014 (Anemüller et al., 2006; Kreft et al., 2016) and the Global Climate Change Alliance (GCCA+) index (Miola et al., 2015). The GCCA+ index is restricted to the least developed countries; all other indices provide maximal coverage given data availability. Table 4.1 provides an overview of the data available from the original indices. To simplify exposition and interpretation, all indices were recoded so that higher index scores indicate a higher level of risk, thereby implying lower levels of resilience. Accordingly, in the present work, higher values of ND-GAIN indicate lower readiness, more vulnerability, or both.

[7] Resilience, vulnerability and adaptation are concepts that apply at all scales. An individual, a community, a city, a country and any other socio-ecological system, in general, can be resilient, vulnerable or adapted. This is one of the reasons why these concepts are rather blurry. In the remainder of this paper the relevant socio-ecological system under consideration is the nation state, unless otherwise stated.

Table 4.1 Overview of vulnerability and resilience measures

Name	Variable	Definition	Direction of original indicator
INFORM	*informrisk*	The INFORM model is based on risk concepts published in scientific literature and envisages three dimensions of risk: hazards and exposure; vulnerability; and lack of coping capacity. The INFORM model is split into different levels to provide a quick overview of the underlying factors leading to humanitarian risk and builds up the picture of risk by 53 core indicators. All natural disaster hazards are included.	(–) higher values imply more risk
WRI, 2015	*wri2015*	WRI refers to the understanding of risk within the natural hazards and disaster risk community, where disaster risk is defined as the product of the interaction of physical hazards and the vulnerabilities of exposed elements. WRI = Exposure * [(1/3) * (Susceptibility + Lack of Coping Capacity + Lack of Adaptive Capacity]	(–) higher values imply more risk
ND-GAIN, 2014	*gain2014*	ND-GAIN shows countries' vulnerabilities caused by climate disruption, as well as their readiness to successfully implement adaptation solutions. ND-GAIN Score = (Readiness score – Vulnerability score + 1) * 50	(+) higher values imply better readiness or lower vulnerability
DARA, 2010	*dara2010*	The vulnerability assessment system indicates the level of climate-related vulnerability. Five vulnerability levels are statistically determined via (mean absolute) standard deviation.	(–) higher values imply more vulnerability
CRI	*criscore*	The CRI indicates the level of exposure and vulnerability to extreme events, it does not provide an all-encompassing analysis of the risks of anthropogenic climate change, but should be seen as just one analysis explaining countries' exposure and vulnerability to climate-related risks as only weather-related events — storms, floods, temperature extremes and mass movements (hot and cold waves etc.) — are incorporated.	(–) higher values imply more exposure and vulnerability
GCCA+	*gccascore*	The GCCA+ index captures vulnerability to climate change. It consists of four components: hazard, exposure, vulnerability and coping/adaptive capacity. Only climate-related hazards are included. GCCA+ score = [(Hazard * Exposure) + Vulnerability + (1 – Capacity)]/3	(–) higher values imply more exposure, higher vulnerability or lower capacity

Summary statistics of the indices are shown in Table 4.2. To some degree the different risk indices capture the same information. This can be seen in Table 4.3, where the correlation coefficients between the indices are depicted. While the overlap is far from perfect, there is considerable correlation between the different indices. It is worth noting that the CRI has negative correlations or no association at all with the other indices. INFORM, WRI, GCCA+ and GAIN were all comparatively strongly correlated with each other.

Table 4.2 Summary statistics of risk indices

Variable	No of observations	Mean	SD	Minimum	Maximum
informrisk	191	3.583	1.751	0.2	8.8
wri_2015	170	7.442	5.098	0.1	36.43
gain2014	180	47.574	13.434	18.13	75.13
dara2010	184	2.554	1.398	1	5
criscore	180	89.282	40.484	10.33	169.67
gccascore	111	0.465	0.076	0.24	0.62

SD, standard deviation.

Table 4.3 Correlation coefficients of risk indices — scores

	informrisk	*wri_2015*	*gain2014*	*dara2010*	*criscore*	*gccascore*
informrisk	1					
wri_2015	0.3861*	1				
gain2014	0.7442*	0.4403*	1			
dara2010	0.4590*	0.4846*	0.7359*	1		
criscore	–0.1987*	–0.1687*	0.0767	–0.0306	1	
gccascore	0.5662*	0.2114*	0.6113*	0.4690*	–0.1378	1

Note: Pearson correlation based on 93–184 observations; *$p < 0.05$.

4.1 Country rankings

As all indices used different metrics, country rankings resulting from the indices were calculated. Lower rankings indicate less vulnerability. Country rankings and index scores are, thus, positively correlated. The correlation coefficients between country rankings are shown in Table 4.4. It is obvious that correlation coefficients are slightly higher for almost all combinations of variables.

Table 4.4 Correlation coefficients of risk indices — ranks

	rank_inform	*rank_wri*	*rank_gain*	*rank_dara*	*rank_cri*	*rank_gcca*
rank_inform	1					
rank_wri	0.5727*	1				
rank_gain	0.7590*	0.6204*	1			
rank_dara	0.4672*	0.6030*	0.7550*	1		
rank_cri	–0.1811*	–0.1647*	0.0776	–0.0397	1	
rank_gcca	0.5564*	0.3655*	0.6874*	0.4964*	–0.026	1

Note: Pearson correlation based on 93–184 observations; *$p < 0.05$.

By using the Spearman rank correlation instead of the Pearson correlation to calculate correlation coefficients, the size of the coefficients and their significance are qualitatively similar for both score and rank.

5 Correlation between measures of culture and resilience

In this section we provide simple, unconditional correlation coefficients between cultural variables and composite indicators of climate risk. As will be seen, there is considerable correlation between most of these variables, providing evidence for the importance of cultural aspects of resilience. Our hypothesis, to be developed further below, relates cultural factors to a society's ability to cooperate and overcome collective action problems, thereby reducing vulnerability and fostering resilience to CC. The interpretation of the correlation coefficients and the relations indicated by these will be examined in the next sections.

5.1 Individualism and collectivism

The simple correlations, as presented in Table 5.1, suggested that more individualistic societies face lower CC risk and vulnerability, and are thus more resilient. The CRI score and the GCCA+ score show no correlation. The GCCA+ sample was probably too small. The CRI score is based on losses from extreme weather events, so cultural aspects should not matter greatly.[8]

Table 5.1 Simple correlations for individualism

	informrisk	*wri_2015*	*gain2014*	*dara2010*	*criscore*	*gccascore*
individualism	–0.52***	–0.47***	–0.68***	–0.45***	0.14	–0.02
	65	64	65	63	66	11
nondrop	–0.45***	–0.29*	–0.56***	–0.25*	0.04	0.26
	71	69	71	69	72	15

*p < 0.05, **p < 0.01, ***p < 0.001.

5.2 Religiousness

For our measures of religiosity, most correlation coefficients, shown in Table 5.2, indicate that more religiosity and a more intensive practice of religion are associated with greater CC risks and lower resilience. Again, the CRI and GCCA+ scores have very low correlations with most measures of religiosity. The results showed that religiousness might be related to socio-economic development. However, this phenomenon needs to be studied further.

[8] The coefficients reported in Section 5 are based on Pearson's correlation. Results are, in general, tested for robustness using the Spearman rank correlation. These statistics are available from the authors upon request.

Table 5.2 Simple correlations for religiousness

	informrisk	*wri_2015*	*gain2014*	*dara2010*	*criscore*	*gccascore*
religion_reg	0.50***	0.39***	0.61***	0.57***	–0.08	0.61***
	99	95	99	96	98	30
pray_reg	0.60***	0.33**	0.66***	0.50***	0.04	0.28
	68	65	68	66	66	15
belief_god	0.40***	0.16	0.49***	0.28**	0.20^{+}	–0.06
	91	87	91	89	90	24
important_god	0.60***	0.33***	0.74***	0.44***	0.15	0.15
	101	97	101	98	100	30

$^{+}p < 0.10$, $*p < 0.05$, $**p < 0.01$, $***p < 0.001$.

5.3 Ethnic, linguistic and religious fractionalisation

The correlations with measures of cultural heterogeneity are all positive, albeit not always significant, and sometimes rather small. Overall, however, a picture emerges that more heterogeneous and fractionalised societies face higher CC risks and exhibit less resilience. Table 5.3 shows the correlation coefficients for the heterogeneity measures used by Fearon (2003). Ethnic fractionalisation (*fe_etfra*) and ethnolinguistic fractionalisation (*elf*) in particular show consistently positive and, for the most part, considerable correlations. The data in Table 5.4 were calculated using the measures employed by Alesina et al. (2003). Coefficients are comparable to those from Fearon. The underlying argument, thoroughly developed in Section 9, is that more heterogeneity prevents cooperation in society and this increases vulnerability and reduces resilience. Note that religious fractionalisation (*al_religion*) is *not* statistically significantly related to any of the risk measures.

Table 5.3 Simple correlations for Fearon-measures of fractionalisation

	informrisk	*wri_2015*	*gain2014*	*dara2010*	*criscore*	*gccascore*
fe_cultdiv	0.30***	0.04	0.33***	0.32***	0.20*	0.17
	153	147	151	152	151	80
fe_etfra	0.43***	0.10	0.53***	0.49***	0.24**	0.40***
	154	148	152	153	152	81
Elf	0.42***	0.23*	0.50***	0.50***	0.17^{+}	0.24^{+}
	125	122	124	124	123	69
numgrps	0.35***	0.05	0.38***	0.37***	0.12	0.36**
	153	147	151	152	151	81

$^{+}p < 0.10$, $*p < 0.05$, $**p < 0.01$, $***p < 0.001$.

Table 5.4 Simple correlations for Alesina-measures of fractionalisation

	informrisk	*wri_2015*	*gain2014*	*dara2010*	*criscore*	*gccascore*
al_ethnic	0.47***	0.05	0.53***	0.44***	0.09	0.15
	93	91	93	92	94	29
al_language	0.43***	0.21^{+}	0.46***	0.52***	0.03	0.47*
	91	89	91	90	92	27
al_religion	0.01	0.03	–0.06	0.09	0.01	0.11
	93	91	93	92	94	29

$^{+}p < 0.10$, $*p < 0.05$, $**p < 0.01$, $***p < 0.001$.

6 Simple correlations of culture and the INFORM index

Composite indicators unite different concepts so that a more disaggregated look at how cultural variables relate to the concepts embodied within the composite indicators might provide additional understanding. We focus here on the INFORM index since it is available for the biggest country sample.

