Overlooked:

Examining the impact of disasters and climate shocks on poverty in the Europe and Central Asia region

MARCH 2021

THE WORLD BANK
IBRD • IDA | WORLD BANK GROUP

GFDRR
Global Facility for Disaster Reduction and Recovery

The International Bank for Reconstruction and Development/ The World Bank

1818 H Street, N.W.
Washington, D.C. 20433, U.S.A.

March 2021

Suggested Citation

World Bank. 2021. Overlooked: Examining the impact of disasters and climate shocks on poverty in the Europe and Central Asia region. Washington, DC: World Bank.

Cover photo: Young boy outside a damaged home near Spitak, Armenia.
Credit: Razmik Zakaryan

Acknowledgments

This report was prepared as part of a regional technical assistance titled 'Strategies and Options for Scaling Up Disaster Risk Management in ECA Countries', supported by a grant from the Global Facility for Disaster Reduction and Recovery (GFDRR). The preparation of this report was led by Yann Kerblat, Ali Arab, Brian Walsh, Alanna Simpson, and Stephane Hallegatte. The team would like to thank David Sislen and Christoph Pusch for overall guidance and insightful contributions provided by peer reviewers: Javier Baez, Sarah Coll-Black, and Zoe Trohanis.

The authors wish to recognize the work of many colleagues who contributed and provided valuable comments and contributions, including Julia Biau, Alexandru Cosmin Buteica, Laurent Debroux, Tafadzwa Dube, Simon Ellis, Salih Bugra Erdurmus, Ayse Erkan, Abdulaziz Faghi, Chris-Philip Fischer, Elena Daniela Ghita, Corina Grigore, Ellen Hamilton, Carlos Hernandez, Amparo Samper Hiraldo, Niels Holm-Nielsen, Ahmet Kindap, Daniel Kull, Andrea Liverani, Michael Lokshin, Catalin Pauna, Joanna Mclean Masic, Nora Mirzoyan, Alice Mortlock, Ana Maria Oviedo, Nicolas Pondard, Paul Prettitore, Tatiana Proskuryakova, Jamele Rigolini, Ana Simundza, Tatiana Skalon, Zuzana Stanton-Geddes, Gallina Andronova Vincelette, and Christoph Ungerer. All errors, interpretations, and conclusions are the responsibility of the authors.

The report was edited by Anne Himmelfarb and designed by Jon Walton and Paperplane Pilots Pte. Ltd.

Table of Contents

Executive Summary

When a disaster strikes, it affects not only households' physical assets but also their income levels and ability to contribute to the local economy.

These multidimensional impacts depend on both the physical characteristics of the hazard event itself (seismic magnitude, flood levels, and so on) as well as the socioeconomic characteristics of affected populations. For example, wealthier households might have access to a wide variety of coping mechanisms (for example, financial savings, housing insurance, and timely access to early warnings) which are not necessarily accessible for many poor households.

Critically, these socioeconomic disparities shape not only the severity of shocks on household-level economies but also the duration of subsequent recovery and reconstruction efforts. This is because disaster effects can persist long after the physical hazards recede—for example, by forcing affected households to manage difficult trade-offs between regular expenditures (for example, food, education, health care, and so on) and longer-term costs linked to the replacement or reconstruction of assets. The effects of severe (or successive) disasters on vulnerable populations become visible when the recovery of housing structures is delayed, when school enrolment rates suddenly drop, when there is a higher exposure to public health risks, or when significant (or recurring) debts constrain reconstruction efforts.

LEFT

A flood defense embankment built from sandbags stands near the banks of the Sava river in Šabac, Serbia in May 2014. Credit: Srđan Popović

Figure 1: The conventional asset-focused risk assessment approach compared to the proposed *'Unbreakable'* model, which focuses on socioeconomic resilience.

Source: Hallegatte et al. 2017.

Socioeconomic characteristics may therefore help determine in advance which households (or communities) are more likely to recover faster and which are in need of external assistance to accelerate reconstruction efforts.

This report explores the links between disaster impacts and poverty levels in select countries in the Europe and Central Asia region—Albania, Armenia, Bulgaria, Croatia, Georgia, Greece, Romania, and Turkey. These eight countries were selected because they are all characterized by (a) relatively high levels of income inequality, (b) relatively high levels of exposure to floods and earthquakes, and (c) significant existing engagements in disaster risk management (DRM) with the World Bank and other development partners. This new disaster risk assessment approach adds the dimension of *socioeconomic resilience* to the conventional risk assessment framework, which traditionally consists of hazard, exposure, and vulnerability (figure 1). Socioeconomic resilience represents the ability of affected households to cope with and recover from disasters. To better understand the economic impacts of disasters, this report presents a new disaster risk assessment model that can identify the most vulnerable socioeconomic groups and assess their ability to withstand disaster-related shocks, helping develop modern, inclusive, and cost-effective resilience solutions that include investments and programs outside conventional DRM instruments such as adaptive social protection, financial inclusion, and formal risk pooling.

The results of this analysis indicate that the economic well-being of citizens in these countries is affected far more than the estimated cost of physical damages to buildings and public infrastructure. In the eight countries that were analyzed, earthquakes and floods could have the most significant impacts on 2016 poverty levels in Yerevan (Armenia), Tbilisi (Georgia), and Bucharest (Romania). Overall, this report demonstrates that the recovery and reconstruction process not only depends on the extent of physical damages due to disasters but is also significantly shaped by the economic context of each country and the level of socioeconomic resilience of their citizens.

Abbreviations

AAL	Average Annual Losses
AHE	Aggregate Household Expenditures
CRRA	Constant Relative Risk Aversion
DRM	Disaster Risk Management
ECA	Europe and Central Asia
ECAPOV	Europe and Central Asia Poverty Data
ECATSD	Europe and Central Asia Team for Statistical Development
ESA	European Space Agency
EU	European Union
EU-SILC	European Union Statistics on Income and Living Conditions
FIES	Food Insecurity Experience Scale
GDP	Gross Domestic Product
GMD	Global Monitoring Database
GNI	Gross National Income
GFDRR	Global Facility for Disaster Reduction and Recovery
GRADE	Global Rapid Post-disaster Damage Estimation
NUTS	Nomenclature of Territorial Units for Statistics
PDNA	Post-disaster Needs Assessment
PML	Probable Maximum (Asset) Loss
PPP	Purchasing Power Parity
ROI	Return on Investments
UNDP	United Nations Development Programme
UNDRR	United Nations Office for Disaster Risk Reduction

CHAPTER 1:

The Europe and Central Asia region faces growing disaster and climate risks

The Europe and Central Asia (ECA) region[1] is vulnerable to a variety of hazards, including floods, earthquakes, droughts, landslides, and wildfires. In the past 30 years, 500 significant floods and earthquakes across the region have led to roughly 50,000 fatalities and more than US$80 billion in damages (World Bank 2017). Some 20 ECA countries are estimated to have a 10–20 percent chance of being affected by a major earthquake during the next 50 years, and they could face economic losses equivalent to more than 20 percent of their gross domestic product (GDP) (World Bank 2017). In Turkey alone, more than 110,000 deaths, 250,000 hospitalizations, and 600,000 destroyed housing units were recorded as a result of earthquakes in the 20th century (Erdik et al. 2003).

The Europe and Central Asia region is vulnerable to a variety of hazards, including floods, earthquakes, droughts, landslides, and wildfires.

Floods pose the highest risk for the Baltic states, the Central European states, and the Russian Federation, whereas the Caucasus states, Southeast European states, and Central Asia tend to be more prone to earthquakes. As shown in figures 2A and 2B, several major ECA cities were nearly or completely destroyed by earthquakes or floods, including Dubrovnik, Croatia (in 1667); Ashgabat, Turkmenistan (in 1948); Skopje, North Macedonia (in 1963); and Bucharest, Romania (in 1977), among others. Over time, close to 30 percent of capital cities across Europe and Central Asia have been destroyed by earthquakes or floods at some point in their history (World Bank 2017).

From a governance perspective, a significant number of countries in the region have faced political, economic, and social disruptions in the past 30 years. As a result, the lack of clarity on institutional roles and sectoral responsibilities has constrained the decision-making process for disaster risk management (DRM). In addition, a series of recent disasters exposed the vulnerability and lack of preparedness in the region, confirming the need for further investment in disaster risk reduction and emergency preparedness (Pollner, Kryspin-Watson, and Nieuwejaar 2008). In May 2014, for example, Bosnia and Herzegovina as well as Serbia experienced the heaviest rainfall ever recorded in the last 120 years. These massive floods in both countries resulted in devastating consequences for a number of important economic sectors, and economic damages were estimated to be up to €3.5 billion (Stadtherr et al. 2016). In Serbia, these floods caused damages and losses

1 The World Bank's Europe and Central Asia region consists of 28 countries. In 2016, almost 489 million people lived in the region, generating an estimated regional gross domestic product of US$1.15 trillion.

Figure 2A: A chronology of significant earthquakes across selected countries in the ECA region over time.

Year	Country	Earthquake name and magnitude	Human and Economic Impact
1667	Croatia	Ragusa Earthquake – **M7.4**	• 3,000–5,000 fatalities • 50 years of economic downturn • US$7.5 billion in damage
1920	Albania	Tepelene earthquakes – **M6.3**	• 200 fatalities • 15,000–30,000 homeless
1928	Bulgaria	Chirpan earthquake – **M6.9** Popovitsa earthquake – **M7.1**	• 120–150 fatalities • 1,800+ injured • Loss of US$1.4 billion (2020 US$), equal to 7% of GDP at the time
1939	Turkey	Erzincan earthquake – **M7.7**	• 30,000–40,000 fatalities • 100,000 injured • Over US$2 billion (2020 US$) in damage
1940	Romania	Vrancea earthquake – **M7.7**	• 593 fatalities, • 1,271 injured
1953	Greece	Great Kefalonia Earthquake – **M6.8**	• 445–800 fatalities • US$1.6 billion in damage (2020 US$)
1977	Romania	Vrancea Earthquake – **M7.2**	• 1,570+ fatalities • 11,221 injured • 200,000 homeless • US$10 billion (2020 US$) in economic losses
1978	Greece	Thessaloniki Earthquake – **M6.2**	• 45–50 killed • 220+ injured • US$250 million–US$1 billion in damage
1988	Armenia	Spitak Earthquake – **M6.8**	• 25,000+ fatalities • 130,000 injured • 514,000 homeless • Economic losses equivalent to US$2.7–4.8 billion (in 2020 US$), close to 1 year's GDP at the time • 40% of Armenia affected
1991	Georgia	Racha earthquake – **M7.0**	• 270+ fatalities • 160,000 homeless • US$7.6 billion (2020 US$) in damage
1999	Greece	Athens Earthquak – **M6.0**	• 143 fatalities • 1,600 injured • 50,000 homeless • US$3–4.2 billion in damage
1999	Turkey	Marmara earthquak – **M7.6**	• 17,000+ fatalities • 250,000 homeless • 43,959 injured • US$5 billion in damage
2003	Turkey	Bingöl earthquak – **M6.4**	• 177 fatalities • 520 injured

Year	Country	Earthquake name and magnitude	Human and Economic Impact
2011	Turkey	Van earthquakes – **M7.2–5.6**	• 604 fatalities (due to several earthquake tremors) • 4,152 injured • 60,000 homeless
2019	Albania	Albania earthquake – **M6.4**	• 51 fatalities • 913 injured • 11,490 housing units heavily damaged or destroyed • €985.1 million in damage and losses
2020	Croatia	Zagreb March Earthquake – **M5.5**	• 1 fatality • 26 injured • 26,000+ damaged buildings (including 24,000+ damaged buildings in housing sector) • €11.3 billion in damage and losses (PDNA)
2020	Turkey and Greece	Aegean Sea earthquake – **M7.0**	• 116 fatalities (in Turkey) • 1,035 injured • US$907 million in damage and losses (estimates)
2020	Croatia	Croatia December Earthquake – **M6.2**	• 7 fatalities and 15 injured in Petrinja and surrounding villages • 43,000+ damaged buildings • €4.8 billion in damage and losses (PDNA)

estimated at 5 percent of its GDP, pushed 125,000 people under the poverty line, and ultimately led to the loss of 52,000 jobs (Government of Serbia et al. 2014). In November 2019, Albania was struck by a strong 6.3 magnitude earthquake, which resulted in €844 million in estimated damages as well as 51 fatalities and displacement of 17,000 people. The earthquake ultimately affected more than 1.9 million (out of a total population of 2.8 million) and caused extensive damage across 11 municipalities, including the two most populous and urbanized cities, Tirana and Durrës (Government of Albania et al. 2020). More recently, in March 2020, Zagreb, the capital and largest city of Croatia, was hit by a 5.5 magnitude earthquake, the strongest earthquake to hit the city since 1880. More than 26,000 buildings were damaged (of which 1,900 are unusable) and a total of 27 people were injured, of whom 1 succumbed to her injuries (Bogaerts 2020). The total cost from this earthquake is estimated at €11.3 billion (World Bank 2021c).

Such shocks not only roll back development gains and disrupt livelihoods of vulnerable residents in hazard-prone areas, they also marginalize vulnerable communities by pushing them into deeper poverty and exacerbate existing income inequalities in affected countries and territories. These recent disasters confirm that many countries in the ECA region are inadequately equipped to manage disasters of such magnitude and highlight the undeniable link between poverty and vulnerability on the one hand and poor governance in disasters on the other (UNDP 2016). They also reemphasize the intrinsic link between poverty impacts and socioeconomic vulnerability, with the lack of local capacity to manage disaster risks in a sustainable manner.

The COVID-19 pandemic exacerbated the effects of natural disasters in 2020, by degrading micro-economic and macroeconomic coping mechanisms and responses. With the direct effects of the pandemic still largely unresolved, it is difficult to estimate its indirect consequences on contemporaneous floods and earthquakes, but what is already known is significant. Clearly, the pandemic complexified coordinated responses at all scales and may have reduced the surge capacity of some local health care systems in their disaster responses. In countries that did not institute robust emergency cash transfers,

Figure 2B: A chronology of significant floods across selected countries in the ECA region over time.

Year	Country	Period	Human and Economic Impact
1926	Romania	January 1926	~1,000 fatalities
1970	Romania	May–June 1970	200–215 fatalities; at least US$3 billion in damage
1992	Albania	November 1992	11 fatalities; US$12 million in damage
1994	Greece	October 1994	11 fatalities; US$700 million in damage
1997	Georgia	April 1997	2 floods caused 7 fatalities and over US$40 million in damage
1997	Armenia	June 1997	4 fatalities; US$12 million
1997	Romania	June–August 1997	US$310 million in damage
1998	Romania	June 1998	US$150 million in damage
1998	Turkey	August 1998	1 million people affected; over US$1 billion in damage
2002	Albania	September 2002	1 fatality; US$23 million in damage
2003	Greece	January–February 2003	US$800 million in damage
2005	Bulgaria	August 2005	30 fatalities; US$600 million in damage
2005	Romania	August 2005	3 floods caused 60 fatalities; almost US$2 billion in damage
2006	Romania	February–April 2006	economic damage over 1% of GNP; 160 localities affected
2009	Turkey	September 2009	31 fatalities; US$600 million in damage
2010	Albania	January 2010	US$51 million in damage
2010	Romania	June–July 2010	23 fatalities; US$1 billion in damage
2012	Georgia	May 2012	100,000 people affected; US$3 million in damage
2013	Georgia	July 2013	Close to 25,000 people affected
2014	Greece	December 2014	24 fatalities
2014	Bulgaria	May 2014	15 fatalities; US$400 million in damage
2014	Croatia	May 2014	3 fatalities; 9,000 people affected
2015	Georgia	June 2015	19 fatalities; over US$20 million in damage

widespread, severe, and sustained shocks to labor earnings depleted many households' precautionary savings. Due to evictions and foreclosures, fears of loss of housing are widespread, leaving populations more exposed and vulnerable to the elements.

The COVID-19 pandemic exacerbated the effects of natural disasters in 2020, by degrading micro- and macroeconomic coping mechanisms and responses.

At a macroeconomic scale, substantial social assistance packages, productivity and tax losses during initial quarantines, and subsequent rapid shifts in consumer behavior have depleted many sources of contingent financing and increased deficits, leading to larger debt and lower ability to respond to future shocks. The considerations described in this report affect the efficiency of compounding crisis responses, targeting poverty reduction to hasten recovery and shared prosperity.

Given the growing influence of disaster and climate shocks on socioeconomic activities in the ECA region, this report presents a disaster risk assessment model to illustrate how earthquake and flood risks affect different sub-national entities and income groups. The analysis focuses on eight countries in the ECA region—Albania, Armenia, Bulgaria, Croatia, Georgia, Greece, Romania, and Turkey—and examines not only their respective level of exposure to earthquake and floods but also their ability to cope with such shocks, that is, their level of socioeconomic resilience. These eight countries were selected because they are all characterized by (a) relatively high levels of income inequality, (b) relatively high levels of exposure to floods and earthquakes, and (c) significant existing engagements in DRM with the World Bank and other development partners.

Building on the *Unbreakable* model (Hallegatte et al. 2017), this disaster risk assessment approach therefore adds a new dimension— socioeconomic resilience—to the conventional risk assessment framework—which consists of hazard, exposure, and vulnerability. The overall objective of these analytics is to (a) inform DRM interventions that are socially inclusive and that reflect in-country needs and context in the coming years and (b) facilitate the prioritization of sub-national measures and related investments that aim to strengthen the level of socioeconomic resilience across the region.

A health official in Bucharest, Romania treats COVID-19 patients in June, 2020.
Credit: M. Moira

Search and Rescue efforts in Izmir (Turkey) during the October 2020 Aegean Sea earthquake.
Credit: hasanucarphotography/Shutterstock.com

CHAPTER 2:

Climate change, urbanization, and socioeconomic vulnerability are the region's main risk drivers

Climate change by raising temperatures and changing hydrology, is expected to produce more frequent, intense disaster events in the ECA region.