The INFORM index embodies 'hazard exposure', 'vulnerability' and 'lack of coping capacity', which are further subdivided into natural and human hazards, socio-economic vulnerability and vulnerable groups, and institutional and infrastructure as determinants of coping capacity (De Groeve et al., 2015). We consider the original index score to be level 1, the underlying concepts (hazard exposure, vulnerability, lack of coping capacity) to be level 2 and their sub-concepts, accordingly, to be level 3. For each group of cultural variables, a first table presents the correlations with level 1 and 2 concepts, and a second table the correlations with level 3 categories. The sub-indices and their different elements are depicted in Table A3 in the appendix.

The correlations indicate that culture and risk/resilience are mainly linked through vulnerability and the lack of coping capacity. This is not surprising. More interesting are the coefficients obtained at level 3. For almost all cultural variables, the correlation with infrastructure is more important than with institutional factors of coping capacity. Socio-economic vulnerability is always more important than vulnerable groups.

6.1 Individualism and collectivism

The correlation of *informrisk* and *individualism* (and *nondrop*) are mainly driven by the lack of coping capacity (see Table 6.1). At level 3 (Table 6.2) it becomes obvious that, not only are institution and infrastructure important determinants of coping capacity, but socio-economic vulnerability also has comparable large, negative correlation coefficients. It is, however, surprising that the exposure to natural hazards is also strongly negatively correlated with individualism.

Table 6.1 Individualism and INFORM level 1 and 2

	Informrisk	*Hazard exposure*	*Vulnerability*	*Lack of coping capacity*
individualism	–0.52***	–0.43***	–0.41***	–0.64***
	65	65	65	65
Nondrop	–0.45***	–0.43***	–0.27*	–0.50***
	71	71	71	71

$^{+}p < 0.10$, $*p < 0.05$, $**p < 0.01$, $***p < 0.001$.

Table 6.2 Individualism and INFORM level 3

	Natural	*Human*	*Socio-economic vulnerability*	*Vulnerable groups*	*Institutional*	*Infrastructure*
individualism	–0.42***	–0.36**	–0.62***	–0.19	–0.59***	–0.60***
	65	65	65	65	65	65
Nondrop	–0.41***	–0.38**	–0.43***	–0.11	–0.57***	–0.38**
	71	71	71	71	71	71

$*p < 0.05$, $**p < 0.01$, $***p < 0.001$.

6.2 Religiosity

At level 2 (Table 6.3) the proportion of people regularly attending religious services (*religion_reg*) is most strongly correlated with vulnerability. All other variables are most strongly linked with lack of coping capacity. At level 3 (Table 6.4,) socio-economic vulnerability and infrastructure have the highest correlation coefficients.

Table 6.3 Religiosity and INFORM levels 1 and 2

	Informrisk	*Hazard exposure*	*Vulnerability*	*Lack of coping capacity*
religion_reg	0.50***	0.32**	0.56***	0.53***
	99	99	99	99
pray_reg	0.60***	0.46***	0.61***	0.62***
	68	68	68	68
belief_god	0.40***	0.25*	0.41***	0.47***
	91	91	91	91
important_god	0.60***	0.43***	0.55***	0.66***
	101	101	101	101

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

Table 6.4 Religiosity and INFORM level 3

	Natural	*Human*	*Socio-economic vulnerability*	*Vulnerable groups*	*Institutional*	*Infrastructure*
religion_reg	0.18^{+}	0.37***	0.66***	0.40***	0.32**	0.63***
	99	99	99	99	99	99
pray_reg	0.29*	0.50***	0.66***	0.45***	0.52***	0.64***
	68	68	68	68	68	68
belief_god	0.12	0.31**	0.48***	0.28**	0.42***	0.44***
	91	91	91	91	91	91
important_god	0.24*	0.48***	0.64***	0.38***	0.60***	0.62***
	101	101	101	101	101	101

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

6.3 Ethnic, linguistic and religious fractionalisation

Table 6.5 Fractionalisation and INFORM level 1 and 2

	Informrisk	*Hazard exposure*	*Vulnerability*	*Lack of coping capacity*
fe_cultdiv	0.30***	0.14^{+}	0.32***	0.36***
	153	153	153	153
fe_etfra	0.43***	0.14^{+}	0.52***	0.52***
	154	154	154	154
Elf	0.42***	0.14	0.48***	0.51***
	125	125	125	125
numgrps	0.35***	0.14^{+}	0.41***	0.39***
	153	153	153	153

$^{+}p < 0.10$, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

The variables of cultural heterogeneity are much more related to vulnerability and coping capacity than to hazard exposure (see Table 6.5). At level 3 (Table 6.7) it is seen that the measures of fractionalisation are most strongly related to socio-economic vulnerability and infrastructure. This also holds true for the fractionalisation measures from Alesina et al. (2003). Again, religious fractionalisation is unrelated to these risk and

resilience measures.

Table 6.6 Fractionalisation and INFORM level 3

	Natural	*Human*	*Socio-economic vulnerability*	*Vulnerable groups*	*Institutional*	*Infrastructure*
fe_cultdiv	–0.04	0.23**	0.35***	0.23**	0.23**	0.40***
	153	153	153	153	153	153
fe_etfra	–0.06	0.26**	0.56***	0.37***	0.36***	0.58***
	154	154	154	154	154	154
elf	–0.03	0.24**	0.50***	0.36***	0.36***	0.57***
	125	125	125	125	125	125
numgrps	–0.03	0.24**	0.42***	0.33***	0.23**	0.46***
	153	153	153	153	153	153

$^{+}p < 0.10$, $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

Table 6.7 Fractionalisation and INFORM levels 1 and 2

	Informrisk	*Hazard exposure*	*Vulnerability*	*Lack of coping capacity*
al_ethnic	0.47***	0.27**	0.48***	0.54***
	93	93	93	93
al_language	0.43***	0.22*	0.49***	0.47***
	91	91	91	91
al_religion	0.01	–0.06	0.04	0.06
	93	93	93	93

$^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

Table 6.8 Fractionalisation and INFORM level 3

	Natural	*Human*	*Socio-economic vulnerability*	*Vulnerable groups*	*Institutional*	*Infrastructure*
al_ethnic	0.09	0.37***	0.56***	0.33**	0.39***	0.56***
	93	93	93	93	93	93
al_language	0.04	0.33**	0.54***	0.38***	0.27**	0.55***
	91	91	91	91	91	91
al_religion	–0.05	–0.10	0.06	0.03	–0.01	0.08
	93	93	93	93	93	93

$^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

7 Conditional correlations

All cultural measures analysed are strongly correlated with socio-economic development (see Table 7.1; summary statistics for the socio-economic variables are presented in Table 7.2), which is, of course, a main determinant of vulnerability and the capacity to cope with adverse events. The observed correlations might thus be driven by the covariation between the cultural variables, economic development and the elements of the composite indicators. To assure that cultural variables are related to risk/resilience conditional on economic development, multivariate regression analysis was employed. Multivariate regressions also allowed us to analyse if individualism, religiosity and cultural heterogeneity are jointly related to risk/resilience.

In general, multivariate regression analysis is used to explain a dependent variable with a set of explanatory, independent variables. As the composite index contains measures of socio-economic development, endogeneity of the estimates is an issue. To attenuate the problem of endogeneity we constructed an indicator variable from the composite index, grouping the countries into quintiles and alternatively, for robustness checks, into deciles. We again focused on INFORM. The newly constructed indicator variables, as well as the measures of socio-economic development, are summarised in Table 7.2. We are aware that our analysis is not suited to identification of a causal relation. Additionally, estimates may still be biased owing to endogeneity bias.

Table 7.1 Correlation coefficients of risk indices/cultural variables with per capita GDP (purchasing power parity)/Human Development Index

	gdp_pc_ppp	undp_hdi
Informrisk	–0.61***	–0.75***
	180	184
wri_2015	–0.41***	–0.40***
	165	170
gain2014	–0.69***	–0.91***
	174	180
dara2010	–0.60***	–0.74***
	175	179
Criscore	0.22**	–0.03
	174	178
Gccascore	–0.59***	–0.67***
	101	102
religion_reg	–0.38***	–0.63***
	97	100
pray_reg	–0.42***	–0.61***
	66	68
belief_god	–0.30**	–0.38***
	89	91
important_god	–0.36***	–0.61***
	99	102

	gdp_pc_ppp	undp_hdi
individualism	0.54***	0.65***
	64	65
nondrop	0.40***	0.44***
	70	71
al_ethnic	–0.24*	–0.50***
	91	94
al_language	–0.24*	–0.52***
	89	92
al_religion	–0.12	–0.05
	91	94
fe_cultdiv	–0.17*	–0.38***
	146	151
fe_etfra	–0.35***	–0.54***
	147	152
elf	–0.44***	–0.57***
	119	124
numgrps	–0.30***	–0.44***
	146	151

Table 7.2 Summary statistics (inform_quint, inform_dec, pc_gdp_ppp and undp_hdi)

Variable	No of observations	Mean	SD	Minimum	Maximum
inform_quint	191	2.979	1.429	1	5
inform_dec	191	5.419	2.915	1	10
gdp_pc_ppp	187	18 381.33	21 539.45	697.87	140 707.8
undp_hdi	185	0.651	0.160	0.288	0.909

SD, standard deviation.

7.1 Individualism and religiosity

Employing ordered logit regressions, the results of the unconditional correlations from sub-sections 5.1 and 5.2 are reproduced with the new indicator variable (*inform_quint*). As shown in Table 7.3, the variables *individualism* and *nondrop* reduce the likelihood that a country is in a high-risk group and the proxies of religiosity increase the likelihood. If socio-economic development, e.g. in the form of per capita GDP in purchasing power parity (PPP) (*gdp_pc_ppp*) is included (Table 7.4), the result for individualism disappears and the coefficient for the linguistic correlate of individualism (*nondrop*) is smaller and has a much higher *p*-value. This indicates that the relation between resilience or vulnerability and individualism are indeed mostly because more individualistic countries have on average, a higher level of socio-economic development, although this does not imply causation.

Table 7.3 Ordered logit estimates for individualism and religiousness

inform_quint	(1)	(2)	(3)	(4)	(5)	(6)
individualism	–0.042***					
	(–3.80)					
nondrop		–2.047***				
		(–3.86)				
religion_reg			4.631***			
			(5.31)			
pray_reg				6.020***		
				(5.08)		
belief_god					5.691***	
					(3.84)	
important_god						0.813***
						(6.10)
N	65	71	99	68	91	101

The *t* statistic is presented in parentheses; **p* < 0.05, ***p* < 0.01, ****p* < 0.001.