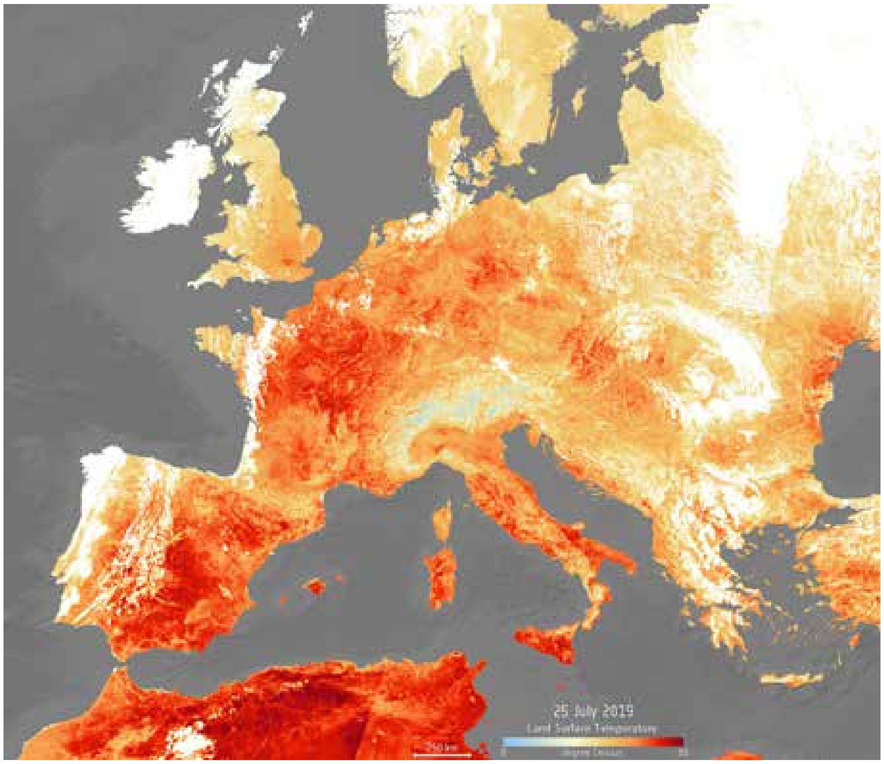
2.1 Climate change projections for Europe and Central Asia

Climate change by raising temperatures and changing hydrology is expected to produce more frequent, intense disaster events in the ECA region. Increased aridity and widespread wildfires will result in the loss of vegetation, while prolonged periods of intense rainfall and snowmelt will increase the frequency of massive mudslides, rockslides, and debris flows. In parts of Central Asia and the Western Balkans specifically, unprecedented heat extremes could occur in over 60 percent of summer months and drought risk could increase by 20 percent in a 4°C warmer world. At the same time, projections suggest an increase in riverine flood risk, mainly in spring and winter, due to more intense snowmelt in spring and heavier rainfall in the winter months. Reduced water availability in some places will become a threat as increases in temperatures head toward 4°C (World Bank 2014a). Recent destructive floods, worsening wildfires, and devastating heat waves (box 1 and figure 3) are already becoming more common throughout the region, illustrating to policy makers the need to prioritize DRM efforts.

Climate change impacts will vary from region to region, but Central Asia, the Western Balkans, and the South Caucasus are often identified as the most vulnerable hotspots in the region, yet they are least ready to adapt to consequences of climate change (World Bank 2014a). Climate shocks will have an adverse effect on the GDP of each country and affect a significant number of sectors, most notably agriculture and forestry. More importantly, they will disrupt the lives and livelihoods of people. Melting glaciers and warming temperatures will shift the growing season and the flow of glacier-fed rivers further into spring in Central Asia, while in the Western Balkans and the South Caucasus, worsening drought conditions will put crops at risk, with potential declines for urban health and energy generation. Decaying infrastructure, unsustainable and inefficient land and water management practices, and aging populations will increase sensitivity to climate change, while socioeconomic vulnerabilities and weaker institutions will put pressure on local capacity to adapt to increasing climate impacts (World Bank 2014a).[2]

2 Today, urbanization in Eastern European and Central Asian countries is profoundly affected by demographic transition. Compared to the rest of the world, countries in the region have much lower population growth rates and are among the only countries experiencing a decline in both their total population and their urban population (Restrepo Cadavid et al. 2017).

Figure 3: A heatmap of Europe for July 25, 2019. Climate change is increasing the frequency and severity of extreme weather events across Europe, such as this recent summer heatwave breaking temperature records in 7 countries.



Source: ESA 2019. © ESA. Contains modified Copernicus Sentinel data (2019), processed by ESA. Licensed under CC BY-SA 3.0 IGO.

Recent decades have also seen record-breaking meteorological events in the ECA region such as heat extremes (particularly in urban areas) or unseasonal rainfall patterns (see table 1). Examples include the Western European heat wave during the 2003 summer, with a death toll estimated at around 70,000 (see box 1), or the heat wave of the 2010 summer in Eastern Europe and Russia, with an estimated death toll of 55,000. More recently, in 2017 and 2019, the Mediterranean region also endured severe heat waves with record-breaking temperature peaks in July and August (Guerreiro et al. 2018). These patterns also confirm that climate and disaster risks have been on the rise (see table 1). In the European Union (EU), disasters and climate shocks (including record-breaking heatwaves) caused economic losses in excess of €511 billion (71 percent of which were uninsured) and more than 91,000 casualties over the last four decades (EEA 2019).[3]

2.2 Deficient infrastructure and urban settlements in transition

In Europe and Central Asia, disaster risks are mainly due to aging and poorly maintained public infrastructure such as roads, schools, and hospitals, which were typically constructed before modern building codes. Moreover, disaster risks are also exacerbated by the ongoing impacts of climate change. While poorly maintained flood protection infrastructure and insufficient weather forecasting systems mean that even small-scale events such as river floods or landslides can result in major disasters,[4] the concentration of assets, services, and populations in urban areas also increases exposure to weather extremes such as floods or heat waves.[5] For instance, informal settlements on floodplains and steep hillsides in the Western Balkans have been severely affected by floods and landslides in recent years (World Bank 2014a).

Old building stocks create a particular challenge, especially in high-density cities exposed to seismic risk. In many ECA countries, one of the key housing-related challenges is the seismic threat faced by certain building types—for example, pre-1990s multifamily apartment buildings—which may be beyond their design lifespan but are not being replaced due to limited demand for urban renewal.[6] The engineering problem of building resilience into public and private infrastructure is also layered with complex political, economic, social, legal, and financial realities, and the sheer scale of the undertaking explains why it has been so difficult to address since the last century. While many poor people will be living in isolated, rural areas,

3 In the EU member states (EU-28), disasters caused by weather- and climate-related extremes accounted for some 83 percent of the monetary losses over 1980–2017. Weather- and climate-related losses amounted to €426 billion (at 2017 values). See EEA (2019).

4 Floods and landslides are a significant problem in almost all countries in the region.

5 As recently seen with the unprecedented heat waves, Europe is the region with the highest average temperature for 2011–2015.

6 Another important challenge is the assumed excessive cost that is associated with seismic strengthening (or rebuilding and relocation) and the complex systems that regulate with multi-unit dwellings (and related insurance policies), this includes for example the weak institutionalization of with Homeowner Associations (Mathema and Simpson 2018).

Table 1: Selection of record-breaking meteorological between 2000 and 2015, their societal impacts, and confidence level that the meteorological event can be attributed to climate change.

Region (Year)	Meteorological record-breaking event	Impact, costs	Level of confidence in attribution to climate change
England and Wales (2000)	Wettest autumn on record since 1766; several short-term rainfall records	£1.3 billion	Medium
Europe (2003)	Hottest summer in at least 500 years	Death toll exceeding 70,000	High
England and Wales (2007)	May to July wettest since records began in 1766	Major flooding causing £3 billion	Medium
Southern Europe (2007)	Hottest summer on record in Greece since 1891	Devastating wildfires	Medium
Western Russia (2010)	Hottest summer since 1500	500 wildfires around Moscow, crop failure of ~25%, death toll estimated at 55,000, US$15 billion in economic losses	Medium
France (2011)	Hottest and driest spring on record in France	Grain harvest down by 12% in France	Medium
Western Balkans (2014)	Heaviest rainfall recorded in last 120 years	€3.5 billion in damages in Serbia and in Bosnia and Herzegovina; at least 86 casualties	Medium

Adapted from World Bank 2012 and Stadtherr et al. 2016.

increased rural-to-urban migration and continued urban expansion into hazard-prone areas in several countries in the ECA region means that a growing proportion of urban populations will be at risk of climate-related extreme events and will face rising food and energy prices (box 1; table 1), thus increasing poverty levels among urban population groups (World Bank 2014a).

2.3 Sources of socioeconomic vulnerability

The adverse impacts of disasters and climate change in the ECA region mostly affect poor and low-income communities, given their increased exposure and their underlying socioeconomic vulnerability. Poor people—that is, economically vulnerable people who do not have access to adequate income and whose human development opportunities are lower than average—are poor not only in terms of basic resources, they also tend to live in hazardous areas or in poorly constructed or ill-maintained houses that easily suffer damage or collapse. For example, in many EU countries, housing inequality is a key driver of uneven climate impacts—and that applies as much to heating (box 1) as to cooling (box 6). The devastating impact of hazard and climate events is not just the result of the presence of risks; it also depends on the capacity of individuals to cope with such shocks and the capacity of surrounding communities to respond or mitigate their effects (UNDP 2016). Given their limited financial resources, households living in poverty are likely to have difficulty in coping with sudden heat waves or droughts, relocating or evacuating in the event of a torrential flood, or absorbing unseasonal spikes in the price of food or energy.

Because employment is often the main source of income and precautionary savings for emergencies, access to employment is a key factor when considering vulnerability of the affected population.

Because employment is often the main source of income

A girl cools off in fountain during a heatwave in Athens, Greece on Aug. 8, 2017. Credit: Alexandros Michailidis.

Box 1: Recent heat waves had disproportionate impact on poorer, socially isolated, and aging population groups in the EU.

With a death toll estimated at 70,000 and losses estimated to exceed €13 billion, the heat wave of 2003 was one of the 10 deadliest disasters in Europe in the last 100 years and the worst recorded in the last 50 years.[a] Yet heat waves (periods of anomalous warmth) do not affect everyone in the same way: vulnerable and low-income population groups will experience more of their effects than other groups due to social isolation, the presence of elderly populations, preexisting health conditions, lack of geographical mobility, and economic disadvantage. For example, in France, both older people from poorer socioeconomic groups and people with more limited social networks were disproportionately impacted by the 2003 heat wave. This health crisis, without precedent since the Second World War, has had serious repercussions and has led the French government to take various steps to limit the effects of any future heat waves on public health. A better understanding of underlying socioeconomic vulnerabilities enabled decision-makers to come up with targeted solutions by strengthening health surveillance (monitoring admissions in emergency wards) and environmental surveillance (meteorological data) and also by reviewing national and local action plans to clearly identify agencies responsible for heat wave issues.

In general, poorer neighborhoods and informal settlements are more likely to be exposed to heat waves and other environmental risks than better-off and formal settlements due to their lower-quality infrastructure, unsuitable building designs, and lower access to essential services (health infrastructure and so on). Europe's poor have historically been concentrated in older, cheaper, and poorly built housing, such as small units in inner-city apartment buildings. Because they have less choice in where they can live, they tend to rely on homes close to workplaces and affordable amenities, often in industrial areas. Older tower blocks, which typically house low-income tenants in the United Kingdom, France, and Eastern Europe, are particularly prone to overheating. Compared to low-income and vulnerable households, wealthier population groups are better protected from extreme weather because they have better access to clean water supplies, cool environments, and air conditioning equipment and are able to temporarily relocate. Several studies also demonstrate that the poorer a household or a neighborhood is, the more exposed it will be to urban heat island effects (World Bank 2020a).[b]

Sources: Chakraborty et al. 2019; Euronews 2019; Joyce 2019; McGregor et al. 2007; Michelon, Magne, and Simon-Delavelle 2005; Saheb 2018, 2019; UNEP 2004 ; World Bank 2020a.

a. In the summer of 2003, the unprecedented heat wave that affected Western Europe raised summer temperatures 20–30 percent higher than the seasonal average in Celsius degrees.

b. Urban heat islands are city areas where buildings and sealed surfaces trap and reradiate heat so that nighttime temperatures do not drop as they do in rural and green areas.

A community's level of resilience (or its lack of resilience) depends on a range of structural vulnerabilities inherent within social groups, which can affect access to protective assets, to essential emergency information, and to strong social networks.

Strengthening the structure of Sisli Vocational High School in Istanbul, Turkey to be more earthquake resistant. Credit: Simone D. McCourtie

and precautionary savings for emergencies, access to employment is a key factor when considering vulnerability of the affected population. Unemployment continues to be a problem in many countries in the ECA region. The absence of jobs also means that social programs are often the only source of income and thus the ultimate safety net for entire households. The unforeseen loss of employment and the absence of temporary opportunities can also marginalize vulnerable groups into deeper poverty and affect their financial resilience. For instance, in the aftermath of the Balkan floods of 2014, people with disabilities could not return to their previous jobs and faced difficulties in accessing workplaces given that recovery efforts were delayed in certain areas, and displaced Roma populations lost their informal and seasonal job opportunities (street vending, for example) and were not eligible for social transfers due to the absence of documentation and preexisting socioeconomic marginalization (UNDP 2016).

Qualitative evidence within the region suggests that persistent poverty and entrenched income disparity generate resilience barriers and are likely to make communities and social groups significantly more vulnerable to shocks over time such as disasters. This is true for both sudden-onset and slow-onset disaster events. A community's level of resilience (or its lack of resilience) also depends on a range of structural vulnerabilities inherent within social groups, which can affect access to protective assets (flood-protection barriers, earthquake-resilient schools), to essential emergency information (evacuation orders, early warning notifications) and to strong social networks (remittances coming from abroad, financial reserves). Finally, resilience depends on the effectiveness of policies and measures usually put in place by local authorities (risk-informed land use planning, building code enforcement, and so on). With limited access to formal insurance, lower incomes, lower-quality assets, and lower levels of human development, poor households have to manage such shocks under highly constrained conditions. Damages induced by disasters therefore exacerbate the preexisting socioeconomic inequalities, disrupt livelihoods, and have the potential to roll back long-term development gains.

A man in Serbia wades through floodwaters to assist his neighbors.
Credit: Vladm

CHAPTER 3:

Disaster effects can be better managed with a resilience-informed analysis looking at households

The proposed risk assessment framework builds on the model from the *Unbreakable* report (2017) and seeks to provide more in-depth insights into second-order effects of disasters than traditional risk assessment.

The proposed risk assessment framework builds on the model from the *Unbreakable* report (2017) and seeks to provide more in-depth insights into second-order effects of disasters than traditional risk assessment. In particular, it shows how regions (or specific geographical areas) that are prioritized for DRM interventions can differ depending on which risk metric is used since each metric informs a different set of policy objectives. Moreover, focusing on average losses or aggregate post-disaster damage figures does not illustrate the distributional effects of disasters, especially given the significant level of socioeconomic inequalities in the ECA region. Instead a focus on factors of poverty increases (such as well-being losses) provides a more granular perspective by broadening the analysis to better represent the interest of all affected income groups and yield benefits with regard to poverty reduction, shared prosperity, and other sustainable development goals. To enable a more socially inclusive approach to disaster risk management, such post-disaster second-order effects therefore need to be aptly estimated and better incorporated in current DRM practices.

Disasters have complex and diverse consequences that can be measured and, increasingly, anticipated. Relevant metrics in this study include recovery time, economic losses at household level (which include both income and consumption), poverty incidence, and welfare (or well-being losses). Each of these metrics provides a different perspective on the costs induced by a given disaster. In contrast to risk analyses centered on direct damages, many of these metrics show how disasters disproportionately affect poor households because such income shocks constrain the poor to make difficult decisions between immediate needs (such as food and health care) and recovery needs. As a result of these trade-offs, poor households take longer to recover from disasters and are more likely to face long-term consequences. Such costs are not included in traditional risk assessments that measure the severity of disasters through their direct damages or by looking at the replacement cost of assets damaged or destroyed by a disaster. Moreover, looking at aggregated data or average post-disaster damage figures may not be insightful in certain instances given the significant level of inequalities in the region. Other side effects resulting from disasters—such as the impacts on health, education, or quality of life—have been more difficult to incorporate into disaster loss estimates or cost-benefit analysis of possible disaster risk reduction interventions.

One implication of the use of asset losses as a measure of disaster impacts is that DRM strategies tend to favor the wealthy population groups, central business districts, and other clusters of valuable assets. Risk analysis solely based on aggregated asset losses tends to drive risk reduction investments toward zones where infrastructure, facilities, and private assets are concentrated. Yet, that type of analysis does not demonstrate how asset losses disrupt people's livelihoods and living conditions at household level, especially for the poorest income groups and the most vulnerable.[7] While this prioritization makes sense from a purely monetary perspective, asset-focused strategies disincentivize attractive investments in the poorest areas, even when small interventions could significantly reduce the effects of disasters on the economic well-being of the population.