The coefficients for religiosity (Table 7.4) are all positive and highly significant, and remain so after controlling for socio-economic development. Accordingly, the relation of religiosity to resilience is, at best, partly mediated through the relation of religiosity with socio-economic development.

Table 7.4 Ordered logit estimates for individualism and religiousness with pc GDP

inform_quint	(1)	(2)	(3)	(4)	(5)	(6)
gdp_pc_ppp	–0.000***	–0.000***	–0.000***	–0.000***	–0.000***	–0.000***
	(–4.23)	(–4.64)	(–5.78)	(–4.16)	(–5.58)	(–5.21)
individualism	0.003					
	(0.19)					
nondrop		–1.054+				
		(–1.72)				
religion_reg			3.066***			
			(3.35)			
pray_reg				4.229***		
				(3.37)		
belief_god					3.046*	
					(2.42)	
important_god						0.580***
						(3.99)
N	63	69	97	66	89	99

The *t* statistic is presented in parentheses; +$p < 0.10$, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

7.2 Ethnic, linguistic and religious fractionalisation

The unconditional correlation results from section 5.3 have been confirmed (see Table 7.5).[9] A higher level of ethnic or ethnolinguistic fractionalisation (*al_ethnic*, *al_language*, *fe_etrfa*, *elf*), more cultural diversity (*fe_cultdiv*) and a higher number of ethnic groups (*numgrps*) all increase the probability of a country being in a high-risk country group. If socio-economic development is added to the estimations (see Table 7.6), coefficients become smaller and *p*-values increase, but the results are qualitatively unchanged. Cultural heterogeneity seems to have a relation with CC risk beyond its relation with socio-economic development.[10]

Table 7.5 Ordered logit estimates for fractionalisation

inform_quint	(1)	(2)	(3)	(4)	(5)	(6)
al_ethnic	4.165***					
	(4.72)					
al_language		3.247***				
		(4.33)				
fe_cultdiv			2.673***			
			(3.72)			
fe_etfra				3.412***		
				(5.60)		
Elf					3.296***	
					(5.32)	
numgrps						0.216***
						(4.36)
N	93	91	153	154	125	153

The *t* statistic is presented in parentheses; *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

[9] For reasons of exposition, religious fractionalisation (*al_religion*) is not included in this and the following tables. Religious fractionalisation was not related to any of our resilience measures and is also not significant in any estimates presented in the current section.

[10] Some authors claim that there is a causal relation between cultural heterogeneity and socioeconomic development (e.g. Easterly and Levine, 1997; Alesina et al., 2003).

Table 7.6 Ordered logit estimates for fractionalisation with per capita GDP

inform_quint	(1)	(2)	(3)	(4)	(5)	(6)
gdp_pc_ppp	–0.000***	–0.000***	–0.000***	–0.000***	–0.000***	–0.000***
	(–5.31)	(–6.40)	(–7.66)	(–7.14)	(–6.58)	(–7.38)
al_ethnic	2.179*					
	(2.12)					
al_language		1.740*				
		(2.05)				
fe_cultdiv			2.045**			
			(2.59)			
fe_etfra				2.117**		
				(3.11)		
elf					1.768*	
					(2.56)	
numgrps						0.107*
						(2.12)
N	91	89	146	147	119	146

The *t* statistic is presented in parentheses; **p* < 0.05, ***p* < 0.01, ****p* < 0.001.

7.3 All categories of cultural variables

Finally, all three aspects of culture, individualism, religiosity and cultural heterogeneity, were looked at together. Table 7.7 presents the results for when the variables for cultural heterogeneity were added to socio-economic development (*gdp_pc_ppp*) and religiosity (i.e. percentage of population that regularly attends religious services, *religion_reg*). Socio-economic development and religiosity produced the expected results and were highly significant. For cultural heterogeneity the coefficients were positive, but only in half of cases were they significant.

Table 7.7 Ordered logit estimates

inform_quint	(1)	(2)	(3)	(4)	(5)	(6)
gdp_pc_ppp	–0.000***	–0.000***	–0.000***	–0.000***	–0.000***	–0.000***
	(-4.76)	(-5.31)	(-5.42)	(-5.28)	(-4.98)	(-5.19)
religion_reg	2.931**	3.205**	3.291***	3.024**	1.315	3.196**
	(2.89)	(3.08)	(3.33)	(3.02)	(0.99)	(3.23)
al_ethnic	1.480					
	(1.38)					
al_language		1.208				
		(1.36)				
fe_cultdiv			1.985+			
			(1.83)			
fe_etfra				1.433		
				(1.52)		
elf					2.652**	
					(2.59)	
numgrps						0.144+
						(1.85)
N	89	87	92	92	69	91

The *t* statistic is presented in parentheses; +*p* < 0.10, **p* < 0.05, ***p* < 0.01, ****p* < 0.001.

If, alternatively, the percentage of people stating that God is important (*important_god*) was used to capture religiousness (Table 7.8), coefficients increased slightly and *p*-values decreased. The measures for ethnic fractionalisation (*al_ethnic*, *fe_etfra*) remained insignificant. Both socio-economic development and religiosity had the expected effect and were highly significant.

Table 7.8 Ordered logit estimates

inform_quint	(1)	(2)	(3)	(4)	(5)	(6)
gdp_pc_ppp	–0.000***	–0.000***	–0.000***	–0.000***	–0.000***	–0.000***
	(–4.30)	(–4.68)	(–4.87)	(–4.77)	(–4.78)	(–4.54)
important_god	0.571***	0.619***	0.613***	0.572***	0.399*	0.626***
	(3.63)	(3.90)	(3.98)	(3.67)	(2.36)	(4.05)
al_ethnic	1.700					
	(1.61)					
al_language		1.873*				
		(2.17)				
fe_cultdiv			2.213*			
			(2.03)			
fe_etfra				1.449		
				(1.57)		
Elf					2.971**	
					(2.99)	
numgrps						0.172*
						(2.26)
N	91	89	93	93	70	92

The *t* statistic is presented in parentheses; *$p < 0.05$, * $p < 0.01$, ***$p < 0.001$.

In a final step, we added the linguistic correlate of individualism to the estimations to understand how the three aspects of culture jointly determine the probability of a country being in a high-risk group. Table 7.9 shows the estimated coefficients when the INFORM-quintiles are jointly explained by socio-economic development, the linguistic characteristic of keeping the pronoun, religiosity and the different measures of ethnic or linguistic heterogeneity. All coefficients have the expected sign. All measures of heterogeneity are strongly significant. However, while *nondrop* is significant at the $p < 0.1$ level, religiosity, as measured by the proportion of respondents who regularly attend religious service, is insignificant.

If, alternatively, the importance of God (*important_god*) is used as a measure of religiosity (Table 7.10), the coefficients for *nondrop* are insignificant and those for religiosity are significant. If the actual individualism measure (*individualism*) is employed instead of *nondrop*, individualism is always insignificant and religiosity has a significant and positive effect for most estimates, independent of which proxy is being used.

Table 7.9 Ordered logit estimates

inform_quint	(1)	(2)	(3)	(4)	(5)	(6)
gdp_pc_ppp	–0.000**	–0.000***	–0.000***	–0.000**	–0.000**	–0.000**
	(–2.88)	(–3.31)	(–3.56)	(–3.11)	(–3.22)	(–3.00)
Nondrop	–1.314^{+}	–1.295^{+}	–1.451*	–1.343^{+}	–1.575^{+}	–1.334^{+}
	(–1.87)	(–1.80)	(–2.11)	(–1.94)	(–1.94)	(–1.85)
religion_reg	0.908	1.434	1.243	1.024	0.966	1.701
	(0.58)	(0.95)	(0.86)	(0.68)	(0.58)	(1.18)
al_ethnic	4.067**					
	(2.65)					
al_language		2.710*				
		(2.10)				
fe_cultdiv			5.186**			
			(3.11)			
fe_etfra				3.719**		
				(2.80)		
elf					3.951**	
					(2.82)	
numgrps						0.230*
						(2.19)
N	59	58	62	62	55	61

The *t* statistic is presented in parentheses; $^{+}p < 0.10$, $*p < 0.05$, $**p < 0.01$, $***p < 0.001$.

We conclude that the degree of religiosity and ethnic and linguistic heterogeneity are related to climate change risk and resilience beyond their effect on socioeconomic development. This is not the case for individualism. Whether or not this relation is causal in nature, and how these cultural aspects influence risk and resilience requires further research. Some preliminary hypothesis to explain these data are discussed in Section 9.

Table 7.10 Ordered logit estimates

inform_quint	(1)	(2)	(3)	(4)	(5)	(6)
gdp_pc_ppp	–0.000**	–0.000***	–0.000***	–0.000***	–0.000***	–0.000**
	(–3.01)	(–3.53)	(–3.62)	(–3.32)	(–3.29)	(–3.17)
nondrop	–0.782	–0.669	–0.897	–0.703	–1.004	–0.734
	(-1.06)	(–0.90)	(-–1.21)	(–0.95)	(–1.21)	(–0.97)
important_god	0.442*	0.552**	0.512**	0.443*	0.528*	0.517**
	(2.24)	(2.84)	(2.63)	(2.21)	(2.42)	(2.66)
al_ethnic	3.455*					
	(2.36)					
al_language		2.526*				
		(2.19)				
fe_cultdiv			4.825**			
			(3.01)			
fe_etfra				2.789*		
				(2.14)		
elf					3.872**	
					(2.99)	
numgrps						0.199^{+}
						(1.94)
N	60	59	63	63	56	62

The *t* statistic is presented in parentheses; $^{+}p < 0.10$, $*p < 0.05$, $**p < 0.01$, $***p < 0.001$.

8 Robustness checks, alternative measures and results for the EU-28 sample

In this section the robustness of the results obtained in Section 7 for alternative specifications are discussed. The extension of the multivariate analysis to the alternative measures of risk/resilience are reported. Sub-section 8.3 reports the results for the analysis of Sections 5–7, performed on the restricted sample of EU-28 countries.

8.1 Robustness checks

The estimations from Section 7 were repeated with four basic modifications.[11] Firstly, to measure socio-economic development, the Human Development Index (HID) (Jahan, 2015) was employed instead of per capita GDP. This leaves the results qualitatively unchanged. If, however, *individualism* is included in the specification with all cultural categories instead of *nondrop*, most estimated coefficients for ethnic and linguistic heterogeneity become insignificant. Religiosity, however, remains important.