At a macroeconomic level, asset losses obscure the relationship between vulnerability and development. Economic growth tends to increase disaster losses as measured in asset losses (Hallegatte et al. 2017; Kahn 2005; Schumacher and Strobl 2011), but development and higher incomes also make people more resilient: the long-term impacts of disasters on communities' well-being and prospects depend not only on direct impacts (asset losses) but also on the accessibility of existing financial tools (for example, social transfers, formal and informal post-disaster support, savings, insurance, and access to credit). Households that lack access to these tools will struggle to cope with shocks and could fall into chronic poverty as a result (Carter and Barrett 2006). In short, a complete focus on asset losses obscures the role of poverty reduction as a tool to reduce disaster impacts and reduces the impact of DRM strategies when considering larger development agendas (Hallegatte et al. 2017).

To provide a more comprehensive measure of disaster impacts, the World Bank's *Unbreakable* report introduced (Hallegatte et al. 2017)—and subsequent studies (for example, Hallegatte, Rentschler, and Walsh 2018; Markhvida et al. 2020) developed—the concept of well-being losses

7 In addition, such second-order effects of disasters—particularly the socioeconomic consequences on poor populations—are often not incorporated as part of the recovery process or considered in cost-benefit analysis to calculate the return on investments of complex infrastructure projects (for example).

Figure 4: The conventional asset-focused risk assessment approach compared to the proposed *'Unbreakable'* model, which focuses on socioeconomic resilience.

Source: Hallegatte et al. 2017.

and socioeconomic resilience. To consider the different abilities of the poor and the nonpoor to cope with the asset losses in the aftermaths of a disaster, the effect of asset losses on income (accounting for capital productivity) and then on consumption (accounting for diversification of income, social protection, and post-disaster transfers) are modelled. Well-being losses are therefore the equivalent loss of consumption for a given population: if the analysis finds that a disaster causes US$1 million in well-being losses for a given population, it means that the impact of the disaster on well-being is equivalent to a US$1 million decrease in their level of consumption (and therefore the share of consumption in the country's GDP), perfectly shared among the population (Hallegatte et al. 2017). Well-being losses therefore incorporate people's socioeconomic resilience, including (a) their ability to maintain their consumption for the duration of their recovery, (b) their ability to save or borrow to rebuild their asset stock, and (c) the decreasing returns in consumption—that is, the fact that people who live on US$2 per day are more affected by a US$1 loss than are wealthier individuals. Socioeconomic resilience measures the ability of a given economy's ability to absorb the impact of well-being losses as a consequences of asset losses (and is calculated as the ration of expected asset losses to well-being losses.) An overview of the *Unbreakable* framework (compared to the traditional risk assessment framework) is shown in figure 4.

> A complete focus on asset losses obscures the role of poverty reduction as a tool to reduce disaster impacts and reduces the impact of DRM strategies when considering larger development agendas.

A woman sits by the side of the road outside of Skopje, FYR Macedonia.
Credit: Tomislav Georgiev/World Bank

The analysis presented in the remaining chapters of this report seek to examine the level of socioeconomic resilience in select countries in the ECA region in the face of disasters (specifically earthquakes and floods). A more comprehensive understanding of factors that contribute to higher socioeconomic resilience can provide actionable insights and encourage decision-makers to incorporate socioeconomic resilience-informed considerations as part of broader DRM interventions both spatially (which sub-national areas should be prioritized?) and at a sector level (which intervention makes more sense?). Compared to previous disaster risk analytics in the ECA region,[8] this study aims to provide more in-depth insights focusing on the second-order effects of disasters (asset losses being the first-order consequences) in the following countries: Albania,

8 See World Bank (2016) for a detailed example.

Debris from the 2015 Tbilisi flood in Georgia. Credit: HeavyDPJ

Armenia, Bulgaria, Croatia, Georgia, Greece, Romania, and Turkey (in alphabetical order). These eight countries were selected because they are all characterized by (a) relatively high levels of income inequality, (b) relatively high levels of exposure to floods and earthquakes, and (c) significant existing engagements in DRM with the World Bank and other development partners. For this study, this analysis combines data generated from exceedance probability curves (as described in the previous chapter) with household data from the World Bank's Global Monitoring Database (GMD)[9] to model the distributional impacts of disasters across households and various income groups.[10] The level of granularity in the analysis is consistent with the granularity of the reported administrative level for the households in each country available in the GMD datasets. This distributional analysis is intended to enhance existing studies, by providing more spatially detailed risk assessments that can inform the development of DRM interventions and related resilience-building measures that are more socially inclusive and better targeted.

9 The GMD is an ex post harmonization effort developed by the World Bank based on available multitopic household surveys, including household budget surveys and a Living Standards Measurement Survey. The main purpose of the GMD is to create a globally comparable harmonized micro-database across countries, regions, and survey years for the purpose of creating, monitoring, and tracking international poverty and shared prosperity indicators as well as data sortable by groups such as gender, age, employment status, and urban/rural.

10 The full methodology and detailed model description are provided in the technical appendix from a previous study focusing on the Philippines (Walsh and Hallegatte 2019).

CHAPTER 4:

Estimated asset losses due to disasters show significant disparity among regions

In Europe and Central Asia, both rural and urban communities are exposed to regular and potentially destructive floods and seismic activity—which pose unique challenges to their economic development.

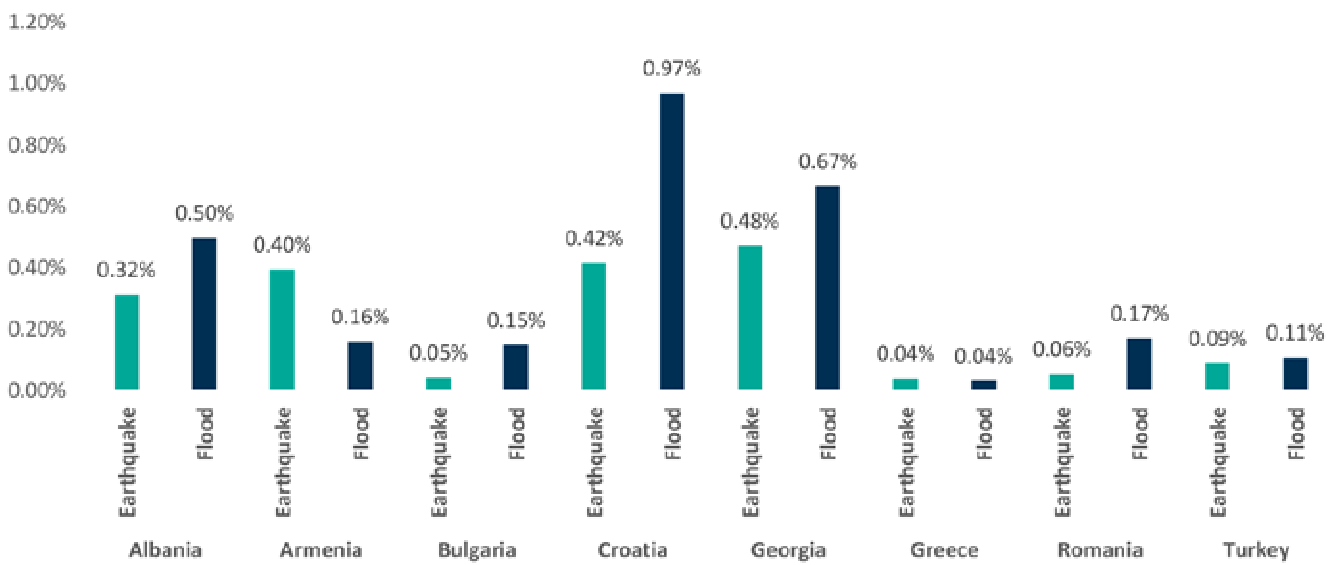
In Europe and Central Asia, both rural and urban communities are exposed to regular and potentially destructive floods and seismic activity—which poses unique challenges to their economic development. Progress on poverty reduction and shared prosperity—the World Bank's twin goals—has also slowed down since the 2008 global financial crisis: 60 million people in the region are still poor and live on US$5.50 or less per day, and nearly 70 percent of the population in lower-middle-income countries are vulnerable and live on US$5.50–US$11 per day. Given this context and with the increase of climate risks, effective DRM strategies are essential for building resilience and protect development gains from such shocks. To reduce the adverse effects of disasters, the three essential elements of risk, that is, **hazard** (earthquake and flood event in this study), **exposure** (the value of natural and built assets that might face a destructive event), and **vulnerability** (the expected consequences to exposed assets when a destructive event occurs) need to be identified, measured, and managed. Combined, these three dimensions help understand the potential extent of **disaster risk**[11] and estimate the average annual asset losses in a given geographical location. With access to comprehensive and reliable risk information, policy makers and at-risk communities can start to better understand the potential impacts of hazards and carry out risk-informed planning and investment to anticipate future disasters.

The terms 'loss' and 'damage' are often used interchangeably in reference to the adverse impacts of disasters on society, economy, and the environment (GFDRR 2014). Direct economic asset losses—defined as the monetary value of physical damage[12] to assets located in the affected area—primarily emerge during the disaster event or within the first few hours after the event and are often assessed soon after the event to estimate recovery cost and determine insurance payouts (UNDRR 2018). These are tangible, relatively easy to measure, and frequently used to estimate the severity of disasters and quantify disaster risks over time (for example by comparing the impacts of disasters across different time periods and/or geographical areas). As a result, direct economic asset losses have become the main financial indicator

11 The potential loss of life, injury, or destroyed or damaged assets which could occur to a system, society or a community in a specific period of time, determined probabilistically as a function of hazard, exposure, vulnerability and capacity (UNDRR 2018).

12 Direct economic asset loss is nearly equivalent to physical damage. Damage is a generic term without quantitative characteristics, which does not mean that damage cannot be measured and expressed as a loss. The damage to a roof, for instance, can be translated into monetary terms (the cost of repairs), which in turn can be incorporated as part of loss inventories overtime (GFDRR 2014).

Figure 5: Multicountry comparison of risk to assets from earthquake and floods (in GDP percentage).



to monitor and track disaster risk reduction achievements in the context of the 2015–2030 Sendai Framework for Disaster Risk Reduction (United Nations 2015).[13]

In anticipating such hazards, it is essential to account for direct and indirect losses on public infrastructures and private assets and incorporate their impacts at household level. For a given disaster event with direct economic asset losses, while a poor household might be affected by long-lasting impacts and resort to coping strategies, a wealthier household might be in a better position to mobilize resources to weather this shock and promptly recover.

13 For example, loss information can be harnessed for, and integrated into, risk assessments as part of efforts to promote community resilience. Loss and hazard profiles can inform land-use planning, zoning, and development decisions; local ordinances on building codes and housing density; taxation and budget decisions; and policy setting at local to national levels. A sound understanding of the drivers and causes of losses, as well as their societal, environmental, and economic implications, enables communities to manage hazards and disasters proactively rather than reactively (GFDRR 2014).

To quantify the total asset losses in a given geographical area,[14] an important input to the model adopted in this study is obtained from exceedance probability curves,[15] which provide the probable maximum (asset) loss (PML) for earthquakes and floods, in each administrative unit in a select country, for various frequencies or return periods.[16] For the sake of simplicity, the model was assumed that a disaster affects only one region at a time.

14 For this study, the NUTS 2 administrative unit was used for Albania, Armenia, Bulgaria, Georgia, Greece, Romania, and Turkey. Due to lack of NUTS 2 level household information in our datasets, NUTS 1 administrative unit for Croatia was used in this study. The *Nomenclature of territorial units for statistics*, abbreviated NUTS, is a geographical nomenclature subdividing the economic territory of the EU into regions at three different levels (NUTS 1, 2, and 3, respectively, moving from larger to smaller territorial units). Above NUTS 1, there is the 'national' level of the member states.

15 This model uses exceedance probability curves based on historical data on floods and earthquakes from, respectively, D. Guha-Sapir, R Below, and Ph. Hoyois, EM-DAT: International Disaster Database (Universite Catholique de Louvain, Brussels, Belgium), www.emdat.be, and Daniell and Schaefer 2014. Damage estimates for all historical events have been inflated to 2015 US$. These exceedance probability curves provide the probable maximum (asset) loss (PML) for earthquakes and fluvial and pluvial flooding), each administrative unit in the country, and various frequencies or return periods from 1 year to 10,000 years. For more detailed information about the datasets used, the assumptions and the methodology, see Annex 2.

Figure 5 displays a summary of average annual asset losses per year due to earthquakes and floods for eight countries in the ECA region (which will be the focus of the chapters below)[17]. These values represent the expected long-term average replacement cost of household's private and income-generating assets damaged or destroyed by floods and earthquake

16 For each region, the input data detail the total value of assets lost due to hazards as well as the frequency of each type of disaster over a range of magnitudes. Magnitudes are expressed in terms of total asset losses. For example, the curves specify "An earthquake that causes at least US$X million in damages in Y region is, on average, expected to occur once every Z years." The following are return periods in this study: 1 year, 2 years, 5 years, 10 years, 20 years, 50 years, 100 years, 200 years, 250 years, 500 years, 1,000 years, 2,000 years, 5,000 years, and 10,000 years.

17 Due to the significant impact of earthquakes and floods on the annual average of affected GDP in these eight ECA countries (according to their country disaster risk profiles), the focus of this study concentrated on these two types of hazards.

Destroyed homes in Krupanj, Serbia following severe mudflows in 2014. Credit: Zoran Dobrin

each year in a given geographical area. These losses consist of the cost to repair or replace damaged assets including homes, vehicles, roads and bridges, factories, and so on. As shown, long-term average annual losses in GDP percentage due to earthquakes for the countries in this study range from 0.05 percent in Bulgaria to 0.48 percent in Georgia. For floods, the range is wider, between 0.04 percent (Greece) and 0.97 percent (Croatia). The total annual expected asset losses due to floods and earthquakes in GDP percentage are more than 1.39 percent in Croatia and 1.14 percent in Georgia.

However, as illustrated in subsequent chapters, direct economic asset losses provide an incomplete picture of the total economic cost of a given disaster event. This is in part due to the fact that direct and indirect economic losses vary from the immediate to delayed losses following a disaster. Indirect economic losses are the subsequent or second-order effects of the initial destruction such as lost wages, business interruption losses due to disruption of supply chains, interruption of basic services (health, education), and disruption caused by temporary or permanent relocation, among other things. Indirect economic losses can occur inside or outside the hazard area and often have a time lag, and, as a result, they become intangible or difficult to measure in a consistent manner (UNDRR 2018). Moreover, it is worth noting

Direct economic asset losses primarily emerge during the disaster event or within the first few hours after the event and are often assessed soon after the event to estimate recovery cost and determine insurance payouts.

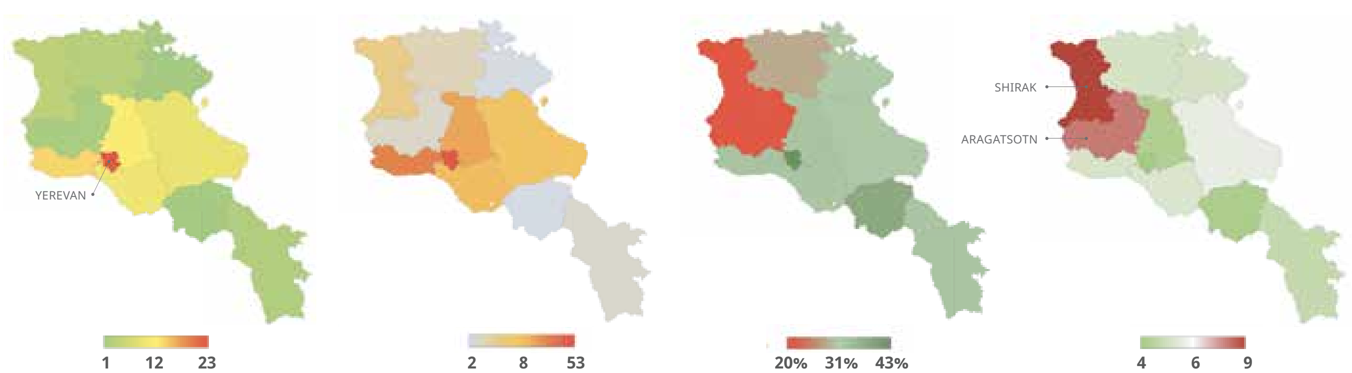
> As illustrated in subsequent chapters, direct economic asset losses provide an incomplete picture of the total economic cost of a given disaster.

that another disadvantage with the use of direct economic losses as a metric is that it cannot be used to measure many of the resilience-building benefits associated with the three specific Sendai Priorities for Action: strengthening disaster governance, investing in resilience, and enhancing preparedness for effective response (Markhvida et al. 2020).

Natural hazard risk is also not equally distributed across the region or across individual countries. Significant differences across regions are explained by variations in the hazard, exposure, and vulnerability of each part of the country. In most cases, asset risks are near major economic centers because that is where the high concentration of valuable assets is and therefore where potential losses are the largest. For example, as shown in figure 6 (left side), the expected average annual losses due to earthquake and flood risk in Armenia are concentrated around the capital city, Yerevan. Due to its elevated hazard and exposure, more than 30 percent of annual losses are expected to occur in the capital region, Yerevan. In an average year in Armenia, flooding causes 59 percent less damage than earthquakes, with losses valued at US$22 million per year. Flood risk is slightly more distributed than earthquake risk and is particularly concentrated in the Gegharkunik region (29 percent) and Yerevan (25 percent).

Well-being losses and post-disaster recovery times are also not uniformly distributed at sub-national level. A slightly different pattern emerges when one looks at the distribution of well-being losses or how long each region would take to recover in the aftermath of a major earthquake in figure 6 (right side). In Armenia, while Yerevan suffers large losses due to the density of exposed infrastructure, facilities, and other productive assets in the capital city, in Armavir, high asset losses due to earthquakes lead to outsized well-being losses. Looking at anticipated post-disaster recovery time at a sub-national level can also provide useful insights for decision-makers, for example, by predicting the most disadvantaged regions during the aftermath of a major earthquake and better inform the allocation of relief efforts to support post-disaster reconstruction efforts. For instance, it would take Shirak and Aragatsotn almost three times as long as Yerevan to recover 75 percent of damaged/destroyed assets in the aftermath of a 200-year earthquake. DRM strategies seeking to minimize time to recover after disasters should therefore focus on providing timely post-disaster support in areas where recovery is expected to be slower. These different maps highlight the importance of not using averages and demonstrate that while a sole focus on asset losses already provides a robust set of priorities, it still does not capture how severe socioeconomic consequences can be at a local level or help us identify which region is more likely to struggle in the aftermath of a disaster.

Figure 6: Multihazard (earthquake and precipitation flooding) risk to assets, by region in Armenia, and compared with maps revealing which regions are least likely to cope (and which regions are likely to face challenges with post-disaster reconstruction and recovery).



Expected average annual losses (floods and earthquakes) in millions (US$)

Regional wellbeing losses in millions (US$) Regional average = US$21 million

Socioeconomic resilience for floods and earthquakes

Average number of years needed to recover 75% of assests (200 year earthquake event)

Results are expressed in US$, millions.

CHAPTER 5:

Disasters increase existing poverty levels

As seen in recent events in the region, when a major disaster event occurs, a significant number of residents in these countries are expected to face transient consumption poverty—which increases the local poverty rate. Depending on available coping mechanisms (or overall level of socioeconomic resilience of a given household or community) such disaster impacts tend to widen income inequalities and create additional sources of vulnerability. Disaggregating asset losses at household level enables this analysis to move from expected asset losses to some of the second-order effects of a given disaster, focusing specifically on income and consumption losses, which are to be expected when households are affected by a given shock. From this perspective, disaster losses are assessed not just in terms of economic costs but also as an obstacle to poverty reduction efforts and other sustainable development aspirations.

As seen in recent events in the region, when a major disaster event occurs, a significant number of residents in these countries are expected to face transient consumption poverty – which increases the local poverty rate.

If a disaster hits a region, it can potentially have significant second-order effects on a large part of the population—particularly on immediate consumption and well-being levels. They may be because they have lost their job or another source of income, because they have lost their home and need to pay for repairs and temporary housing or because they need to replace possessions that have been lost. This sudden reduction in consumption levels makes some people fall under the poverty or subsistence line, and many of these people are already poor or near-poor. By definition, the poorest income groups do not have much assets to lose but minor losses can have disproportional impacts on their well-being—especially relative to wealthier income groups, who have higher precautionary savings or better access to financial resources to smooth the impacts of shocks. At a community level, disasters also affect livelihoods, disrupt local markets and income flows, and make it hard for affected populations to rebuild their homes and businesses.

Net income losses therefore incorporate these socioeconomic characteristics, which influence households' recovery pathways. Accordingly, income losses describe better than asset losses the real impacts of disasters on well-being and recovery prospects and provide a complementary perspective to asset losses, by generating new insights into the costs of disasters in these countries. However, as a metric of disaster impacts, income losses may underestimate the link between poverty and disasters. First, they do not account for the reconstruction costs that households incur in rebuilding their assets after a disaster. Second, while wealthy households may have access to considerable savings, credit, remittances, and insurance to finance

their recovery, these resources are rarely available, if at all, to poor households (Morduch 1995; Townsend 1995). This is important, because access to these tools can mean the difference between a speedy, smooth recovery and a long-term poverty trap (Carter and Barrett 2006; Carter et al. 2007). These costs and resources all affect households' ability to maintain a certain level of consumption after a shock, or else their consumption level drops.

In the eight countries that were analyzed, earthquakes and floods could have the most significant impacts on pre-COVID poverty levels in Yerevan (Armenia), Tbilisi (Georgia), and Bucharest (Romania).

The key findings generated in this analysis are presented below and aim to link regionwide earthquake and flood risk assessment with more granular insights on the household economy. The analysis particularly focuses on how individual households' socioeconomic characteristics can mitigate or magnify the impact of disasters. To illustrate the post-disaster consumption loss distributions across selected countries, two major disaster scenarios were simulated—a 200-year earthquake event and a 200-year flood event—in the sub-national areas with major concentration of flood and earthquake disaster risks for each of these select eight countries

Table 2: Most exposed regions in selected countries used to calculate consumption loss distributions for 200-year earthquake scenario and 200-year flood scenario.

Country	Earthquakes region	Flooding region
Albania	Tirana	Shkoder
Armenia	Yerevan	Gegharkunik
Bulgaria	South-Western and South Central	South-Western and South Central
Croatia	Countrywide	Countrywide
Georgia	Tbilisi Municipality	Tbilisi Municipality
Greece	Attica	North Greece
Romania	Bucharest-Ilfov	North-East
Turkey	Istanbul	Mediterranean

(listed in table 2).[18] It is also worth noting that disaster events with return periods of at least 200 years are not as rare as they may seem: statistically speaking, there is about 5 percent probability (4.8 percent to be accurate) of observing at least one such catastrophic earthquake in a given region in a 10-year period. In addition, there is about 5 percent probability of observing at least one such catastrophic flood in a given region in a 10-year period.[19] The goal of this analysis is to illustrate the impact of a plausible major disaster event in a foreseeable future to inform the development of resilience-building measures that are risk informed and socially inclusive.

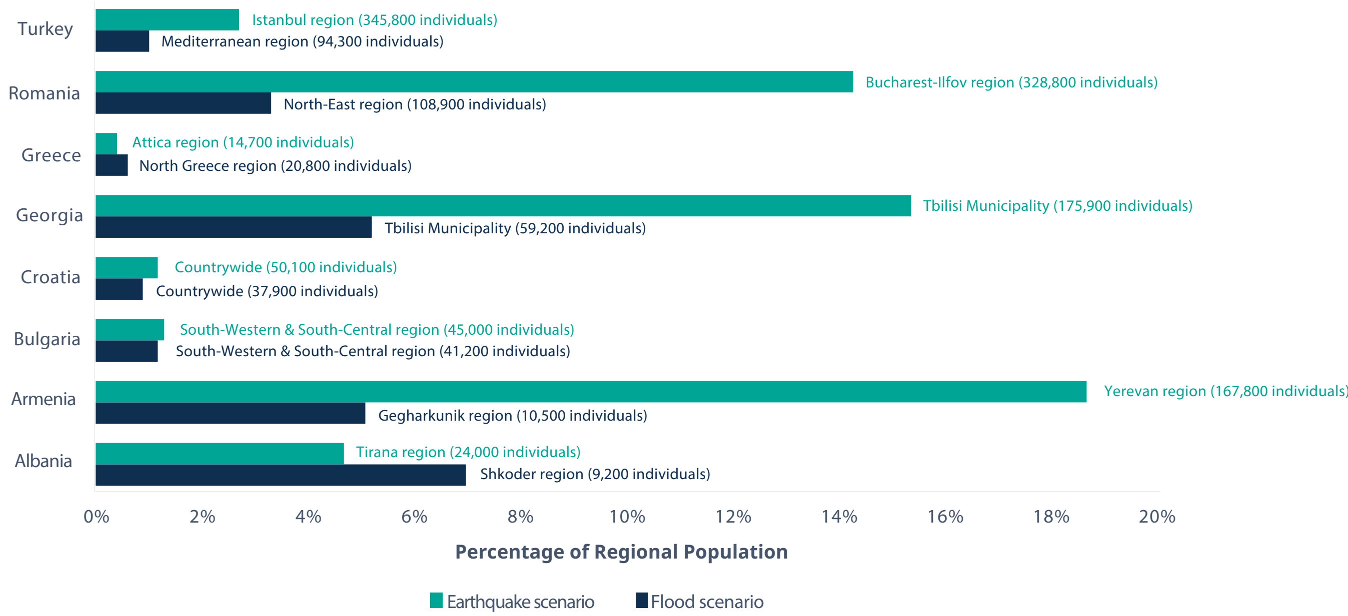
In the eight countries that were analyzed, earthquakes and floods could have the most significant impacts on pre-COVID poverty levels in Yerevan (Armenia), Tbilisi (Georgia), and Bucharest (Romania). This is an important point to consider when deciding where to intervene and invest to manage existing disaster risks: risk analyses that solely focus on asset losses could generate different priorities than risk analyses that look at poverty incidence or other socioeconomic impacts. Figure 7 summarizes the post-disaster increases in consumption poverty in each of these eight countries due to a 200-year earthquake and due to a 200-year flood in the sub-national areas that had the highest concentrations of asset risks due to earthquakes and floods.

In the event of a 200-year earthquake scenario, Yerevan (Armenia) Tbilisi (Georgia) and Bucharest (Romania) could experience the highest poverty increases (compared to 2016 poverty levels), with, respectively, an additional 18.7 percent of the local population (167,800 individuals), 15.4 percent of the local population (175,900 individuals), and 14.3 percent (328,800 individuals) of the local population who could immediately fall into poverty in the aftermath of such an event.

18 Note that Croatia was analyzed at country level because the geographical locations of households included in the GMD datasets were not available.

19 A disaster event with X-year return period has a 1/X chance of occurrence in every given year.

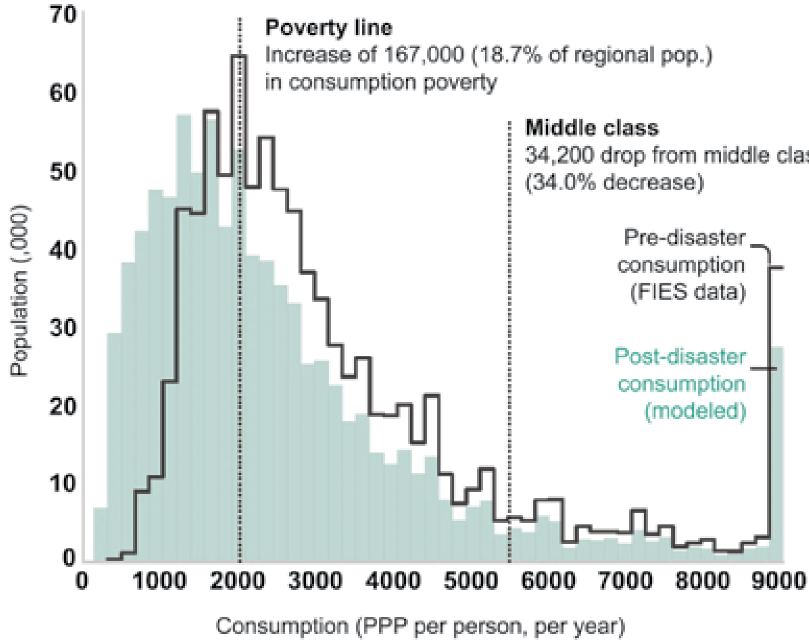
Figure 7: Multicountry comparison of post-disaster impact on 2016 poverty rates for 200-year earthquake scenario and for a 200-year flood scenario



Select regions listed in table 2 are considered for each country.

Community members raise the walls banks with sandbags during the worst flooding ofthe Sava River on record across the Balkans in May, 2014. Credit: Nebojsa Markovic

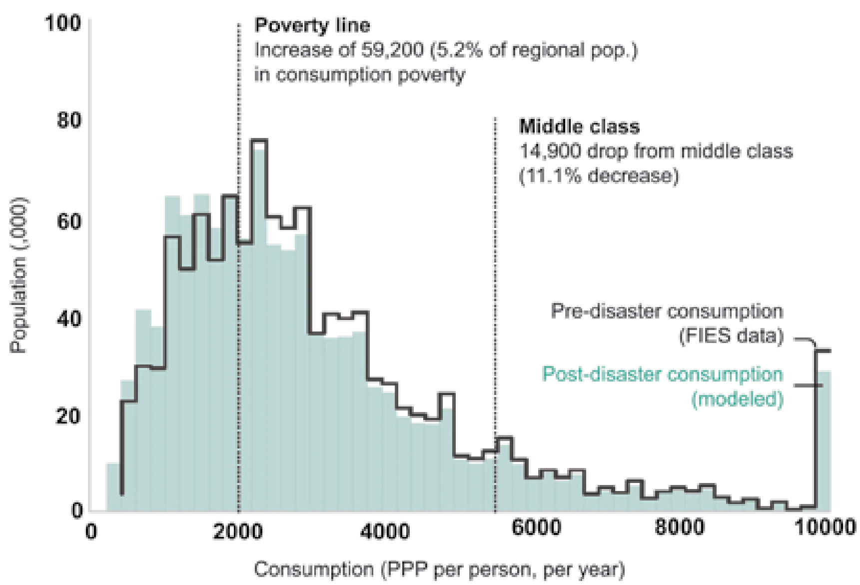
Figure 8: Per capita consumption (US$) in capital region of Yerevan (Armenia), before and immediately after a 200-year earthquake event (scenario projection).



Note: PPP = Purchasing power parity.

Source: World Bank calculations using GMD data (2016). Pre-disaster consumption uses Food Insecurity Experience Scale (FIES) data.

Figure 9: Per capita consumption (US$) in Tbilisi Municipality (Georgia), before and immediately after a 200-year flood event (scenario projection).



Note: PPP = Purchasing power parity.

Source: World Bank calculations using GMD data (2016). Pre-disaster consumption uses FIES data.

In the event of a 200-year flood scenario, Shkoder (Albania), Tbilisi (Georgia), and Gegharkunik (Armenia) could experience the highest poverty increases (compared to 2016 poverty levels), with, respectively, an additional 7 percent of the local population (9,200 individuals), 5.2 percent of the local population (59,200 individuals), and 5.1 percent of the local population (10,500 individuals) who could immediately fall into poverty in the aftermath of such an event.

To further illustrate post-disaster poverty increases, the impacts of a 200-year earthquake event in Armenia's capital, Yerevan, and a 200-year flood event in Georgia's capital, Tbilisi, are represented in figure 8 and in figure 9, respectively. These histograms illustrate the distributional impact of damages on consumption level and the proportion of people living below the international poverty line before and after a disaster.[20] This poverty might be transitory, but rather than making assumptions on the duration of the consumption loss, the analysis focused on the increase in poverty as a direct impact of a given disaster scenario (200-year earthquake or flood event).

In figure 8 and in figure 9, the poverty line and middle-class threshold are indicated by the dotted lines which correspond to US$5.50 and US$15.00 per day per person. In Yerevan, a closer look at the consumption distribution show that the large majority of individuals in the region consume between US$1,000 and US$3,000 per year per person (black outline), with approximately 25 percent of Yerevan's population

20 Based on the World Bank's International Poverty Line for upper-middle-income countries (US$5.50 a day/person in US$ 2011 PPP).

Romania Urban Search And Rescue (USAR) crews at work after a large earthquake in the Durrës region (Albania) on November 26, 2019. Credit: Italy Civil Protection.

Box 2: The November 2019 Earthquake in Albania worsened local poverty levels.

A magnitude 6.4 earthquake hit Albania on November 26, 2019, causing 51 fatalities, leaving 17,000 people displaced, impacting more than 1 percent of its GDP, and ultimately affecting more than 200,000 people across 11 municipalities. Throughout Albania, a total of 11,490 homes were damaged or destroyed, and another 83,000 needed repairs. According to the PDNA (Government of Albania et al. 2020), an additional 26,000 people have been pushed into poverty in the affected districts as a result of the earthquake and its impact on economic activity, representing a 2.3 percentage point increase over the pre-earthquake situation (table 3).[a] To put these figures in context, across Albania, 14.3 percent of population (414,000 people) lived below the national poverty line (Dávalos et al. 2016).[b]

Table 3: Subjective poverty levels before and after the 2019 earthquake in affected municipalities in Albania.

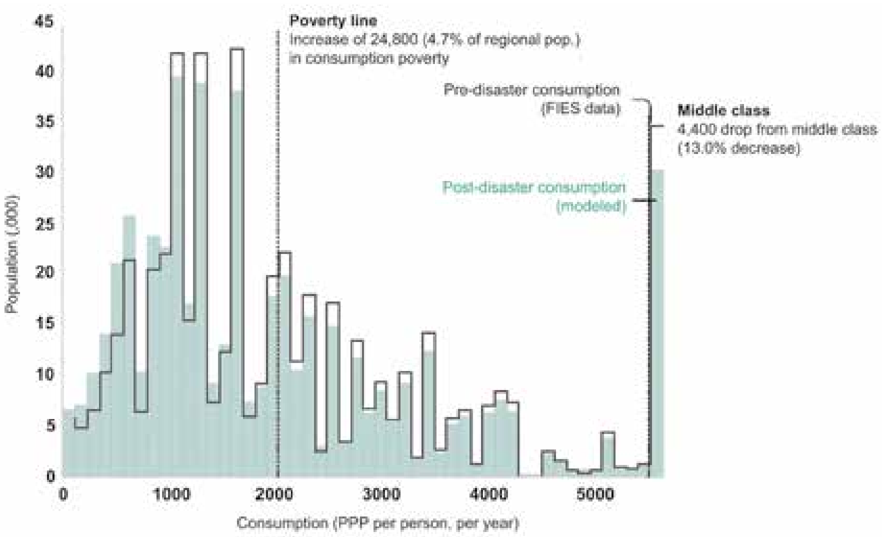
Municipalities	Before earthquake	After earthquake	After-Before	
	Percentage	Percentage	p.p.	Percentage
Durres	5.0%	8.0%	2.9	59%
Kamza	20.3%	21.6%	1.3	6%
Kruja	2.2%	5.2%	3.0	135%
Kurbin	4.4%	6.8%	2.4	53%
Shijak	6.0%	11.9%	5.9	99%
Tirana	14.0%	15.4%	1.4	10%
Vora	13.4%	29.3%	15.9	118%
Total	**11.9%**	**14.2%**	**2.3**	**19%**

Source: Government of Albania et al. 2020.

a. Subjective poverty based on self-assessment of the household in seven municipalities was estimated at 11.9% before the earthquake, and it is raised to 14.2% after the earthquake. Similarly, in Serbia and in Bosnia and Herzegovina, the floods of 2014 and 2015 resulted in a deepening of poverty in already poor municipalities and an expansion of poverty in others.

b. The World Bank poverty projections in Albania indicate there has been a slow decline in poverty levels in recent years, down to about 34.5 percent (approximately 990,000 people) in 2019 (World Bank, 2019). Based on upper-middle-income Class Poverty Line (US$5.5 per person per day, 2011 PPP). The latest official poverty figures for Albania date to 2012, when the poverty headcount was 39.1 percent (measured as US$5.5 per person per day, 2011 PPP), so it is not possible to accurately measure changes in poverty since then.