Secondly, instead of the ordered logit the ordered probit technique was used for estimation. Again, there is no qualitative change. In a third specification change, the dependent variable was changed: instead of using quintiles of INFORM, deciles were used. The use of deciles instead of quintiles resulted in a slight increase in the *p*-values of the estimates for cultural heterogeneity. Most of the coefficients that are significant at $p < 0.01$ for quintiles are significant only at $p < 0.1$ for deciles. While the quantitative results became somewhat weaker, the conclusions do not require modification.

Finally, the original INFORM score was used as a dependent variable and estimations were performed using standard ordinary least squares (OLS). This method uses all the information contained in the index. However, problems with endogeneity are excessive in this case. If socio-economic development is measured by per capita GDP, the results are qualitatively similar to those reported in Section 7 and the conclusion remains unchanged. If, instead, the HDI is used, almost all cultural variables become insignificant for all specifications. Only the percentage of respondents who find God important in life (*important_god*) shows significant effects in those specifications that include all cultural categories.

It is noteworthy that the use of the HDI considerably reduces the importance of cultural heterogeneity and most measures of religiosity. However, the HDI is an element of the INFORM index and endogeneity, accordingly, is rampant. The HDI is a composite index combining health and long life, knowledge and economic development. The question of how the elements of the HDI are related to the risk indictors and to the cultural aspects is an interesting one for future analysis.

[11] Regression tables can be obtained from the authors upon request.

8.2 Multivariate regressions with alternative risk and resilience measures

The regression analysis for the alternative measures of resilience presents a mixed picture. With data from the WRI, the effect of the cultural variables vanishes if jointly estimated with per capita GDP. For the regressions with all cultural categories, only some religious variables show a significant and positive association. In contrast, for the ND-GAIN index, the cultural variables have explanatory power also if socio-economic development is included in the calculation. For all cultural categories, individualism is not a significant factor; most estimates for religiousness re significant, with the expected positive correlation, and some of the cultural heterogeneity variables are also significant and positively related.

A different result is obtained if the DARA data are used as dependent variables. While individualism and religiosity were not significant when controlling for socio-economic development, ethnic and linguistic heterogeneity remained important. This held also true when all categories are included simultaneously. When the Global CRI data are examined, the inclusion of socio-economic development makes some variables of religiousness and cultural diversity significant. The CRI, which is very hazard driven, shows a positive, albeit largely insignificant, effect of the examined variables on socio-economic development.[12] Overall, these results strengthen the notion that religiosity and to some degree cultural heterogeneity (but not individualism) are related to climate change risk and resilience.

8.3 The EU-28 sample

To understand if and how this analysis is applicable in the European Union context, the analytical steps of Sections 5 and 7 were repeated on a sample of EU-28 countries only. In this sub-section we provide an overview of the findings.[13] The analysis was restricted to a cross-section as cultural attributes are slow-changing and no reasonable times-series data is available. As this analysis was restricted to a cross-section of 28 countries, sample size was an issue.

The individualism variables have significant negative correlations with resilience indicators; for religiousness variables, which are all positively correlated, only those correlations with the ND-GAIN index (*gain2014*) are significant. For the variables of cultural heterogeneity, some correlation coefficients have a negative sign. The results from the WRI index show that those correlations are significant, indicating that more ethnically diverse countries in Europe could be more resilient.

[12] The positive correlation between hazard exposure and socio-economic development could be driven by reporting bias or the fact that relatively more assets are being insured in more developed countries. For a discussion, see for example, Neher and Miola (2015).

[13] All tables are available upon request.

Table 8.1 Ordered logit estimates EU-28 sample

inform_quint	(1)	(2)	(3)	(4)	(5)	(6)
gdp_pc_ppp	–0.000^{+}	–0.000	–0.000^{+}	–0.000	–0.000*	–0.000
	(–1.86)	(–1.24)	(–1.84)	(–1.59)	(–2.20)	(–1.48)
important_god	0.285	0.882*	0.643*	0.634^{+}	0.803^{+}	0.914*
	(0.97)	(2.27)	(2.01)	(1.93)	(1.76)	(2.37)
al_ethnic	–1.341					
	(–0.54)					
al_religion		6.215*				
		(2.34)				
fe_cultdiv			–3.878			
			(–1.24)			
fe_etfra				–0.845		
				(–0.34)		
elf					6.196	
					(1.50)	
numgrps						0.372
						(1.15)
N	27	27	25	25	17	24

The *t* statistic is presented in parentheses; $^{+}p < 0.10$, $*p < 0.05$, $**p < 0.01$, $***p < 0.001$.

Employing multivariate regressions, a picture similar to the one in Table 8.1 emerges for all kind of specifications (also with *individualism* or *nondrop* included). Individualism and ethnic heterogeneity are not significant. The variables for religiosity are significant, however, particularly when taken together with the measure of religious heterogeneity (*al_religious*). This positive and significant effect for religiosity (all measures) and religious heterogeneity was found in all estimations, including those in which HDI was used instead of per capita GDP. We conclude that for the European Union, in contrast to the global perspective, religiousness and religious heterogeneity are more important and ethnic diversity less important with respect to resilience to climate change.

9 Why does culture relate to risk from and resilience to climate change?

We argue for two basic mechanisms that link cultural characteristics to resilience to climate change. Arguably the more important mechanism, on which most attention is focused, rests on the argument that culture systematically influences a society's propensity to cooperate and overcome problems of collective action. Both are seen as crucial inputs for resilience.[14] The argument is built on a trove of results from the published literature, and individualism, religiousness and cultural heterogeneity will each be discussed separately. An alternative, but rather general, link from culture to resilience is the phenomenon of cultural cognition, which provides a culture-based explanation for disagreement about 'empirical dimensions of public policy questions' (Kahan and Braman, 2015). It is obvious that widespread disregard of climate change within a society would reduce efforts to build adaptive capacity, thereby reducing resilience.[15]

What aspects of culture determine a society's propensity to cooperate?

While the evolutionary foundations of human cooperation are hotly debated in the literature (Smith, 2010; Boyd et al., 2011; Gintis et al., 2012; Rand and Nowak, 2013), there is widespread agreement that humans' ability and propensity to cooperate is a decisive factor for the success of the species (e.g. Gächter et al., 2010; Roos et al., 2015). As Simpson and Willer (2015) point out, cooperation can be explained by causes internal to the individual (altruism, pro-social preferences) or causes external to the individual (social norms, networks and reputation systems). The internal and external components are, however, most certainly interdependent (e.g. Fehr and Hoff, 2011). Some degree of cooperation is implicit in most aspects of society, and social preferences that facilitate cooperation are widespread: Bruhin et al. (2016) measure preferences implied by behaviour in experiments and claim that 40% of the population strongly care for the payoffs of their fellow humans (strong altruists).[16]

In the endeavour to understand human cooperation, the problem of separating the effects of culture and institutions arises continuously.[17] Some authors identify culture as a driver of institutions (Licht et al., 2007; Pryor, 2008; Mathers and Williamson, 2011; Maseland, 2013), others identify institutions as a cause of cultural variance (Tabellini, 2008; Henrich, 2015; Lowes et al., 2015a) and a third view emphasises a co-evolution of culture and institutions (Richerson and Henrich, 2009; Greif and Tabellini, 2010, 2015; Gächter and Schulz, 2016). A review of this literature is provided by Alesina and

[14] A positive relation between social capital, a close correlate of cooperation, and resilience is shown by Carter and Maluccio (2003).

[15] For a more detailed account, refer to Kahan (2012), and especially Kahan et al. (2012).

[16] The relation between preferences and cooperative behaviour is itself a tricky question. If cooperation implies a trade-off at the individual level between the optimal strategy for the individual and the optimal strategy for the collective, altruists are not cooperators in this sense since individual and collective optimal behaviour is aligned.

[17] The problems related to the conceptual fuzziness of 'culture' have been mentioned repeatedly. The concept of institutions faces similar problems. Institutions could refer to governments and corporations, specific rules of governance, the rule of law and even social norms. Social norms are often regarded as an aspect of culture so that there is a potential conceptual overlap between institutions and culture.

Giuliano (2015). A similar notion of circularity emanates from the literature on trust and institutions, in which trust is generally perceived as a specific cultural characteristic closely linked to cooperation.[18]

We now return to the specific cultural characteristics that have been the object of our quantitative analysis and related findings from the literature.

9.1 Individualism/collectivism

There is some evidence that in individualistic societies there are more conditional cooperators and, thus, higher levels of cooperation (Hermann et al., 2008). The findings of Hermann et al. (2008) are corroborated by so far unpublished experiments by Schulz and co-authors, which also show that, in public good games with punishment, played across a large number of societies, contribution levels decrease and anti-social punishment increases with the level of collectivism.[19] At first sight, this is a surprising result since, by definition, collectivists put greater emphasis on the collective and thus should be more willing to cooperate and give up individual benefit for the benefit of the group (as argued by, for example, Wagner, 1995). This line of argument, however, neglects the fact that the relevant group for which the collectivist is willing to sacrifice individual benefits is of limited size, namely his or her in-group. It is precisely this in-group bias that reduces the propensity to cooperate in society at large. A similar argument is used in what Banfield calls 'amoral familism' (Banfield, 1967).[20] In the words of Greif in a paper on cultural beliefs:

> "In collectivist societies the social structure is 'segregated' in the sense that each individual socially and economically interacts mainly with members of a specific religious, ethnic, or familial group in which contract enforcement is achieved through 'informal' economic and social institutions, and members of collectivist societies feel involved in the lives of other members of their group. At the same time, noncooperation characterizes the relations between members of different groups. In individualist societies the social structure is 'integrated' in the sense that economic transactions are conducted among people from different groups and individuals shift frequently from one group to another."
>
> (Greif, 1994, p. 913)

The grammatical category of pronoun drop is strongly related to collectivism; the propensity to cooperate should be lower in countries with languages that drop the pronoun (Kashima and Kashima, 1998, 2003).

However, individualism/collectivism and underlying grammatical structures of the language do not only affect the propensity to cooperate, but might also directly or

[18] This will be further discussed below. For a literature survey on trust, see Algan and Cahuc (2013).
[19] On antisocial punishment, see Hermann et al. (2008).
[20] Experiments have in fact shown that strong family ties inhibit the generalized trust necessary for collective cooperation (Ermisch and Gambetta, 2010).

indirectly affect socio-economic and institutional development. Gorodnichenko and Roland (2011a, b, 2012) show that individualism is a determinant of long-term economic growth. It has also been shown that individualism induces democratisation and improves governance (Licht et al., 2007; Davis and Abdurazokzoda, 2015; Gorodnichenko and Roland, 2015) while collectivism promotes corruption (Mazar and Aggarwal, 2011).