Figure 10: Per capita consumption (US$) in the capital city of Tirana (Albania), before and immediately after a 200-year earthquake event (scenario projection).



Note: PPP = Purchasing power parity.

Source: World Bank calculations using GMD data (2016). Pre-disaster consumption uses FIES data.

Consumption losses resulting from a simulated earthquake with 200-year return period are expected to push some 24,800 individuals into consumption poverty in Tirana.

currently living below the poverty line (Fuchs Tarlovsky et al. 2019). Figure 8 shows in red the same distribution, but after a 200-year earthquake event hits the region. In Yerevan, the consumption losses caused by an earthquake of this magnitude have approximately a 5 percent chance of occurring in the next 10 years, and is expected to push close to 168,000 individuals into consumption poverty (corresponding to 18.7 percent of its region's population). Moreover, a 200-year earthquake would also displace some 34,200 people individuals away from middle-class consumption level, representing a 34 percent drop of the of Yerevan's middle-class population,[21] compared to pre-disaster levels.

Similarly, as shown in figure 9, consumption losses in the Tbilisi Municipality (Georgia) resulting from a 200-year flood event are expected to push some 59,000 individuals (corresponding to 5.2 percent of its local population). In a municipality which had 11 percent of its population already living below the poverty line in 2016 (approximately 121,000 individuals), this simulated post-disaster effects shows a significant increase in the population of individuals below poverty line. In addition, the 200-year flood event would also push out some 15,000 individuals away from middle-class consumption level, representing a 11.1 percent drop, compared to pre-disaster levels.

For benchmarking purposes, results of an analysis conducted for the Albanian capital, Tirana (figure 10), were compared to the poverty results from the post-disaster needs assessment (PDNA) as a result of the recent November 2019 Albania earthquake (Government of Albania et al. 2020). While the post-disaster poverty levels were calculated using a different methodology (subjective poverty rate) and the November 2019 earthquake in Albania was not a 200-year event, the results for the actual event were relatively consistent with those from the simulated 200-year earthquake event. Consumption losses resulting from a simulated earthquake with 200-year return period are expected to push some 24,800 individuals into consumption poverty in Tirana (4.7 percent of the regional population) and displace some 4,400 individuals away from middle-class consumption level (corresponding to a 13 percent decrease compared to pre-disaster levels) (figure 10). The PDNA for the actual event that took place in November 2019 indicates that following the earthquake, subjective poverty rates in the affected districts increased by 2.3 percentage points, equal to 26,000 people (this would be the equivalent of a 19 percent increase in poverty rate compared to pre-disaster levels) (box 2).

21 US$15.00 a day in 2011 PPP dollar a day per person was used for delineating middle-class line.

CHAPTER 6:

Disasters accentuate existing socioeconomic inequalities

When disasters damage or destroy the assets on which individuals rely for their livelihood, affected households face income losses. Households' ability to anticipate or mitigate these losses will inherently depend on their socioeconomic capacities, such as their pre-disaster income and their access to other types of financial resources.

6.1 Disasters tend to increase income inequality and reveal uneven access to mitigation measures

In the event of a disaster, income losses are intrinsically linked to destruction of, or damage to, an individual's own assets (local business or agriculture field), but they are also due to the disruption of factories, supply chains, and other types of infrastructure owned and maintained by others. Some individuals who have lost assets may receive public assistance or additional remittances, which supplement their regular income as they rebuild, while others will be left to their own devices. As seen with the Roma populations in Bulgaria (box 3) or in Serbia in the aftermath of the 2014 floods (box 5),[22] poor households can also be further constrained if there are already underlying factors of vulnerability (for example, absence of recorded land tenure) and uneven access to protective infrastructure and risk information (for example, neighborhoods with inadequate drainage or outdated hazard maps) before a disaster.

When disasters damage or destroy the assets on which individuals rely for their livelihood, affected households face income losses.

Spatial patterns of socioeconomic inequalities between and within countries[23]—whether it's related to income distribution or access to essential services (health, education, transport connectivity, and so on)—constrain poverty reduction efforts but can also have important implications in terms of potential post-disaster recovery (UNDP 2016). Asset losses and consumption poverty analysis describe individual households' status in the instant right after a given disaster event takes place, and this information can provide important insights into how governments, local decision-makers and other stakeholders involved in the recovery should sequence early recovery efforts accordingly. But another important concern is whether disaster-affected households become mired in chronic poverty or are able to achieve a speedy

22 Box 5 in chapter 7 describes a similar post-flood experience of the Roma community in Serbia, looking specifically at the extent to which preexisting marginalization delayed the community's recovery.

23 These patterns of spatial socioeconomic inequalities are often referred as 'lagging regions' in the European Union context (Farole, Goga, and Ionescu-Heroiu 2018).

Natural hazards in Bulgaria can expose the decades-old, unsafe housing conditions of Roma communities. Credit: Nikolai Totukhov

Box 3: In Bulgaria, unequal access to preventive measures and risk information reveal vulnerability of Roma populations.

Major damages due to disasters (flooding, earthquakes, landslides) tend to have a disproportionate impact on low-income communities living in marginalized areas. Such occurrences are also more common in these areas because infrastructure is less developed (for example, flood protection barriers) and emergency response planning (for example, access to life-saving facilities) more limited. In June 2014, torrential rains caused severe flash flooding across northeastern Bulgaria,[a] a submerging large parts of several cities in the region. The city of Asparuhovo—home to many minority groups, including nearly 1,000 Roma—was hardest hit by the unprecedented amount of rainfall. The municipality noted that 122 families had to evacuate their houses and that 60 percent of destroyed houses were owned by members of the Roma community.

Because many of these homes were part of informal settlements and had been built without complying with existing building codes or zoning restrictions, they were not stable enough to survive torrential waters. This event highlighted the inadequate and unsustainable housing conditions of the Roma community as well as the lack of preventive measures put in place by the municipality. As a result of the flood, 14 people—most of them Roma—died. The Roma community in Asparuhovo is only one of many Roma communities living in flood-prone zones across Central and Eastern Europe. There are no clear data indicating how many Roma live in flood-prone regions across the Balkans, but in Bulgaria, where EU estimates place the Roma population at about 800,000, government data suggest that about half live in informal settlements. Many of these are poorly constructed, lack basic facilities, and are isolated and located outside residential areas.

Sources: Ionova 2014; Minority Rights Group International 2018; Naydenova 2014.

a. Bulgaria is highly exposed to disasters. From 2010 to 2016, disasters caused damages up to US$1 billion and prompted the government to spend US$600 million on recovery and over US$100 million on rescue and emergency. Flood and extreme temperatures were the most frequent disasters, with flood causing the greatest damage and largest numbers of affected population (Government of Bulgaria 2018).

recovery[24] as poverty impacts only highlight the situation of people living near the poverty line (and disregards what happens to other income groups in a given affected area). In contrast to asset losses per se, income and consumption losses can also support policy makers to better manage the severity and the duration of a disaster-related shock.

6.2 Anticipated post-disaster recovery trajectories (national and sub-national level)

Although a disaster is a shock from which recovery takes years, households in some regions will take longer to recover than in others. In the aftermath of a disaster, affected households lose productive assets, which directly reduce their income but household-level consumption losses do not end there, however, because destroyed assets do not rebuild themselves. Rather, affected households will have to increase their savings rate—that is, avoid consuming some fraction of their post-disaster income—to recover these assets. Assuming each household pursues an exponential asset reconstruction pathway, a reconstruction rate for each household to optimize its well-being over the 10 years following a disaster while avoiding bringing consumption below the subsistence level (if possible) is calculated. To model each household's recovery,

24 The recovery phase is usually structured by three main stages: (a) humanitarian relief, including search and rescue, and medical care; (b) restoration of basic services, including the supply of clean water, food, and sanitation, basic energy, mobility, and health care needs; and (c) the reconstruction phase, including infrastructure reconstruction, repair or replacement of building and production equipment, and asset recovery by households—typically the longest and most costly phase of recovery (Hallegatte, Rentschler, and Walsh 2018).

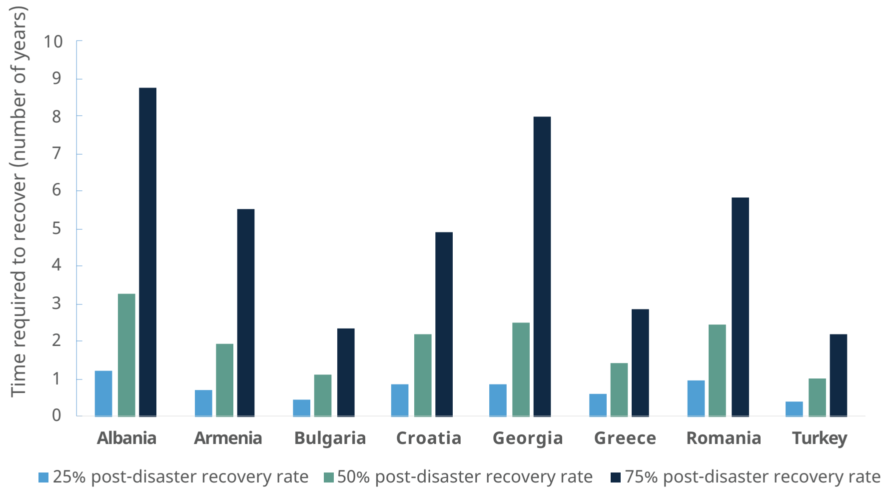
it was assumed that disaster-affected households rebuild their lost assets exponentially over some number of years after a given shock. In addition, another parameter was that households must maintain their consumption above a certain level to meet their essential needs.[25]

Although a disaster is a shock from which recovery can take years, households in some regions will take longer to recover than in others.

When a given disaster takes place, it is assumed that the government borrows externally to finance the cost of public asset reconstruction, to hasten recovery and minimize the financial burden on affected households. Eventually, the government recovers these costs through taxation but only when recovery is complete. Through this mechanism, all households throughout the country share the cost of public asset reconstruction in the affected area. Because this is conceived as a one-time tax to fund reconstruction, public asset reconstruction costs are not spread across the duration of the reconstruction (in contrast to income lost due to the destruction of public assets, which does last for years after the disaster). It is assumed that the government does not collect the special tax at any point during recovery but rather covers the cost of public asset reconstruction for the duration of reconstruction and collects taxes to fund this process many years later, after full recovery.

25 If the households cannot avoid having consumption below the subsistence line (for instance, because consumption is below the subsistence level even without repairing and replacing lost assets), then it is assumed that reconstruction takes place at the pace possible with a saving rate equal to the average saving rate of people living at or below subsistence level in each region of the eight selected countries.

Figure 11: Multicountry comparisons of time to reconstruct after a 200-year earthquake.

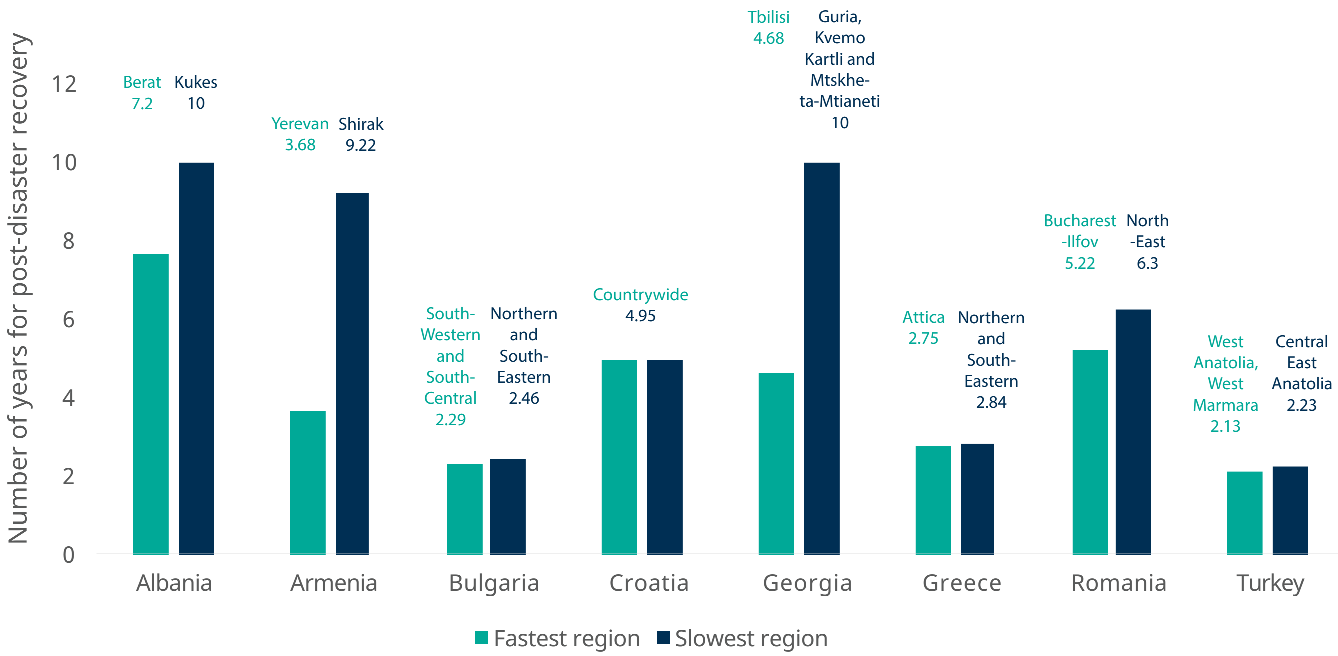


Looking at anticipated post-disaster recovery durations can provide useful insights for decision-makers and better inform post-disaster recovery and reconstruction efforts (for example, by predicting which affected areas are more likely to face reconstruction bottlenecks and recovery challenges than other areas). Figure 11 shows how long it takes *on average* in each of these eight countries to recover 25 percent, 50 percent, and 75 percent of assets destroyed in the aftermath of a 200-year earthquake event. While most countries would be able to recover 25 percent of their assets in less than a year (with the exception of Albania[26]), the completion rate of reconstruction rates diverges significantly over time: to reach a reconstruction completion rate of 75 percent, the expected recovery milestones are shortest in Turkey and Bulgaria (approximately 2 years), and the longest in Albania and Georgia (8–9 years). As shown in figure 11, a full recovery requires more than 10 years in some countries, while in other countries, the recovery time is significantly shorter.

26 In Albania, for example, national average time to recover for 25 percent, 50 percent, and 75 percent of assets is 1.21 years (442 days), 3.26 years (39 months), and more than 8.75 years (8 years and 9 months), respectively (Figure 11).

The speed of reconstruction can vary significantly from region to region within the same country. For each country, figure 12 shows the fastest and slowest times to recover 75 percent of assets. As shown, the recovery rate gap (that is, the difference between the fastest and slowest reconstruction rates) in Armenia and Georgia is very high and corresponds to more than five years, while this same gap is much shorter in Bulgaria, Greece, and Turkey, corresponding to less than a year. Box 4 looks at this example in more detail and provides reasons why urban and rural marginalized communities in Romania's northeastern regions are disproportionately affected by disasters and have access to limited

Figure 12: In-country gap between fastest and slowest sub-national post-disaster recovery for 200-year earthquake (time required for recovering 75 percent of assets).



Romania's northeastern regions are disproportionately affected by disasters and have access to very limited resources to cope with and recover from such shocks.

resources to cope with and recover from such shocks (both at the household and community levels). In terms of sub-national recovery within the same country, DRM strategies seeking to minimize time to recover after disasters should therefore focus on providing timely post-disaster support in areas that are likely to face bottlenecks and have a much slower expected recovery process.

As stated earlier, one of the reasons for different recovery trajectories is primarily the average productivity of capital (at national and sub-national level),[27] the extent of damage, the level of social protection (and post-disaster assistance) provided by governments, and feasible level of capital reallocation from household consumption expenditures to rebuild the lost assets—with other conditions remaining the same.

The productivity and vulnerability of these assets to various hazards can vary from region to region—that will result in variations in the reconstruction time. In addition, it is important to note that the liability for reconstruction and well-being losses that follow a disaster vary as well: households reconstruct their own assets using their savings and allocating their consumption budget to reconstruction, unless they carry private insurance; the national or regional taxpayers reconstruct public assets; and other private assets are rebuilt by private business owners or corporations. Again, this modeling result is largely independent of initial asset losses, expressing instead the expected capacity of each region in each of the eight countries (except Croatia)[28] to cope with losses in the aftermath of a 200-year earthquake event.

27 The average capital productivity is the measure of how well physical capital is used in providing goods and services. Productive use of physical capital and labor are the two most important sources of a nation's material standard of living. In addition, how well a nation uses its physical capital affects the return people get on money they save. The higher the returns, the less they need to save for the future and they can consume today (Agrawal et al. 1996). Therefore, the higher the productivity of capital in a region is, the lower the capital required to restore production, thus the lower need for reconstruction resources.

28 Due to the lack of NUTS 2 geospatial data for households in the Croatia dataset, the analysis for this country is limited to the country level and is not able to measure the post-disaster recovery gap between regions within Croatia.

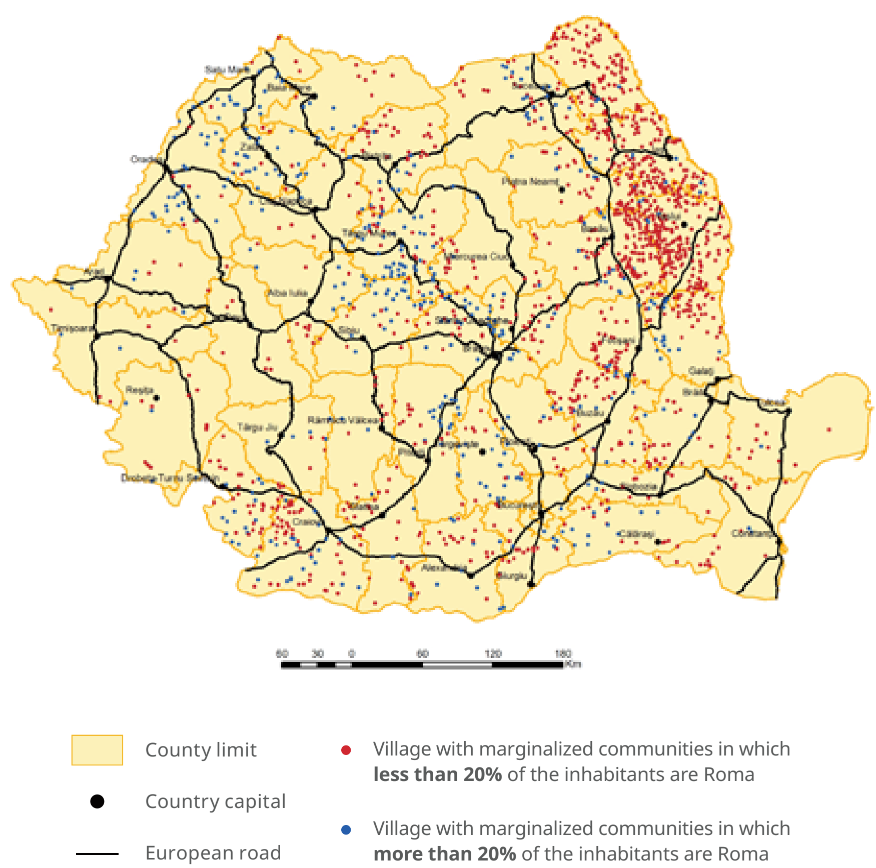
Box 4: Enhance socioeconomic resilience across Romania: How to best target interventions?

The risks posed by disasters are disproportionately higher for the poor and other vulnerable groups, whose welfare and long-term prospects have always been acutely vulnerable to exogenous shocks. In Romania, from a poverty alleviation perspective, the concept of *marginalized areas* – in both urban and rural areas – are defined and empirically identified as census sectors that simultaneously experience severe levels of deprivation in three distinct areas: human capital, employment, and housing conditions. The populations living in these areas are characterized by a deficit of human capital, tend to generate revenue from the informal sector (combined with social transfers and agriculture in rural areas), and often live in precarious dwellings even by the usual low standard for rural housing. Such areas are therefore territorial concentrations of multidimensional poverty and, as a result, are particularly vulnerable to exogenous shocks such as disasters (floods, earthquake, landslides) or climate risks (heatwaves, droughts, and so on).

There are significant differences between marginalized areas that are urban (ghettos, slums, mahalas, social housing concentrations, and historical areas) and those that are rural (as shown in figure 13). While urban marginalized areas are often localized centrally (as shown in figure 14), rural marginalized areas are prone to geographic isolation and are usually located at the outskirts of well-connected villages. In terms of percentage of population, 6.2 percent of Romania's rural population and 3.2 percent of its urban population live in marginalized areas (estimates based on the 2011 Population and Dwelling Census).

The main targeting tools used for the analysis of marginalized areas in Romania are *The Atlas of Urban Marginalized Communities in Romania* (Anton et al. 2014) and *Atlas Marginalized Rural Areas and Local Human Development in Romania* (Sandu et al. 2016).[a] These tools demonstrate that in Romania both the urban and the rural marginalized areas are spread across all counties and regions, with a particular concentration in the North-East region. Most rural marginalization areas are small (under 500 inhabitants) and have an ethnic dimension, as Roma people are statistically overrepresented and concentrated in segregated communities. The main limitation of the existing targeting tools is the lack of municipal geographical references, which sometimes prevents the data from shaping more granular interventions in target areas.

Figure 13: Distribution of rural marginalized areas across Romania, 2011.



Note: World Bank estimations were based on data from the 2011 Population and Housing Census. The analysis was carried out at the census sector level for all rural administrative units. Sectors with fewer than 50 inhabitants were not included in the analysis.

Source: Sandu et al. 2016 (World Bank).

a In 2012, the Government of Romania and the World Bank partnered to facilitate the preparation and implementation of projects funded by the European Union. This agreement included these two atlas initiatives, which were framed within a wider project of designing strategies for the integration of poor areas and disadvantaged communities across Romania.

Box 4: Continued.

For both rural and urban areas, the empirical evidence generated in both atlases confirmed that marginalized communities face disproportionately high exposure to hazards and have access to limited resources to cope with and recover from such shocks (both at the household and community levels). Poverty reduction efforts in Romania could thus generate significant disaster risk reduction dividends if interventions prioritize the targeting of marginalized areas in both urban and rural zones.

Figure 14: City maps with marginalized communities reported by the local authorities: Medgidia town example.

Region: South-East
County: Constanța
City: Medgidia
Marginalized communities declared by local authorities

Legend

City limit

(number) Estimated number of inhabitants in the area

Cartography: ESRI, ArcGIS 10.1

Types of marginalized urban areas

- Ghetto-type areas with blocks of flats
- Ghetto-type areas in former industrial colonies
- Slum-type areas with houses
- Slum-type areas with improvised shelters
- Areas with modernized social housing
- Historical (central) neighborhoods with social housing and/or buildings abusively occupied
- Mixed areas

Next to the marginalized communities, the local name and the estimated number of inhabitants are shown, only if and as declared by the local authorities.

Source: Anton et al. 2014 (World Bank).

Sources: Anton et al. 2014; Sandu et al. 2016 ; Walsh and Hallegatte 2020.

CHAPTER 7:

When hit by disasters, poor people tend to incur more well-being losses than wealthier groups

7.1 Regional benchmarking

Given their limited livelihood choices, poor people are often more vulnerable than others to direct and indirect disaster losses and more likely to rely on unsustainable coping mechanisms. Even if disaster-affected households suffer identical asset losses, their consumption losses and recovery time will vary according to their socioeconomic status and the resources available to them (in part because insurance, savings, remittances, and public support help some households to smooth the consumption shocks). In particular, wealthier households will be able to spend down their savings or reduce luxury consumption, while poorer households will often have to cut spending on basic needs and essential consumption (for example, reducing food and health expenditures, withdrawing children from school activities, sending children to work, and taking on additional debt) thus potentially damaging their long-term prospects (UNDP 2016). Moreover, since most assets in low-income households and communities are uninsured, poor people often shoulder the greatest share of disaster losses. The example of the Roma community the 2014 floods in Serbia is given in box 5 to illustrate how the same disaster can affect several income groups in different ways: US$1 in consumption losses can have widely different consequences for individual households, depending on their income level.

Given their limited livelihood choices, poor people are often more vulnerable than others to direct and indirect disaster losses and more likely to rely on unsustainable coping mechanisms.

To maximize development co-benefits, DRM strategies and budgets should account for these differences, and here the concept of well-being losses can be useful. The full impact of disasters on the population's well-being depends not only on direct impacts but also on the duration of the recovery and reconstruction period and the tools that affected populations have to cope with and recover from such shocks. Ideally, these include social transfers, formal and informal post-disaster support, savings, insurance, and access to credit. The effects of disasters on individuals' welfare therefore depends on their ability to cope with and recover from a shock. Even if the asset losses of the poor account for just a small fraction of the total in any disaster, US$1 in asset losses matters more to a poor household than to a wealthy one. Well-being losses are defined so that US$1 in well-being losses indicates the same impact on poor people as on the wealthy even when their asset losses differ. Therefore, well-being losses measure the effects of disasters on all individuals' welfare more fully than asset losses.

FACING PAGE

Dried sunflowers on the side of the road. Credit: Boris Rumenov Balabanov

Roma settlement in Belgrade (Serbia) in the aftermaths of the May 2013 floods. Credit: Baloncici/Shutterstock.com

Box 5: Socioeconomic marginalization constrained the recovery of the Roma population after the 2014 floods in Serbia.

In the context of disasters, minorities are often at risk due to a combination of different types of vulnerabilities. These include their pre-disaster level of economic poverty, likelihood of living and working in hazard-prone areas, likelihood of living and working in substandard buildings that are of poor quality and/or insufficiently maintained, lack of access to optimal social services, and exclusion from information channels and decision-making and consultation structures. In several cases, discrimination and marginalization are the root causes of these layers of vulnerabilities (UNDP 2016).

An example demonstrating how these layers of vulnerability interplay with risk drivers is the experience of the Roma population in Serbia during the May 2014 floods. Roma, who are among Serbia's most vulnerable communities, tend to live in informal settlements in high-risk and underserviced areas such as floodplains and in housing built without construction permits or property registration. They are therefore more likely than less vulnerable groups to have their homes and livelihood prospects damaged or destroyed by floods. At the time of the floods, 93 percent of Roma households owned their own dwellings but had no insurance coverage (UNDP 2016).

Along with the lack of insurance, the lack of tenure security added further constraints to the reconstruction process. A major obstacle to housing reconstruction during the recovery phase was the absence of documentation for informal Roma settlements. Because most Roma housing units did not meet the requirements for registration as property during the pre-disaster phase, households were unable to provide documentation for their lost homes. Lacking official identification, Roma families became effectively invisible and were not able to access help. Floods also affected Roma livelihoods. The large portion of the population engaged in subsistence farming suffered the destruction of farms and yards. The sale of agricultural products from flood-affected areas was also temporarily banned due to possible contamination risks. Children in poor and vulnerable Roma families were also at elevated risk of not enrolling in school in September 2014 because floods had lowered incomes and had worsened living conditions (Government of Serbia et al. 2014). On average, Roma represented 2.1 percent of the population in flood-affected municipalities of Serbia, but their spatial distribution suggests that as a population group they were disproportionately affected by the May 2014 Floods in Serbia.[a]

Sources: Government of Serbia et al. 2014; UNDP 2016.

a. According to the 2011 Population Census, 147,607 Roma live in Serbia, representing 2 percent of the total population. However, unofficial data place their numbers at 450,000 to 500,000 (6.0–6.5 percent of the total population). The Roma National Council found that the 2014 floods affected 6,032 Roma in 714 households from 2,255 municipalities. Obrenovac, with 2,064 individuals distributed across 296 households, was the municipality most affected by the floods (Government of Serbia et al. 2014).

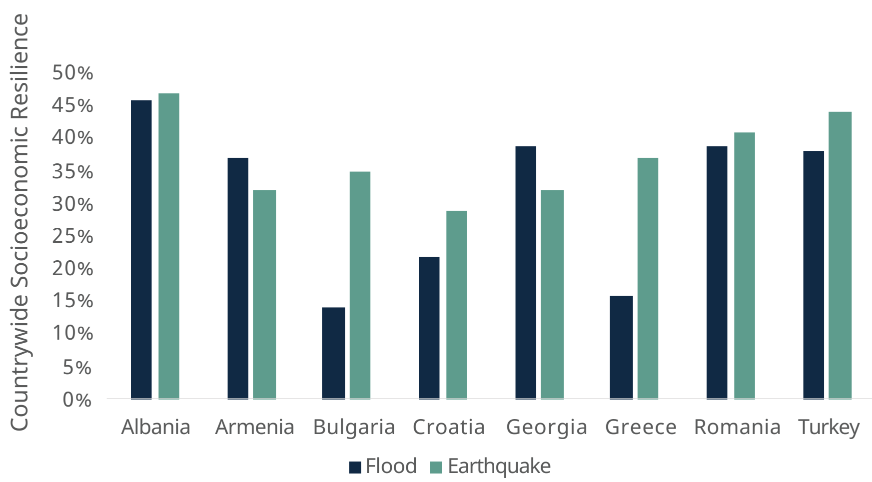
Table 4: Comparison of annual average risk to assets, annual average risk to well-being, and socioeconomic resilience for select countries in the ECA region.

Country	GDP (US$, millions in 2019 values)	Annual average asset risk					Annual average well-being risk					Socioeconomic resilience (%)	
		Asset risk (US$, millions)	Asset risk (GDP %)	Type of hazard	Asset risk (US$, millions)	Asset risk (GDP %)	Well-being risk (US$, millions)	Well-being risk (GDP %)	Type of hazard	Well-being risk (US$, millions)	Well-being risk (GDP %)	Earthquakes OR floods	Earthquakes AND floods
Albania	15,279	124.6	0.82%	EQ	48.2	0.32%	267.5	1.75%	EQ	101.5	0.66%	47%	47%
				F	76.4	0.50%			F	166	1.09%	46%	
Armenia	13,672	76.5	0.56%	EQ	54.4	0.40%	226.6	1.66%	EQ	167.1	1.22%	32%	34%
				F	22.1	0.16%			F	59.5	0.44%	37%	
Bulgaria	68,558	135.9	0.20%	EQ	31.7	0.05%	788.2	1.15%	EQ	90.4	0.13%	35%	17%
				F	104.2	0.15%			F	697.8	1.02%	14%	
Croatia	60,752	844.3	1.39%	EQ	253.6	0.42%	3,460.9	5.70%	EQ	849.1	1.40%	29%	24%
				F	590.7	0.97%			F	2,611.80	4.30%	22%	
Georgia	17,477	199.8	1.14%	EQ	83.1	0.48%	579.3	3.31%	EQ	285.5	1.63%	32%	34%
				F	116.7	0.67%			F	293.8	1.68%	39%	
Greece	209,852	166.5	0.08%	EQ	89.8	0.04%	698.1	0.33%	EQ	238.4	0.11%	37%	24%
				F	76.7	0.04%			F	459.7	0.22%	16%	
Romania	250,077	575.4	0.23%	EQ	139.2	0.06%	1,429.8	0.57%	EQ	332.6	0.13%	41%	40%
				F	436.2	0.17%			F	1,097.20	0.44%	39%	
Turkey	761,425	1,554.2	0.20%	EQ	711	0.09%	3,800.0	0.50%	EQ	1,598.60	0.21%	44%	41%
				F	843.2	0.11%			F	2,201.40	0.29%	38%	

EQ = Earthquake, F = Flood

*GDP in US$, billions in 2019 values.

Figure 15: Comparison of socioeconomic resilience for entire population of select countries.



Socioeconomic resilience integrates the real impacts of disasters on households' well-being by measuring an economy's ability to minimize the impact of asset losses on well-being levels, for example, by evaluating the ability of households (or communities) to cope with and recover from disasters.[29] These variations from a modelling perspective are due to the level of asset exposures (and subsequent damages), susceptibility of household income and consumption to asset losses, and the variety of reconstruction dynamics in each geographic area. From an economic point of view, these variations are due to the level of investments that are allocated to housing, private, and public infrastructure, and social transfers, as well as structural characteristics of local and regional economies and their level of susceptibility to natural hazards.

Table 4 summarizes the average annual risk to assets, average annual risk to well-being, and socioeconomic resilience with respect to floods and earthquakes for the entire population of each of the eight countries of interest. As shown, Georgia has the highest expected annual asset losses due to earthquakes in GDP percentage (0.48 percent), and Greece has the lowest (0.04 percent). Given its higher exposure of assets to disaster risks (in GDP percentage), Georgia has the highest expected annual well-being losses due to earthquakes in GDP percentage (1.63 percent), and Greece has the lowest (0.11 percent). Moreover, Croatia has the highest expected annual asset losses due to floods in GDP percentage (0.97 percent), while Greece has the lowest (0.04 percent). Similarly, Croatia has the highest expected annual well-being losses due to floods in GDP percentage (4.30 percent), while Greece has the lowest (0.02 percent). While the expected annual asset losses due to both earthquakes and floods combined in GDP percentage for Croatia are estimated at 1.39 percent, at the other end of the range is Greece at 0.08 percent. Similarly, Croatia has the highest expected annual well-being losses due to both earthquakes and floods combined in GDP percentage (5.70 percent) while Greece has the lowest (0.14 percent).

Figure 15 displays the average socioeconomic resilience of all eight countries with respect to both floods and earthquakes. As shown, socioeconomic resilience to earthquakes is highest for Albania (47 percent) and lowest for Croatia (29 percent). Albania also has the highest socioeconomic resilience to floods (46 percent), while Bulgaria has the lowest socioeconomic resilience to floods (14 percent).[30]

Socioeconomic resilience integrates the real impacts of disasters on households' well-being by measuring an economy's ability to minimize the impact of asset losses on well-being levels.