As discussed previously, our results indicate that the positive effect of individualism on higher levels of resilience vanishes once socio-economic development is taken into account. The effect of individualism on development and institutions might be driven by the propensity to cooperate. However, the effect of individualism on the propensity to cooperate does not directly foster resilience, but is more probably moderated via socio-economic development.

9.2 Religiousness

Religiousness is in general associated with pro-social behaviour (e.g. Hoffmann, 2013; Preston and Ritter, 2013). Although pro-social behaviour is necessary but not sufficient for cooperative behaviour, it is difficult to align our results with our fundamental premise that specific cultural aspects affect resilience via their influence on society's propensity to cooperate. In fact, experimental studies have shown that people who are more religious are not any more or less cooperative than those who are not (Chuah et al., 2014, and references therein). What could explain the observation that more religious countries are less resilient?

At the outset it is important to emphasise that religiousness is a complex phenomenon that might induce different behaviours in individuals contingent on the intensity of religious beliefs, the content of religious beliefs, the difference in religious practices and the social context. For example, Preston and Ritter (2013) showed that priming of individuals with 'religion' directs their pro-social behaviour towards the in-group while priming with 'God' directs the pro-social behaviour towards the out-group. In addition, while it has often been found that people who are more religious prefer lower levels of state redistribution of income, Jordan (2014) showed that this effect depends on the denomination of the respondents.

Could there be a similar effect to the one seen for collectivism, namely that more religious individuals have a stronger in-group bias? This does not seem to be the case. The variable religious fractionalisation (fractionalisation will be discussed in more detail below) never showed any statistically significant relation with resilience or vulnerability to climate change, even when it interacted with the intensity of religious beliefs. If there was in-group bias, the negative effect of in-group-bias on cooperation should increase with the number of religious groups in society.[21] What alternative explanations are there?

[21] Chuah et al. (2014, 2015) claim that religious similarity increases trust and cooperation while the knowledge of religious difference does not reduce it.

Barro and McCleary (2003) found a differential effect of religious beliefs and religious practices. While religious beliefs were positively associated with economic growth, an increase in religious activities, such as church attendance, ceteris paribus had a negative correlation with growth. The authors hypothesise that religious beliefs are an output of the religion sector while church attendance is an input in the religion sector so that 'for given beliefs, higher church attendance signifies more resources used up the religious sector' (Barro and McCleary, 2003, p. 760).

Bénabou et al. (2015) constructed a political economy model to analyse the interplay between science, religion and growth. Their model results in three possible long-term outcomes (1) a secularised society with declining religiosity and high levels of innovation, taxation and secular public spending; (2) a theocratic society with knowledge stagnation, high taxes and high subsidies to the religious sector; and (3) an intermediary regime in which inequality can create interesting effects. More importantly for the present context, the authors uncovered a novel empirical regularity, namely that societies that are more religious have significantly lower levels of innovation. The model does not explicitly assume that the religious sector is conservative and defies innovation, but simply assumes that there are costs of adaptation for the religion to adapt to new scientific discoveries. Research evaluating personality traits and values has in fact established that individuals who are more religious tend to be more conservative and have a dislike for new things (Saroglou et al., 2004).

The findings of Bénabou et al. (2015) and Barro and McCleary (2003) could provide one explanation for why we observe a negative statistical relation between religiousness and resilience, namely that lower levels of innovation coupled with comparatively more inputs into the religious sector in societies that are more religious might result in comparatively lower levels of adaptive capacity, thus increasing vulnerability and reducing resilience. On an individual level, conservatism and a dislike for new things might, in the vein of cultural cognition, reduce individuals' acceptance of scientific forecasts and perceptions of CC and, thus, reduce individual and collective willingness to engage in adaptive activities with respect to those events, resulting in lower levels of adaptive capacity and less resilience as a consequence.

9.3 Fractionalisation

The third cultural category under review is a structural category in the sense that all measures capture structural characteristics of society. We interchangeably call this aspect of culture fractionalisation, diversity or heterogeneity with respect to ethnicity, language and religion, respectively. Sometimes we also refer to this category as cultural heterogeneity, which is, however, not strictly correct as cultural and ethnic heterogeneity are not the same thing (Desmet et al., 2015).[22] We first look to see if the literature on cultural and ethnic heterogeneity supports our central hypothesis that culture affects resilience by way of influencing society's propensity to cooperate. Often,

[22] The literature on ethnic heterogeneity sometime further differentiates between fragmentation, polarisation and segregation of ethnic groups. These complexities were not considered in the present context.

this link is established not directly but by way of trust or social capital, which are intimately linked to cooperation (e.g. Carpenter et al., 2004; Gächter et al., 2004; Thöni, 2015). We will then consider alternative transmission mechanisms linking fractionalisation to resilience.

There is a literature that establishes a link between ethnic and cultural heterogeneity and lower levels of trust, cooperation and reduced provisions of public goods. Alesina et al. (1999) showed that in US cities the supply of productive public goods decreased with an increase in ethnic fragmentation. Habyarimana et al. (2007) undertook experiments in Africa that showed that ethnic diversity undermines the provision of public goods. The authors also proposed an explanation as to why it does.

A number of contributions have established that ethnic, linguistic and cultural diversity are detrimental to generalised (and potentially personal) trust (Alesina and La Ferrara, 2000; Alesina and La Ferrara, 2002; Leigh, 2006; Dincer, 2011; Algan and Cahuc, 2013). Trust and social capital[23] in turn have a well-established and intimate link to cooperation (e.g. Pretty, 2003; Carpenter et al., 2004; Gächter et al., 2004, 2010; Thöni et al., 2012; Thöni, 2015). This link is so ingrained that trust and cooperation are often mentioned together as if they are similar concepts (e.g. Carpenter et al., 2004). Thöni et al. (2012) argue that survey questions on trust are a proxy for individual 'preferences for cooperation'.

Why might the existence of multiple ethnic, linguistic and cultural groups hamper the overall propensity to cooperate? Several possible explanations are identified in the literature; in-group bias based on social identity and the observability of behaviour are probably the two more important explanations, but equity concerns or social connectedness could also play a role. In the latter case, experiments have shown that in smaller groups and in groups where players had pre-game interaction, better coordination and cooperation outcomes could be achieved (Attanasi et al., 2016). Social distance has also been shown to decrease trust levels (Binzel and Fehr, 2013). With respect to equity concerns, Gangadharan et al. (2015) found that more heterogeneous populations achieve less efficient outcomes because, in such populations, some efficiency is traded for more equitable outcomes.

Individuals identify with groups along the lines of ethnicity, language and culture. Rustagi and Veronesi (2016) showed that individuals' social identity is paramount for their propensity to cooperate. The phenomenon that ethnic identity often results in an in-group preference that necessarily sets back the out-group has been discussed, for example by Lowes et al. (2015b). A special form of ethnic in-group bias is ethnic favouritism, i.e. political leaders favour their own ethnic group. This effect is shown to have robust economic impacts (De Luca et al., 2015). Finally, a number of authors have established peer effects in the sense that cooperative acts by individuals that are observable to others in the group increase reciprocity and thus improve overall levels of cooperation (Rand et al., 2014; Dimant, 2015; Kraft-Todd et al., 2015).

[23] Social capital is a broader concept than trust. However, trust is the most commonly used proxy variable to measure social capital.

In addition, there are a number of alternative mechanisms not directly related to trust and cooperation that could also create a negative association between ethnic and cultural fragmentation and the resilience to climate change. Ethnic and linguistic cleavages are said to negatively impact economic growth (e.g. Easterly and Levine, 1997; Alesina et al., 2003; Desmet et al., 2016).[24] Further, the negative effect of ethnic and cultural heterogeneity on trust and social capital could lead to a reduction in institutional quality (Alesina et al., 2003; Tabellini, 2008; Brondizio et al., 2009; Bjørnskov, 2010; Nannicini et al., 2013), increase corruption (Dincer, 2008; Graeff and Svendsen, 2013; Graf Lambsdorff, 2015) and decrease economic growth (Algan and Cahuc, 2013; Bjørnskov and Méon, 2013; Serritzlew et al., 2014).

[24] These findings are questioned by Arcand et al. (2000) and Arcand and Grin (2013).

10 Conclusion

This paper analyses the statistical relation between a number of a country's cultural attributes and measures of risk of susceptibility to CC. Assuming that CC risk and vulnerability are closely linked to resilience to CC, this analysis ultimately helps to shed some light on cultural determinants of resilience.

Individualism/collectivism, religiousness and cultural heterogeneity are the cultural attributes analysed. Variables quantifying those aspects of culture are consistently correlated with standard risk and vulnerability measures. Further inquiry reveals that religiousness, and to a lesser degree cultural heterogeneity, contribute to explaining national differences in resilience. We hypothesise that culture influences trust and a society's propensity to cooperate, which are important inputs for resilience.

What conclusions can be drawn for policy formulation? It could be argued that none of the cultural attributes analysed in this study should directly influence policy efforts. Although policy and the cultural attributes studied in this report have been combined in the past (historic secularisation in Europe was, to a considerable degree, state driven; forceful integration of ethnic minorities in authoritarian regimes; ethnic divides that were used by elites in a Machiavellian sense), such policies would probably violate human rights. However, it can be recommended that in conditions of intense religiousness of the population and high levels of ethnic or linguistic fractionalisation, extra effort, attention and provision of additional resources will be necessary to build better institutions and improve communication and trust between different societal groups.

References

Adger, W. N., Barnett, J., Brown, K., Marshall, N., and O'Brien, K. (2013). Cultural dimensions of climate change impacts and adaptation. *Nature Climate Change*, 3(2), 112–117.

Adger, W. N., Dessai, S., Goulden, M., Hulme, M., Lorenzoni, I., Nelson, D. R., Otto Naess, L., Wolf, J., and Wreford, A. (2009). Are there social limits to adaptation to climate change? *Climatic change*, 93(3–4), 335–354.

Alesina, A., and Giuliano, P. (2015). Culture and institutions. *Journal of Economic Literature*, 53(4), 898–944.

Alesina, A., and La Ferrara, E. (2000). Participation in heterogeneous communities. *Quarterly Journal of Economics,* 115(3), 847–904.