The difference in socioeconomic resilience of each region is due to variations in estimated asset losses and well-being losses. In other words, while countries (or sub-national areas) that enjoy higher resilience levels are better able to absorb the disaster-related shocks, countries (or sub-national areas) with a lower socioeconomic resilience level would benefit from resilience-

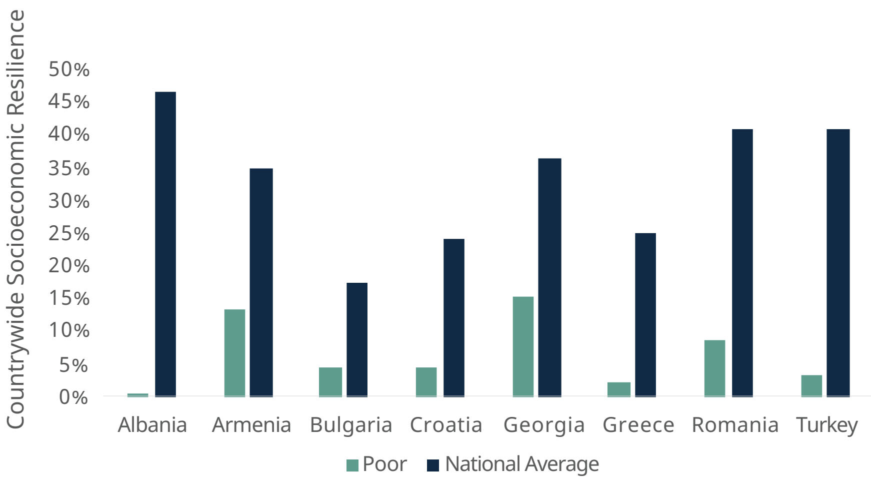
29 Socioeconomic resilience can be defined as the ratio of expected asset losses to well being losses.

30 Socioeconomic resilience to each type of natural disaster in a region is obtained by dividing the estimated asset losses by estimated well-being losses. For example, socioeconomic resilience of Albania to earthquakes is obtained as 48.2/101.5 = 47%.

FACING PAGE

A family stand in front of their house, following flash floods in Athens (Greece) in November 2017. Credit: Alexandros Michailidis/Shutterstock.com

Figure 16: Comparison of socioeconomic resilience levels in different socioeconomic groups for select countries.



building investments—including financial inclusion, public and private insurance, and other optimized post-disaster support mechanisms—to complement the traditional DRM toolbox of measures, policies, and investments.

7.2 Quantifying disaster impact on the poor and other socioeconomic groups

Since this study was conducted based on household data in each country, it is also possible to understand patterns of asset losses and well-being losses not just at the regional and country level but also across different socioeconomic groups. Figure 16 compares the level of socioeconomic resilience of each country's poor population with the average national socioeconomic resilience in each of the eight countries. As shown, the socioeconomic resilience gap between the poor and the national average in Albania is extremely high, while socioeconomic resilience gap is relatively lower in Georgia and Armenia. Similar to previous figures, low-income groups with a low socioeconomic resilience level would benefit from targeted solutions and measures that specifically strengthen their ability to weather disaster-related shocks—including adaptive social safety nets, increase in income diversification, or improved post-disaster recovery policies—in addition to traditional DRM toolbox of measures and investments (a) to reduce their exposure to hazards (for example neighborhood upgrading through enhanced drainage or risk-informed land use planning) and (b) to reduce the vulnerability of their assets (providing reliable land tenure to encourage housing investments or small-scale protective infrastructure).

At a household level, asset losses tend to increase with pre-disaster income because wealthier households own higher valued assets (figure 17). This type of asset-centered loss metric, however, does not indicate how the overall consumption and well-being of the household is disrupted since it does not take into account loss of labor income, availability of savings, the need to relocate during repair works, and the household's pre-disaster socioeconomic status (Markhvida et al. 2020).
By comparing annual asset losses and annual well-being losses due to floods and earthquakes across different socioeconomic groups in Greece,[31] figure 18 illustrates the disproportionate consequences of disasters on the poorest households, looking at overall totals (left) and per capita levels (right).

This significant gap in socioeconomic resilience can be partly explained by the difference in pre-disaster income levels and access to financial resources.

As shown, while each household in the poorest income category suffers only US$4 in asset losses every year, they experience US$226 in well-being losses every year, far exceeding the value of their asset losses. On the other hand, the wealthiest income group suffers 83 percent of the overall asset losses while experiencing only 46 percent of the overall well-being

31 Socioeconomic groups have been defined as follows: poor (households with consumption level of less than PPP US$5.50 per household member per day), vulnerable (households with consumption level of equal or more than PPP US$5.50 but less than PPP US$10.00 per household member per day), secure (households with consumption level of equal or more than PPP US$10.00 but less than PPP US$15.00 per household member per day), and middle class (households with consumption level of more than PPP US$15.00 per household member per day).

losses.[32] On the other hand, while each household in the middle class category on average loses US$34 in assets every year (that is, about eight times greater than each poor household's asset losses), their average well-being loss is about US$61 per year (that is, about a fourth of each poor household's well-being losses).

In addition, as shown in figure 18, the level of resilience of households of poor, vulnerable, secure, and middle-class socioeconomic groups in Greece is 2 percent, 9 percent, 18 percent, and 56 percent, respectively. This significant gap can be partly explained by the difference in pre-disaster income levels and access to financial resources, which affects the households' ability to recover in a timely and efficient manner (Markhvida et al. 2020).

Figure 17: Average total annual losses for various socioeconomic groups in Greece.

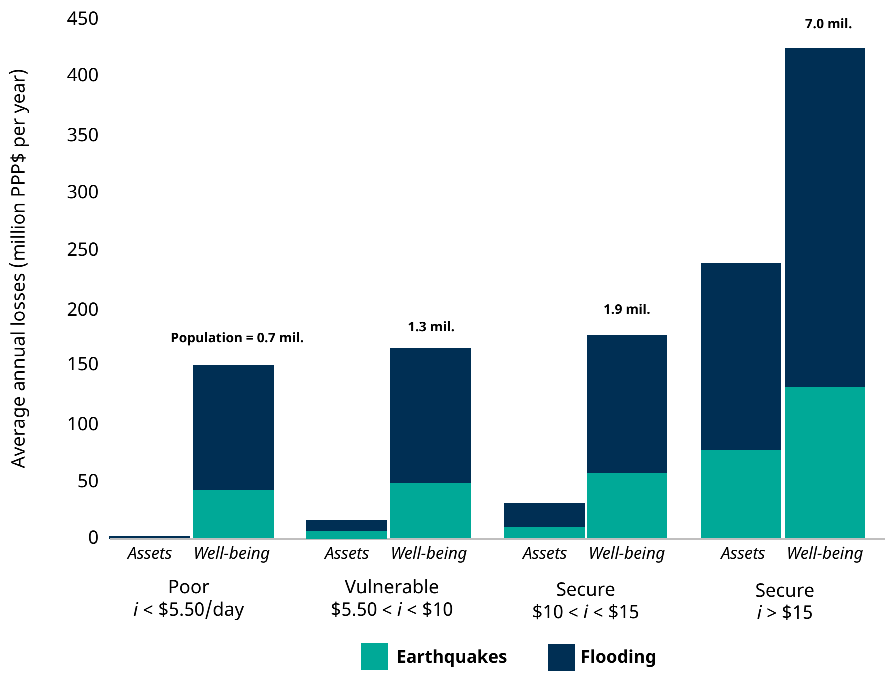
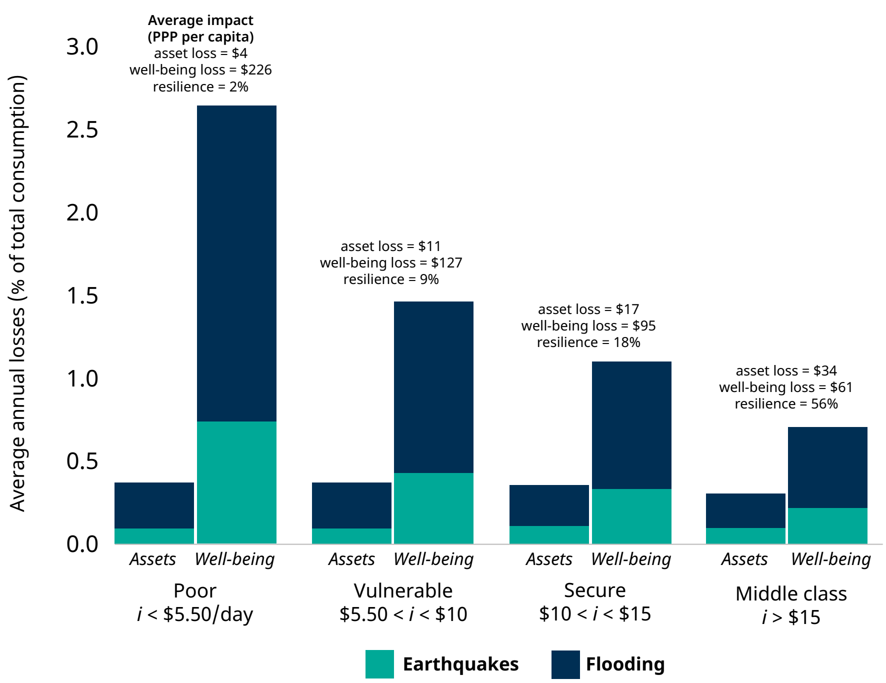


Figure 18: Average per capita annual losses for various socioeconomic groups in Greece.



32 It is also worth noting at this stage that the urban poor are likely to be underrepresented within country-level averages. Members of this group face higher costs of living in search of economic opportunity and may receive little support from their home communities while still being expected to send remittances home. Indeed, while the analysis is limited to only the poorest group in each country, the range of socioeconomic resilience values narrow significantly.

A woman fills a pail of water in Azerbaijan.
Credit: Allison Kwese

CHAPTER 8:

Policy actions that can minimize disaster impacts at a household level

Policy actions need to reflect communities' ability (or inability) to cope with and recover from shocks, such as disasters. Determining well-being losses and the resulting level of socioeconomic resilience can inform resilience-building and risk reduction interventions for both pre-disaster and post-disaster contexts, and also examine their added value across different income groups (or between different geographical areas such as different regions within the same country country). This section examines and compares three targeted policy options at country level: (a) reducing the asset vulnerability of the poor population by 30 percent, (b) increasing the income of the poor population by 30 percent, and (c) reducing the post-disaster reconstruction time by 30 percent. The objective is to benchmark the impacts of each of those policies with respect to the status quo in each of these countries and create opportunities to review optimal policy actions for each of these countries.

Policy actions need to reflect communities' ability (or inability) to cope with and recover from shocks, such as disasters.

The World Bank's *Unbreakable* report (Hallegatte et al. 2017) and subsequent studies not only developed the concept of well-being loss and socioeconomic resilience but also introduced a set of policy actions that could either focus on reducing asset losses (table 5) or on increasing resilience against disasters and climate shocks (table 6). While the former policy actions focus on reducing exposure or asset vulnerability (enforcing risk-informed land-use planning, rolling out nature-based solutions to mitigate flood hazards, enforcing robust building codes, and so on), the latter policy actions are applicable when asset losses cannot be entirely prevented and when there is a need to improve the ability of people to cope with shocks that cannot be avoided (financial inclusion, revenue diversification, access to catastrophe insurance, and so on).

For example, social protection—through scalable or adaptive social safe nets—is increasingly perceived as an effective approach for building community resilience against climate change and disasters. By ensuring basic levels of consumption, encouraging investments in resilient productive livelihood assets (drought-resistant crops, purchasing solar panels, and so on), or accelerating the reconstruction and recovery process (housing repairs and so on), social protection facilitates access to basic services and increases the capacity of at-risk populations to withstand, manage, and recover from shocks. The rationale behind adaptive social services is that these systems should be available to all and adjusted to the specific needs of the most vulnerable and marginalized population, considering cultural characteristics, social fabric, and structural inequities (UNDP 2016). However, when a specific shock overwhelms existing coping mechanisms, more robust instruments are required. Wealthier

Table 5: Policy actions focusing on asset loss reduction.

Policy actions focusing on asset loss reduction	Policy examples
Reduce the exposure of the poor	Upgrade neighborhoods with improved drainage; initiate preventive resettlement programs away from at-risk areas; undertake ecosystem conservation; and so on.
Reduce the exposure of the non-poor	Adopt risk-informed land use and urbanization plans; influence future urban development.
Reduce the vulnerability of the poor people's assets	Record land tenure to enhance investments in housing; improve infrastructure that serves the poor.
Reduce the vulnerability of non-poor people's assets	Change construction and building norms; improve general infrastructure.
Provide universal access to early warning systems	Invest in hydrometeorological observation systems' and weather forecasting capacity; ensure capacity to issue and communicate early warning and for people to react.

Source: Hallegatte et al. 2017.

Table 6: Policy actions focusing on increasing resilience.

Policy actions focusing on increasing resilience	Policy examples
Favor savings in financial forms	Develop banking sector and favor mobile banking; support development of savings instrument for the poor.
Accelerate reconstruction	Develop access to borrowing and insurance for people, firms, and local authorities to facilitate recovery and reconstruction; ensure the government has the liquidity to fund reconstruction; increase openness for workers, materials, and equipment to facilitate reconstruction; streamline administrative processes (for example, building permits, scale-up of post-earthquake inspection checks, debris clearing, and so on).
Increase income diversification (social protection and remittances)	Create new cash transfers; ensure that contributory social protection schemes are available to poor people; reduce the cost of remittances.
Make social safety nets more scalable	Create social registries that can add beneficiaries; implement a budgetary process to increase social expenditures after a disaster; create the right delivery mechanisms; develop indicators and procedures for the automatic scale-up of social safety nets.
Develop contingent finance and reserve funds	Create a reserve funds with utilization rules; prepare access to contingency credit lines (such as CAT-DDOs); create regional risk pools (such as CCRIF); transfer part of the risk to global reinsurance or global capital markets (such as FONDEN bonds).
Improve capacity to deliver post-disaster support	Combine the two previous sets of actions.
Improve access to insurance for firms and households	Create insurance markets and ensure their sustainability.

Note: Cat-DDO = Catastrophe Deferred Drawdown Option; CCRIF = Caribbean Catastrophe Risk Insurance Facility; FONDEN = Natural Disasters Fund (Mexico).

Source: Hallegatte et al. 2017.

income groups might have access to savings or market insurance, but the poorest households might face high transaction costs and might resort to detrimental coping strategies as a result. In all cases, a variety of social protection programs exist that build resilience in the long term, and their benefit can be measured in avoided well-being losses, even if they do not necessarily help lower the reconstruction cost or cost of insurance premiums.

Well-being losses and socioeconomic resilience are therefore useful not just as diagnostics of disaster impacts, but they can also be used to measure the expected or actual benefits of DRM investments and related resilience-building measures (for both pre- and post-disaster interventions) across different income groups. The proposed disaster impact metrics—poverty headcount, poverty gap, and well-being losses—can be used to better understand the effectiveness of resilience-building measures outside the traditional DRM toolbox (Walsh and Hallegatte 2020). Even if asset losses will not necessarily be reduced, these interventions can still enhance communities' level of socioeconomic resilience—that is their capacity to cope with and recover from asset losses when they occur and reduce the well-being impact of disasters (Hallegatte et al. 2020). In addition, while DRM interventions that are asset-informed primarily focus on protective infrastructure (flood barriers for example) and location and maintenance of key assets (for instance, risk-informed land use planning or building codes), interventions that are well-being informed can justify a wider set of interventions such as financial inclusion, adaptive social safety nets, emergency preparedness, or contingent planning.

It is worth noting that while this method of analysis can help examine the advantages and disadvantages of promising solutions, a comprehensive set of DRM solutions needs to be systematically sought after. One of the main reasons is that one standalone, specific instrument will be insufficient because interventions need to be adapted to the scale of different disasters and reflect the socioeconomic needs of poor populations (and other vulnerable people). In other words, determining a definitive decision on any of these potential interventions would necessitate more comprehensive policy analysis than what is presented here. Instead, what is provided is a starting point for stakeholders and decision-makers to initiate discussions on policy options in different sectors that could reduce the impact of disasters and increase the level of socioeconomic resilience at community level. Theoretically, there are virtually infinite combinations of policy options to be examined. However, for comparative purposes, the impacts of the following three policy actions[33] on asset losses, well-being losses, and socioeconomic resilience of these eight countries in ECA region are examined.

1. **Reducing the asset vulnerability of the poor population by 30 percent.** This hypothetical policy could be achieved through various strategies including the structural reinforcement of buildings where households from the poorest income groups reside (that is, those living with less than US$5.50 per person per day).

2. **Increasing the income of the poor population by 30 percent.** In the short term, this hypothetical policy can be achieved through various social safety nets and government-funded social transfers and even potentially by reducing the cost of remittances. In the long term, this can be achieved through inclusive growth, for example, by improving the productivity of the poor through better health care, investing in education, and creating more opportunities for stable and well-paying jobs. However, for this study, only the income of the poor was increased by 30 percent, ceteris paribus.

3. **Reducing the post-disaster reconstruction time by 30 percent.** This hypothetical policy can be achieved through the combination of engineering and macroeconomic solutions that would lead to improving the average productivity of capital and enabling better access to financial products (such as accessing reconstruction loans; streamlining administrative procedures such as building permits; providing better access to equipment, workers, and materials for reconstruction; and so on).

While these interventions have intrinsic characteristics and require a range of policy instruments tailored for different hazard contexts or types of affected populations, this type of benchmarking is not always possible with traditional direct asset loss assessments. The implementation strategy of these policy actions is not in the scope of this study. However, the assessment of impacts of each of these three hypothetical policies is the focus of this report—regardless of the means to achieve those ends. Figure 19 illustrates the annual

33 Each of these policy options, based on findings provided in the previous chapters, are also compared with a counterfactual scenario (with no policy action in place) to better measure their added value.

Figure 19: Comparison of expected annual Avoided losses with different policies for select countries.