Alesina, A., and La Ferrara, E. (2002). Who trusts others? *Journal of Public Economics*, 85(2), 207–234.–1284.

Alesina, A., Devleeschauwer, A., Easterly, W., Kurlat, S., and Wacziarg, R. (2003). Fractionalization. *Journal of Economic growth*, 8(2), 155–194.

Algan, Y., and Cahuc, P. (2013). Trust, growth and well-being: new evidence and policy implications. *Handbook of Economic Growth*, 2, 49–120.

Anemüller, S., Monreal S., and Bals, C. (2006). *Global Climate Risk Index 2006*. Germanwatch, Bonn. Available at: http://germanwatch.org/en/3644

Arcand, J. L., and Grin, F. (2013). Language in economic development: Is English special and is linguistic fragmentation bad? In Erling, E. J., and Seargeant, P. (eds.), *English and Development: Policy, Pedagogy and Globalization*. Multilingual Matter, Bristol, pp. 243–266.

Arcand, J. L., Guillaumont, P., and Jeanneney, S. G. (2000). How to make a tragedy: on the alleged effect of ethnicity on growth. *Journal of International Development*, 12(7), 925.

Arrow, K. J. (1971). Political and economic evaluation of social effects of externalities. In Margolis, J. (ed.), *The Analysis of Public Output*. National Bureau of Economic Research, New York, pp. 1–30.

Atlas Narodov Mir (1964). Moscow: Glavnoe upravlenie geodezii i kartografii.

Attanasi, G., Hopfensitz, A., Lorini, E., and Moisan, F. (2016). *Social Connectedness Improves Co-ordination on Individually Costly, Efficient Outcomes*. Toulouse School of Economics, Toulouse.

Banfield, E. C. (1967). *The Moral Basis of a Backward Society*. Free Press, New York.

Barro, R. J., and McCleary, R. M. (2003). Religion and economic growth across countries. American Sociological Review, 68(5), 760–781.

Bénabou, R., Ticchi, D., and Vindigni, A. (2015). *Forbidden Fruits: the Political Economy of Science, Religion, and Growth*. National Bureau of Economic Research, New York.

Binzel, C., and Fehr, D. (2013). Social distance and trust: experimental evidence from a slum in Cairo. *Journal of Development Economics*, 103, 99–106.

Birkmann, J., Welle, T., Krause, D., Wolfertz, J., Suarez, D. C., and Setiadi, N. (2011). *World Risk Index: Concept and Results*. Alliance Development Works (eds.), World Risk Report, Berlin. pp. 13–42.

Bjørnskov, C. (2010). How does social trust lead to better governance? An attempt to separate electoral and bureaucratic mechanisms. *Public Choice*, 144(1–2), 323–346.

Bjørnskov, C. (2012). How does social trust affect economic growth? *Southern Economic Journa*l, 78(4), 1346–1368.

Bjørnskov, C., and Méon, P. G. (2013). Is trust the missing root of institutions, education, and development? *Public Choice*, 157(3–4), 641–669.

Bowles, S. (1998). Endogenous preferences: the cultural consequences of markets and other economic institutions. *Journal of Economic Literature*, 36(1), 75–111.

Boyd, R., Richerson, P. J., and Henrich, J. (2011). Rapid cultural adaptation can facilitate the evolution of large-scale cooperation. *Behavioral Ecology and Sociobiology*, 65(3), 431–444.

Brandts, J., Saijo, T., and Schram, A. (2004). How universal is behavior? A four country comparison of spite and cooperation in voluntary contribution mechanisms. *Public Choice*, 119(3–4), 381–424.

Brondizio, E. S., Ostrom, E., and Young, O. R. (2009). Connectivity and the governance of multilevel social-ecological systems: the role of social capital. *Annual Review of environment and Resources*, 34, 253–278.

Bruhin, A., Fehr, E., and Schunk, D. (2016). *The Many Faces of Human Sociality: Uncovering the Distribution and Stability of Social Preferences*. CESifo working paper. Centre for Economic Studies, Munich.

Carpenter, J. P., Daniere, A. G., and Takahashi, L. M. (2004). Cooperation, trust, and social capital in Southeast Asian urban slums. *Journal of Economic Behavior and Organization*, 55(4), 533–551.

Carpenter, S., Walker, B., Anderies, J. M., and Abel, N. (2001). From metaphor to measurement: resilience of what to what? *Ecosystems*, 4, 765–781.

Carter, M. R., and Maluccio, J. A. (2003). Social capital and coping with economic shocks: an analysis of stunting of South African children. *World Development*, 31(7), 1147–1163.

Chuah, S. H., Hoffmann, R., Ramasamy, B., and Tan, J. H. (2014). Religion, ethnicity and cooperation: an experimental study. *Journal of Economic Psychology*, 45, 33–43.

Chuah, S. H., Gächter, S., Hoffmann, R., and Tan, J. H. (2015). Religion, Discrimination and Trust. *European Economic Review*, 90, 280–301.

Croson, R., and Buchan, N. (1999). Gender and culture: international experimental evidence from trust games. *American Economic Review*, 386–391.

Chen, C., Noble, I., Hellmann, J., Coffee, J., Murillo, M., Chawla, N. (2015). *University of Notre Dame Global Adaptation Index. Country Index Technical Report*. University of Notre Dame, Indiana.

DARA (2013). *Risk Reduction Index (RRI) in West Africa, Analysis of the conditions and capacities for Disaster Risk Reduction*. Available at: http://reliefweb.int/report/cape-verde/risk-reduction-index-west-africa-analysis-conditions-and-capacities-disaster-risk

Davis, L. S., and Abdurazokzoda, F. (2015). Language, culture and institutions: evidence from a new linguistic dataset. *Journal of Comparative Economics*, 44(3), 541–561.

De Groeve, T., Poljansek, C. and Vernaccini, L. (2015). *Index for Risk Management – INFORM: Concept and Methodology*. Publications Office of the European Union, Luxembourg.

De Luca, G., Hodler, R., Raschky, P., and Valsecchi, M. (2015). *Ethnic Favoritism: An Axiom of Politics?* (No. 5209). Centre for Economic Studies, Munich.

Desmet, K., Ortuño-Ortín, I., and Wacziarg, R. (2015). *Culture, Ethnicity and Diversity* (No. w20989). National Bureau of Economic Research, New York.

Desmet, K., Ortuño-Ortín, I., and Wacziarg, R. (2016). Linguistic cleavages and economic development. In Ginsburgh, V., and Weber S. (eds.), *The Palgrave Handbook of Economics and Language*. Palgrave Macmillan, London, UK, pp. 425–446.

Dimant, E. (2015). *On Peer Effects: Behavioral Contagion of (Un)Ethical Behavior and the Role of Social Identity*. Munich University, Munich.

Dincer, O. C. (2008). Ethnic and religious diversity and corruption. *Economics Letters*, 99(1), 98–102.

Dincer, O. C. (2011). Ethnic diversity and trust. *Contemporary Economic Policy*, 29(2), 284–293.

Easterly, W., and Levine, R. (1997). Africa's growth tragedy: policies and ethnic divisions. *Quarterly Journal of Economics*, 112(4), 1203–1250.

Ermisch, J., and Gambetta, D. (2010). Do strong family ties inhibit trust? *Journal of Economic Behavior and Organization*, 75(3), 365–376.

EVS (European Values Study) (2015). *European Values Study Longitudinal Data File 1981–2008 (EVS 1981–2008).* GESIS Data Archive, Cologne. ZA4804 Data file Version 3.0.0, doi:10.4232/1.12253.

Fearon, J. D. (2003). Ethnic and cultural diversity by country*. *Journal of Economic Growth*, 8(2), 195–222.

Fehr, E., and Hoff, K. (2011). Introduction: tastes, castes and culture: the influence of society on preferences. *The Economic Journal*, 121(556), F396-F412.

Fernández, R. (2011). Does culture matter? In Benhabib, J., Jackson, M. O., and Bisin, A. (eds.), *Handbook of Social Economics*, Vol. 1A, North-Holland, Amsterdam.

Fleischacker, S. (2013). Adam Smith's moral and political philosophy. In Edawrad, N. (ed.), *The Stanford Encyclopedia of Philosophy* (Spring 2013 Edition). Available at: https://plato.stanford.edu/archives/win2015/entries/smith-moral-political/

Füssel, H. M. (2010). *Review and Quantitative Analysis of Indices of Climate Change exposure, adaptive Capacity, Sensitivity, and Impacts*. World Bank, Washington DC.

Gächter, S., and Schulz, J. F. (2016). Intrinsic honesty and the prevalence of rule violations across societies. *Nature*, 531, 496–499.

Gächter, S., Herrmann, B., and Thöni, C. (2004). Trust, voluntary cooperation, and socio-economic background: survey and experimental evidence. *Journal of Economic Behavior and Organization*, 55(4), 505–531.

Gächter, S., Herrmann, B., and Thöni, C. (2010). Culture and cooperation. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 365(1553), 2651–2661.

Gangadharan, L., Nikiforakis, N., and Villeval, M. C. (2015). *Equality Concerns and the Limits of Self-governance in Heterogeneous Populations*. Available at: http://dx.doi.org/10.2139/ssrn.2665966.

Gauri, V., Woolcock, M., and Desai, D. (2013). Intersubjective meaning and collective action in developing societies: theory, evidence and policy implications. *Journal of Development Studies,* 49(1), 160–172.

Gintis, H., Doebeli, M., and Flack, J. (2012). The evolution of human cooperation. *Cliodynamics: The Journal of Theoretical and Mathematical History*, 3(1).

Gorodnichenko, Y., and Roland, G. (2011a). Individualism, innovation, and long-run growth. *Proceedings of the National Academy of Sciences of the USA*, 108(Suppl. 4), 21316–21319.

Gorodnichenko, Y., and Roland, G. (2011b). Which dimensions of culture matter for long-run growth? *American Economic Review*, 101(3), 492–498.

Gorodnichenko, Y., and Roland, G. (2012). Understanding the individualism-collectivism cleavage and its effects: Lessons from cultural psychology. In Aoki, D. M., Kuran, T., and Roland, G. (eds), *Institutions and Comparative ECONOMIC Development*, 150, 213.

Gorodnichenko, Y., and Roland, G. (2015). *Culture, institutions and Democratization* (No. w21117). National Bureau of Economic Research, New York.

Graeff, P., and Svendsen, G. T. (2013). Trust and corruption: The influence of positive and negative social capital on the economic development in the European Union. *Quality and Quantity*, 47(5), 2829–2846.

Graf Lambsdorff, J. (2015). Preventing corruption by promoting trust: Insights from behavioral science. Passauer Diskussionspapiere. *Volkswirtschaftliche Reihe*, 69(15).

Greif, A. (1994). Cultural beliefs and the organization of society: A historical and theoretical reflection on collectivist and individualist societies. *Journal of Political Economy*, 912–950.

Greif, A., and Tabellini, G. (2010). Cultural and institutional bifurcation: China and Europe compared. *American Economic Review*, 100(2), 135–140.

Greif, A., and Tabellini, G. (2015). *The Clan and the Corporation: Sustaining Cooperation in China and Europe* (No. 5233). CESifo Group, Munich.

Guiso, L., Sapienza, P., and Zingales, L. (2006). Does culture affect economic outcomes? *Journal of Economic Perspectives*, 20(2), 23–48.

Gurven, M., Zanolini, A., and Schniter, E. (2008). Culture sometimes matters: Intra-cultural variation in pro-social behavior among Tsimane Amerindians. *Journal of Economic Behavior and Organization*, 67(3), 587–607.

Hallegatte, S. (2014). *Economic Resilience: Definition and Measurement*. World Bank, Washington DC.

Habyarimana, J., Humphreys, M., Posner, D. N., and Weinstein, J. M. (2007). Why does ethnic diversity undermine public goods provision? *American Political Science Review*, 101(04), 709–725.

Henrich, J. (2015). Culture and social behavior. *Current Opinion in Behavioral Sciences, 3, 84–89.*

Henrich, J., Boyd, R., Bowles, S., Camerer, C., Fehr, E., Gintis, H., and McElreath, R. (2001). In search of *Homo economicus*: behavioral experiments in 15 small-scale societies. *American Economic Review*, 91(2), 73–78.

Henrich, J., Boyd, R., Bowles, S., Camerer, C., Fehr, E., and Gintis, H. (2004). *Foundations of Human Sociality: Ethnography and Experiments in Fifteen Small-scale Societies*. Oxford University Press, New York.

Herrmann, B., Thöni, C., and Gächter, S. (2008). Antisocial punishment across societies. *Science*, 319(5868), 1362–1367.

Hoffmann, R. (2013). The experimental economics of religion. *Journal of Economic Surveys*, 27(5), 813–845.

Hofstede, G. (2001). *Culture's Consequences: Comparing Values, Behaviors, Institutions and Organizations Across Nations*. Sage, London.

Holling, C. S. (1973). Resilience and stability of ecological systems. *Annual Review of Ecology and Systematics*, 4, 1–23.

IPCC (2014) *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge.

Jahan, S. (2015). *Human Development Report 2015. Work for Human Development*. United Nations Development Programme, New York.

Jordan, J. (2014). Religious belief, religious denomination, and preferences for redistribution: a comparison across 13 countries. *West European Politics*, 37(1), 19–41.

Kahan, D. M. (2012). Cultural cognition as a conception of the cultural theory of risk. In Lee, C.-F., and Lee, J. (eds.), *Handbook of Risk Theory*. Springer, the Netherlands. pp. 725–759.

Kahan, D. M., and Braman, D. (2015). Cultural cognition and public policy. *Yale Law and Policy Review*, 24(1), 5.

Kahan, D. M., Peters, E., Wittlin, M., Slovic, P., Ouellette, L. L., Braman, D., and Mandel, G. (2012). The polarizing impact of science literacy and numeracy on perceived climate change risks. *Nature Climate Change*, 2(10), 732–735.

Kashima, E. S., and Kashima, Y. (1998). Culture and Language: The case of cultural dimensions and personal pronoun use. *Journal of Cross-Cultural Psychology*, 29(3), 461–486.

Kashima, Y., and Kashima, E. S. (2003). Individualism, GNP, climate, and pronoun drop: Is individualism determined by affluence and climate, or does language use play a role? *Journal of Cross-Cultural Psychology*, 34(1), 125–134.

Kashima, E. S., and Kashima, Y. (2005). Erratum to Kashima and Kashima (1998) and reiteration. *Journal of Cross-Cultural Psychology*, 36(3), 396–400.

Knack, S., and Keefer, P. (1997). Does social capital have an economic payoff? A cross-country investigation. *Quarterly Journal of Economics*, 1251–1288.

Kraft-Todd, G., Yoeli, E., Bhanot, S., and Rand, D. (2015). Promoting cooperation in the field. *Current Opinion in Behavioral Sciences*, 3, 96–101.

Kreft, S., Eckstein, D., Dorsch, L., and Fischer, L. (2016). *Global Climate Risk Index 2016*. Germanwatch, Bonn.

Leigh, A. (2006). Trust, inequality and ethnic heterogeneity. *Economic Record*, 82(258), 268–280.

Licht, A. N., Goldschmidt, C., and Schwartz, S. H. (2007). Culture rules: The foundations of the rule of law and other norms of governance. *Journal of Comparative Economics*, 35(4), 659–688.

Lopez-Claros, A., and Perotti, V. (2014). *Does Culture Matter for Development*? Policy Research Working Paper. World Bank, Washington, DC.

Lowes, S., Nunn, N., Robinson, J. A., and Weigel, J. (2015a). *The Evolution of Culture and Institutions: Evidence from the Kuba Kingdom*. National Bureau of Economic Research, New York.

Lowes, S., Nunn, N., Robinson, J. A., and Weigel, J. (2015b). Understanding ethnic identity in Africa: Evidence from the Implicit Association Test (IAT). *The American Economic Review*, 105(5), 340–345.

Maseland, R. (2013). Parasitical cultures? The cultural origins of institutions and development. *Journal of Economic Growth*, 18(2), 109–136.

Marini, A. (2016). *Cultural Beliefs, Values and Economics: A Survey*. Munich Personal Research Archive, Munich.

Mathers, R. L., and Williamson, C. R. (2011). Cultural context: explaining the productivity of capitalism. *Kyklos*, 64(2), 231–252.

Mazar, N., and Aggarwal, P. (2011). Greasing the palm: Can collectivism promote bribery? *Psychological Science*, 22(7), 843–848.

Minkov, M., and Hofstede, G. (2014a). A replication of Hofstede's uncertainty avoidance dimension across nationally representative samples from Europe. *International Journal of Cross Cultural Management*, 14(2), 161–171.

Minkov, M., and Hofstede, G. (2014b). Nations versus religions: which has a stronger effect on societal values? *Management International Review*, 54(6), 801–824.

Miola, A., and Simonet, C. (2014). *Concepts and Metrics for Climate Change Risk and Development-Towards an index for Climate Resilient Development*. Joint Research Centre, Publications Office of the European Union, Luxembourg.

Miola, A., Paccagnan V., Papadimitriou E. and Mandrici A. (2015). *Climate Resilient Development Index: Theoretical Framework, Selection Criteria and Fit for Purpose Indicators*. Joint Research Centre, Publications Office of the European Union, Luxembourg.

Nannicini, T., Stella, A., Tabellini, G., and Troiano, U. (2013). Social capital and political accountability. *American Economic Journal: Economic Policy*, 5(2), 222–250.

Neher, F., and Miola, A. (2015). *The Role of Social Inequalities for the Vulnerability to Climate Related Extreme Weather Events*. Joint Research Centre, Publications Office of the European Union, Luxembourg.

O'Brien, K. L., and Wolf, J. (2010). A values- based approach to vulnerability and adaptation to climate change. *Wiley Interdisciplinary Reviews: Climate Change*, 1(2), 232–242.

Ostrom, E. (2010). Analyzing collective action. *Agricultural Economics*, 41(s1), 155–166.

Putnam, R. D. (1995). Bowling alone: America's declining social capital. *Journal of Democracy*, 6(1), 65–78.

Putnam, R. D., Leonardi, R., and Nanetti, R. Y. (1994). *Making Democracy Work: Civic Traditions in Modern Italy*. Princeton University Press, New Jersey.

Preston, J. L., and Ritter, R. S. (2013). Different effects of religion and God on prosociality with the ingroup and outgroup. *Personality and Social Psychology Bulletin*, 39(11), 1471–1483.

Pretty, J. (2003). Social capital and the collective management of resources. *Science*, 302(5652), 1912–1914.

Pryor, F. L. (2008). Culture rules: a note on economic systems and values. *Journal of Comparative Economics*, 36(3), 510–515.

Rand, D. G., and Nowak, M. A. (2013). Human cooperation. *Trends in Cognitive Sciences*, 17(8), 413–425.

Rand, D. G., Yoeli, E., and Hoffman, M. (2014). Harnessing reciprocity to promote cooperation and the provisioning of public goods. *Policy Insights from the Behavioral and Brain Sciences*, 1(1), 263–269.

Richerson, P., and Henrich, J. (2009). *Tribal Social Instincts and the Cultural Evolution of Institutions to Solve Collective Action Problems*. Context and the Evolution of Mechanisms for Solving Collective Action Problems Paper.

Roos, P., Gelfand, M., Nau, D., and Lun, J. (2015). Societal threat and cultural variation in the strength of social norms: an evolutionary basis. *Organizational Behavior and Human Decision Processes*, 129, 14–23.

Roth, A. E., Prasnikar, V., Okuno-Fujiwara, M., and Zamir, S. (1991). Bargaining and market behavior in Jerusalem, Ljubljana, Pittsburgh, and Tokyo: An experimental study. *The American Economic Review*, 1068–1095.

Rustagi, D., and Veronesi, M. (2016). *Social Identity, Attitudes Towards Cooperation, and Social Preferences: Evidence From Switzerland*. University of Verona, Verona.

Saroglou, V., Delpierre, V., and Dernelle, R. (2004). Values and religiosity: a meta-analysis of studies using Schwartz's model. *Personality and Individual Differences*, 37(4), 721–734.

Schimmack, U., Oishi, S., and Diener, E. (2005). Individualism: a valid and important dimension of cultural differences between nations. *Personality and Social Psychology Review*, 9(1), 17–31.

Schwartz, S. H. (2014). Rethinking the concept and measurement of societal culture in light of empirical findings. *Journal of Cross-Cultural Psychology*, 45(1), 5–13.

Serritzlew, S., Sønderskov, K. M., and Svendsen, G. T. (2014). Do corruption and social trust affect economic growth? A review. *Journal of Comparative Policy Analysis: Research and Practice*, 16(2), 121–139.

Simpson, B., and Willer, R. (2015). Beyond altruism: Sociological foundations of cooperation and prosocial behavior. *Annual Review of Sociology*, 41, 43–63.

Smith, E. A. (2010). Communication and collective action: language and the evolution of human cooperation. Evolution and Human Behavior, 31(4), 231–245.

Tabellini, G. (2008). Presidential address. Institutions and culture. *Journal of the European Economic Association*, 6(2–3), 255–294.

Thöni, C. (2015). Trust and cooperation: survey evidence and behavioral experiments. Forthcoming in, Van Lange, P. A. M., Rockenbach, B., and Yamagishi, T. (eds.), *Social Dilemmas: New Perspectives on Trust*. Oxford University Press, New York.

Thöni, C., Tyran, J. R., and Wengström, E. (2012). Microfoundations of social capital. *Journal of Public Economics*, 96(7), 635–643.

Teorell, J., Dahlberg, S., Holmberg, S., Rothstein, B., Khomenko, A., and Svensson, R. (2016). *The Quality of Government Standard Dataset*. Version Jan16. University of Gothenburg, The Quality of Government Institute, Gothenburg. Available at: http://www.qog.pol.gu.se doi:10.18157/QoGStdJan16.

Wagner, J. A. (1995). Studies of individualism-collectivism: effects on cooperation in groups. *Academy of Management Journal*, 38(1), 152–173.

Welle, T., and Birkmann, J. (2015). The World Risk Index – an approach to assess risk and vulnerability on a global scale. *Journal of Extreme Events*, 2(1).

Woolcock, M. (2014). Culture, politics, and development. World Bank Policy Research Working Paper (6939). The World Bank, Washington DC.

WVS (World Values Survey) (2015). *World Values Surveys 1981–2014 official aggregate v.20150418*. World Values Survey Association. JDSystems, Madrid.

Yoo, B., Donthu, N., and Lenartowicz, T. (2011). Measuring Hofstede's five dimensions of cultural values at the individual level: development and validation of CVSCALE. *Journal of International Consumer Marketing*, 23(3–4), 193–210.

APPENDIX A

Table A1. Construction of religiousness variables (WVS and EVS)

Frequency of attending religious services	
Survey item: Apart from weddings, funerals and christenings, about how often do you attend religious services these days?	
religion_reg	1 More than once a week 2 Once a week 3 Once a month
religion_some	4 Only on special holy days/Christmas/Easter days 5 Other specific holy days 6 Once a year
religion_never	7 Less often 8 Never/practically never
Meaning: The variable measures the percentage of respondents who attend religious services regularly, sometimes or never.	
Construction: Indicator variable indicates if respondent chose respective response category, these indicator variables are then averaged across country-wave observations and then averaged across all available survey waves.	
Frequency of praying[25]	
Survey item: How often do you pray to God outside religious services? Would you say ...	
pray_reg	1 Every day (Often) 2 More than once a week 3 Once a week (Sometimes)
pray_some	4 At least once a month (Hardly ever) 5 Several times a year (Only in times of crisis) 6 Less often
pray_never	7 Never
Meaning: Percentage of respondents who pray regularly, sometimes or never outside religious services.	
Construction: Indicator variable indicates if respondent chose response category; these indicator variables are then averaged across country-wave observations and then averaged across all available survey waves.	
Belief in God	
Survey item: Which, if any, of the following do you believe in?	
belief_god	0 No, 1 Yes
Meaning: Percentage of respondents who state that they believe in god.	
Construction: Responses averaged across country-wave observations and then averaged across all available survey waves.	
Importance of God	
Survey item: How important is God in your life? Please use this scale to indicate — 10 means very important and 1 means not at all important.	
important_god	1 not at all important … 10 very important
Meaning: Higher values indicate that respondents, on average, find God more important	

[25] Between waves, the wording of the response categories was changed. The responses in brackets give the alternative wordings used.

in their lives.
Construction: Responses averaged across country-wave observations and then averaged across all available survey waves

Table A2. Description of variables for cultural and ethnic heterogeneity

Variable	Source	Description
al_ethnic	(1)	'Ethnic fractionalization: The definition of ethnicity involves a combination of racial and linguistic characteristics. The result is a higher degree of fractionalization than the commonly used ELF-index (see el_elf60) in for example Latin America, where people of many races speak the same language.' (Teorell et al., 2016)
al_language	(1)	'Linguistic fractionalization: Reflects probability that two randomly selected people from a given country will not belong to the same linguistic group. The higher the number, the more fractionalized society.' (Teorell et al., 2016)
al_religion	(1)	'Religious fractionalization: Reflects probability that two randomly selected people from a given country will not belong to the same religious group. The higher the number, the more fractionalized society.' (Teorell et al., 2016)
fe_etfra	(1)	'Ethnic fractionalization: Restricting attention to groups that had at least 1 percent of country population in the 1990s, Fearon identifies 822 ethnic and ethnoreligious groups in 160 countries. This variable reflects the probability that two randomly selected people from a given country will belong to different such groups. The variable thus ranges from 0 (perfectly homogeneous) to 1 (highly fragmented).' (Teorell et al., 2016)
fe_cultdiv	(1)	'Cultural diversity: This measure modifies fractionalization (fe_etfra) so as to take some account of cultural distances between groups, measured as the structural distance between languages spoken by different groups in a country. If the groups in a country speak structurally unrelated languages, their cultural diversity index will be the same as their level of ethnic fractionalization (fe_etfra). The more similar are the languages spoken by different ethnic groups, however, the more will this measure be reduced below the level of ethnic fractionalization for that country.'
numgrps	(2)	Number of groups listed in a country (Fearon, 2003, dataset)
elf	(2)	'Ethnolinguistic fractionalization: Measures probability that two randomly selected people from a given country will not belong to the same ethnolinguistic group. Original source: Atlas Narodov Mira (1964).' (Teorell et al., 2016)

Sources:
(1) Quality of Government Database (http://qog.pol.gu.se/data, Teorell et al., 2016).
(2) Fearon, 2003 (http://web.stanford.edu/group/ethnic/publicdata/publicdata.html).

Table A3. Components and levels of the INFORM index

	Level 5	Level 4	Level 3	Level 2
1	Physical exposure to earthquake MMI VI (absolute)	Earthquake	**Natural**	**Hazard and exposure**
2	Physical exposure to earthquake MMI VI (relative)			
3	Physical exposure to earthquake MMI VIII (absolute)			
4	Physical exposure to earthquake MMI VIII (relative)			
5	Physical exposure to tsunamis (absolute)	Tsunami		
6	Physical exposure to tsunamis (relative)			
7	Physical exposure to flood (absolute)	Flood		
8	Physical exposure to flood (relative)			
9	Physical exposure to surge from tropical cyclone (absolute)	Tropical cyclone		
10	Physical exposure to surge from tropical cyclone (relative)			
11	Physical exposure to tropical cyclone of SS 1 (absolute)			
12	Physical exposure to tropical cyclone of SS 1 (relative)			
13	Physical exposure to tropical cyclone of SS 3 (absolute)			
14	Physical exposure to tropical cyclone of SS 3 (relative)			
15	People affected by droughts (absolute)	Drought		
16	People affected by droughts (relative)			
17	Frequency of drought events			
18	Agriculture drought probability			
19	GCRI violent internal conflict probability	Projected conflict risk	**Human**	
20	GCRI high violent internal conflict probability			
21	Current national power conflict intensity	Current conflict intensity		
22	Current subnational conflict intensity			
23	Human development index	Poverty and development	**Socio-economic vulnerability**	**Vulnerability**
24	Multidimensional poverty index			
25	Gender inequality index	Inequality		
26	Gini coefficient			
27	Public aid per capita	Aid dependency		
28	Net ODA Received (% of GNI)			
29	Total persons of concern (absolute)	Uprooted people	**Vulnerable groups**	
30	Total persons of concern (relative)			
31	Children underweight	Other vulnerable groups, children under-5		
32	Child mortality			

33	Prevalence of HIV-AIDS above 15 years	Other vulnerable groups, health conditions		
34	Tuberculosis prevalence			
35	Malaria mortality rate			
36	Relative number of affected population by natural disasters in the last three years	Other vulnerable groups, recent shocks		
37	Prevalence of undernourishment	Other vulnerable groups, food security		
38	Average dietary supply adequacy			
39	Domestic food price level index			
40	Domestic food price volatility index			
41	Hyogo framework for action	DRR implementation	**Institutional**	**Lack of coping capacity**
42	Government effectiveness	Governance		
43	Corruption perception index			
44	Access to electricity (% of population)	Communication	**Infrastructure**	
45	Internet users (per 100 people)			
46	Mobile cellular subscriptions (per 100 people)			
47	Adult literacy rate			
48	Road density (km of road per 100 km^2 of land area)	Physical connectivity		
49	Access to improved water source (% of population with access)			
50	Access to improved sanitation facilities (% of pop with access)			
51	Physicians density	Access to health system		
52	Health expenditure per capita			
53	Measles immunisation coverage			

Source: De Groeve et al., (2015) p. A-5. (DRR, disaster risk reduction; GCRI, global conflict risk index; GNI, gross national income; MMI, modified Mercalli intensity scale; ODA, overseas development assistance; SS 1, Saffir–Simpson category 1; SS 3, Saffir–Simpson category 3.)

List of tables

Europe Direct is a service to help you find answers to your questions about the European Union.

Freephone number (*):

00 800 6 7 8 9 10 11

(*) The information given is free, as are most calls (though some operators, phone boxes or hotels may charge you).

More information on the European Union is available on the internet (http://europa.eu).

HOW TO OBTAIN EU PUBLICATIONS

Free publications:

- one copy:
  via EU Bookshop (http://bookshop.europa.eu);

- more than one copy or posters/maps:
  from the European Union's representations (http://ec.europa.eu/represent_en.htm);
  from the delegations in non-EU countries (http://eeas.europa.eu/delegations/index_en.htm);
  by contacting the Europe Direct service (http://europa.eu/europedirect/index_en.htm) or
  calling 00 800 6 7 8 9 10 11 (freephone number from anywhere in the EU) (*).

  (*) The information given is free, as are most calls (though some operators, phone boxes or hotels may charge you).

Priced publications:

- via EU Bookshop (http://bookshop.europa.eu).

LB-NA-28314-EN-N

JRC Mission

As the science and knowledge service of the European Commission, the Joint Research Centre's mission is to support EU policies with independent evidence throughout the whole policy cycle.

EU Science Hub
ec.europa.eu/jrc

@EU_ScienceHub
EU Science Hub - Joint Research Centre
Joint Research Centre
EU Science Hub

Publications Office

doi:10.2788/937554

ISBN 978-92-79-64531-0