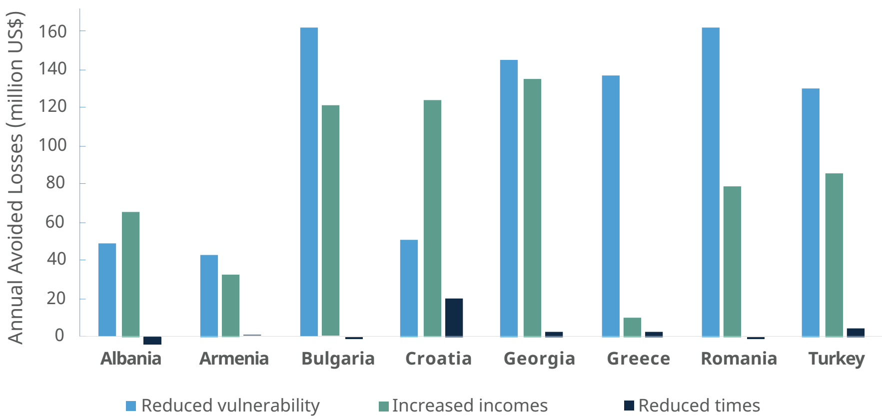
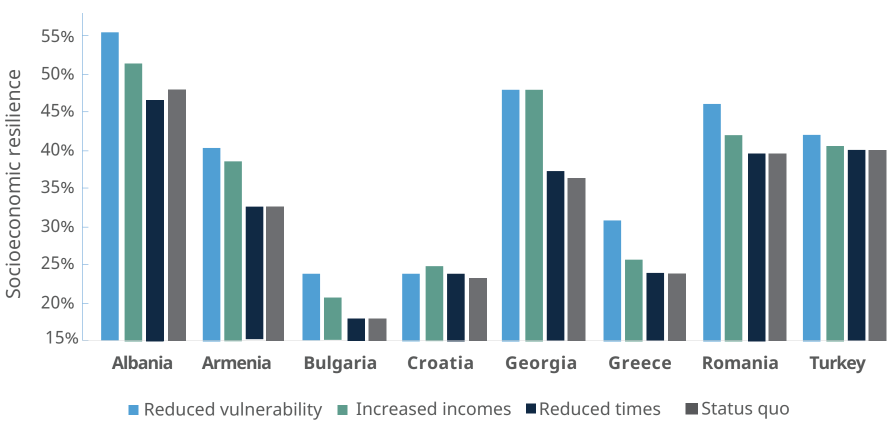


Figure 20: Comparison of socioeconomic resilience with different policies for select countries.



average avoided losses[34] due to implementing each of these three policies compared to the status quo in each of these eight countries. As shown, reducing the asset vulnerability of the poor population by 30 percent leads to higher annual average avoided losses in all eight countries. This is promising given that several governments in the region are increasingly recognizing the need to improve the housing stock for the most at-risk populations (including those living in disaster-prone areas), for example, by thoroughly investigating the seismic safety of apartment buildings.[35]

On the other hand, the reduction of reconstruction time has limited effectiveness and, in some rare cases, it can even result in higher annual average losses in Albania, Bulgaria, and Romania. This is due to the acceleration of households' spending rates to rebuild the damaged assets in a shorter period. Therefore, without increasing the post-disaster support, the acceleration of reconstruction can potentially create more harm and push the most vulnerable population deeper into consumption poverty.

Similarly, figure 20 illustrates the gains in socioeconomic resilience that can be achieved through each of these policies. As shown, reducing the asset vulnerability of the poor population by 30 percent seems to be the policy option that yields the highest benefits (among policy options listed), given that it would increase the average level of socioeconomic resilience in most countries, closely followed by 30 percent income increase for the poor population. Albania, closely followed by Georgia and Romania, are the countries where reducing the asset vulnerability of the poor population can realize the largest increases in socioeconomic resilience benefits (slightly over 50 percent). It is worth noting that results from this study indicate that Albania, Georgia, and Romania are also the same countries that are projected to have the slowest pace of post-disaster recovery and reconstruction in the aftermath of a 200-year earthquake. It is worth noting that reducing the reconstruction time without increasing the government support for the poor either has no significant impact on socioeconomic resilience or, in some cases, can result in decreasing household resilience. That is due to the higher allocation rate of households' consumption budget to reconstruction that is needed in a shorter period.

34 Annual average avoided losses is defined as the sum of annual well-being losses per year that can be prevented to accrue by implementing each policy compared to the status quo.

35 According to the World Bank, some 20 countries across the ECA region have a 10–20 percent chance of being affected by a major earthquake in the next 50 years. Of particular concern in these countries are pre-1990s mass-produced, prefabricated, multifamily residential buildings which constitute a significant percentage of the housing stock. The poor quality of these buildings was tragically illustrated in the 1988 Armenia (Spitak) earthquake, when many of them collapsed—significantly contributing to the nearly 50,000 fatalities and 130,000 injuries that resulted from this disaster (Mathema and Simpson 2018).

CHAPTER 9:

Conclusions and considerations for further analysis

As illustrated in this report, the risks posed by disasters and climate risks are rising most acutely for the poor and other vulnerable population groups, whose welfare and long-term economic prospects have been acutely vulnerable to exogenous shocks such as disasters and climate risks. Today, with access to a variety of analytical tools, commensurable datasets, global best practices, and other forms of innovative methods to better grasp, quantify, and explain the effects of disaster impacts, decision-makers can rethink the ways such shocks are quantified so that they can better anticipate or identify which population groups (or geographical areas) are likely to be the most impacted, and why. Additional areas of analysis are also highlighted for consideration in similar future research in the ECA region.

The risks posed by disasters and climate risks are rising most acutely for the poor and other vulnerable population groups.

This report has presented the results of a multicountry risk assessment in the ECA region based on an expanded framework which highlights the ability of households to cope with and recovery from disaster asset losses. The concept of *well-being losses* was used as the main metric to measure the severity of disaster impacts. The proposed framework adds to the three traditional components of disaster risk assessment—hazard, exposure, and vulnerability—and a fourth component, socioeconomic resilience. Similar to traditional risk assessments, socioeconomic resilience can be quantified using a variety of spatial resolutions, ranging from household to national averages. This risk assessment methodology has also been applied in several countries to shape DRM strategies, to better incorporate socioeconomic resilience considerations—including the capacities of affected communities, economies, and other networks to recover from such shocks. In particular, from a socioeconomic perspective, it generates empirical evidence to identify priority income groups as well as at-risk sub-national areas that are significantly vulnerable to disasters. Informed by a more socially inclusive accounting of disaster costs, this methodology can provide new justifications to invest in disaster risk reduction and guide new policy tools to do so. Following this logic, increasing resilience can lead to greater equity while reducing the costs of disasters by prioritizing interventions in a way that mainstream DRM practices into wider sustainable development agendas.

This model provides more in-depth insights into the consequences of disasters than a traditional risk assessment. In particular, it shows how regions (or specific areas) that are prioritized for DRM interventions can differ depending on the objective of decision-makers and on which risk metric is used since each metric informs a different set of policy objectives. While a simple cost-

benefit analysis based on asset losses would drive risk reduction investments toward asset-heavy regions and areas, a focus on factors that increase poverty levels (such as well-being losses) broadens the analysis and can provide a different set of intervention priorities—for example, by anticipating which income groups (or geographical areas) are likely to face larger socioeconomic obstacles in terms of post-disaster recovery and reconstruction. Finally, quantifying disaster impacts by using poverty and well-being considerations can also help quantify the benefits of interventions that may not necessarily reduce asset losses but instead could reduce the well-being consequences of disasters by increasing the level of resilience of a given at-risk population. Such interventions could include, for example, financial inclusion, social protection, or more generally the provision of timely and well-targeted post-disaster support to affected households.

Follow-up work

Future research could further expand these initial findings from the eight countries that were analyzed and confirm the pervasive socioeconomic impact of disasters and climate risks in the ECA region. For instance, additional research on this issue could include some of the following items:

- **Expanding the analysis to other similar countries.** The eight countries that were examined were selected given that they all have (a) a high level of disaster exposure to floods and earthquakes, (b) a relatively high level of income inequality, and (c) an existing engagement in DRM with the World Bank and with other development partners. This study could scale up the analysis to additional countries with a similar disaster and socioeconomic profile, provided that household survey data (GMD dataset) and hazard data were available and reliable.
- **Integrating more granular data related to housing conditions.** The breadth and quality of household survey data was inconsistent across the selected countries, limiting the comparative perspective at times. For instance, future research could also include data on housing conditions to better examine how building damages can mitigate or accelerate well-being losses, depending on the level of socioeconomic resilience.
- **Including additional hazards to better understand distributional impacts in rural areas.** Depending on data availability, further research could expand the scope to other hazards beyond earthquake and floods, such as extreme weather events (hail, frost, droughts) or landslides. Given that a significant number of economies in the region rely significantly on agriculture and that climate shocks are expected to affect sectors that are particularly sensitive to weather patterns (irrigation, forestry, energy, and so on), expanding this analysis to additional hazards will provide a more comprehensive understanding of the distributional impact of disasters in the region.
- **Testing potential applications for rapid post-disaster needs assessments.** While the insights and the results generated by this study are about improving ex ante measures (such as investing in cost-effective risk reduction, developing financial protection solutions, and so on), it would be worth exploring if this methodology could be applied to rapidly quantify well-being losses in the immediate aftermath of a disaster—similar to the *Global RApid post-disaster Damage Estimation* (GRADE) methodology.[36] If it is feasible, quantifying well-being losses in the immediate aftermath of a disaster could be potentially used to better target post-disaster financing mechanisms as well as inform reconstruction efforts and other related early recovery interventions.

36 The GRADE approach is a remote, desk-based, rapid damage assessment method deployed soon after a disaster. The approach adopts evolving and innovative natural hazard risk modeling technology to rapidly fulfill post-event damage assessment requirements. The GRADE assessment provides decision-makers with a first order of the economic impact to gauge the magnitude of the event's consequences, identify reconstruction priorities, provide information on geographic impacts, and inform on relative public versus private sector damages. *For more information: https://www.gfdrr.org/en/publication/methodology-note-global-rapid-post-disaster-damage-estimation-grade-approach-2018.*

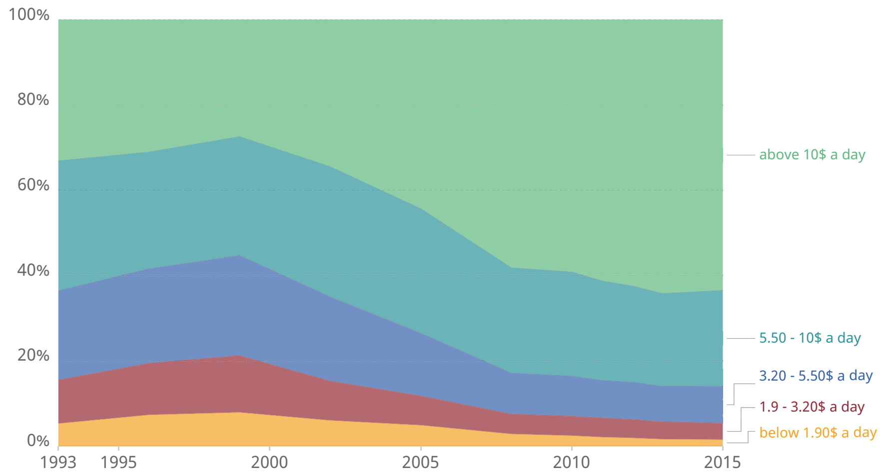
ANNEX 1:

Poverty trends in the ECA region

Poverty remains a central issue in Europe and Central Asia. Poverty levels have significantly declined over the past 30 years, but those development gains are still fragile. Almost all countries in the ECA region underwent a transition at the end of the 20th century from various types of closed, planned economies to more open, free market economies. This transition, with the dissolution of trade networks and production shifts, was accompanied by a steep increase in poverty and inequality within the region (World Bank 2014a). Owing to rapid economic growth during the 2000s, the region experienced a rapid and dramatic decline in poverty.

This was followed by a phase of slower poverty reduction (figure 21), further constrained by repercussions from the global financial and food crises that affected the world in 2008 and 2009. The extreme poverty rate, measured as US$1.90 a day per person (2011 PPP), was 7.9 percent (equal to 37 million people) in 1999. Almost half of the ECA population was living in moderate poverty in 1999 (36.9 percent, equivalent to 172 million people), that is, on US$5.50 a day (2011 PPP), the majority in Central Asia. By 2015, both moderate and extreme poverty rates had declined, to 12.5 percent (61 million people) and 1.5 percent (7.1 million people), respectively. As of 2018,

Figure 21: ECA population by income and consumption level as share of the whole, 1993–2015. In the ECA region, the middle class has significantly expanded in the last 20 years, but a large proportion of the population is still at risk of falling back in poverty.



Note: Estimates rely on a combination of income and consumption data.

Source: World Bank, PovcalNet 2019.[a]

a. PovcalNet is an interactive computational tool that allows users to replicate the calculations made by the World Bank's researchers in estimating the extent of absolute poverty in the world. PovcalNet also allows researchers to calculate the poverty measures under different assumptions and assemble the estimates using alternative economy groupings or for any set of individual economies of the user's choosing. PovcalNet is self-contained; it has reliable built-in software that quickly does the relevant calculations for researchers from the built-in database. For more information: http://iresearch.worldbank.org/PovcalNet/home.aspx.

the proportion of population living in households with consumption or income per person below the poverty line (moderate poverty) remained high in many countries in the ECA region, ranging from 2 percent (Russia) to 50 percent (Armenia).[37]

37 Poverty data are provided by World Bank PovcalNet: http://iresearch.worldbank.org/PovcalNet/data.aspx.

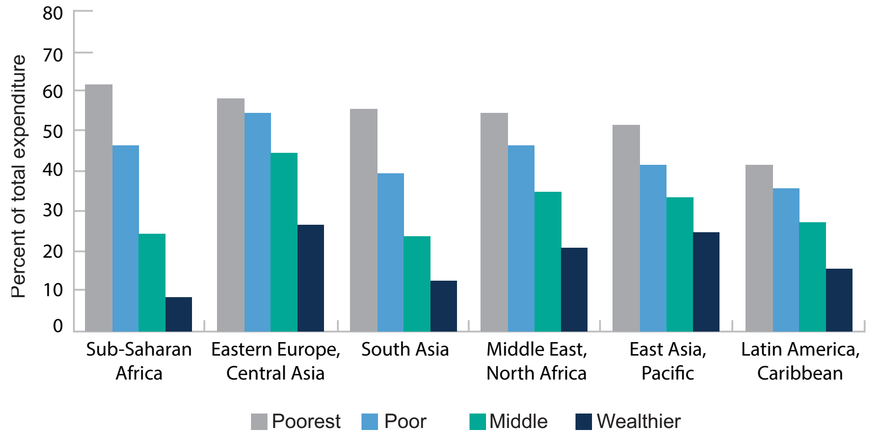
In 2018, the share of people living on US$5.50 or less per day in the region was 12.1 percent—equivalent to a population of 59.73 million (Bussolo et al. 2018). Moreover, in line with differences across living standards, sub-national poverty rates can vary significantly within countries, particularly in 'lagging regions' (Farole, Goga, and Ionescu-Heroiu 2018). In Armenia, for

example, the difference in poverty rates between the less well-off and the more well-off regions rose from 25 percentage points to 38 percentage points between 2005 and 2014 (Bussolo et al. 2018).

The middle class expanded significantly across the ECA region between 2000 and 2015. Across many countries in the region, a significant proportion of households moved out of poverty into the middle class (especially during the period preceding the 2008 financial crisis); more importantly, once out of poverty, they tended not to fall back into it. As seen in figure 21, this trend was especially evident before the 2008 financial crisis (Bussolo et al. 2018). Upward mobility in the majority of countries during the 2000s translated into a sizable expansion of the middle class in the region, measured as the share of people living on over US$10 a day. In 2015, almost half of the region's population could be considered middle class, a rapid increase from the 17 percent in 2000 (Dávalos et al. 2016). Income inequality, measured by the Gini coefficient, also declined in many countries. However, according to the World Bank, a large proportion of the overall population in the ECA region is still vulnerable and at risk of falling back into poverty—corresponding to 70 percent of the population in lower-middle-income countries and 40 percent of the population in upper-middle-income countries.[38]

38 Calculated using 2011 PPP, ECATSD (Europe and Central Asia Team for Statistical Development) calculations using ECA Poverty data (ECA POV) and EU-SILC data; see http://ecadataportal. *Note. The European Union Statistics on Income and Living Conditions (EU-SILC) aims at collecting timely and comparable cross-sectional and longitudinal multidimensional microdata on income, poverty, social exclusion, and living conditions.*

Figure 22: In the ECA region, due to harsh winter conditions, the poorest and poor population groups tend to spend more on food (and energy) compared to other regions.



Note: Calculated based on total consumption value in 2010 (US$ PPP values) in developing countries. Consumption groups defined based on global income distribution data: poorest = US$2.97 Per capita a day; poor = between US$2.97 And US$8.44 Per capita a day; middle = between US$8.44 And US$23.03 Per capita a day; wealthier = above US$23.03 Per capita a day.

Source: Hallegatte et al., 2018.

At a household level, the 'poorest' and 'poor' in the ECA region tend to spend more of their budget on food and energy, making them more vulnerable to spikes in food prices and to unanticipated weather extremes.[39]

Winters in ECA can be characterized with temperatures as low as -30°C (-22°F), sometimes as low as -45°C (-49°F) in the coldest parts of the region. Given these temperature patterns, the average household in ECA spends over 7 percent of their income to pay for energy and food, compared to 4.7 percent in the East Asia and Pacific region and 4.6 percent in the Latin America and the Caribbean region. The severe cold in the region means that households need to spend a significant amount of money not only to stay warm but also to ensure that they get the minimum required number of calories to survive winters (box 6). Paying for heating and food, which are essential to survive the region's winters, can drive almost every decision made by poorest and poor households in the region throughout the year (World Bank 2014b). However, the significant proportion of expenses also left the most vulnerable households with little to no money given that the poorest and poor people in the region also devoted, 55 to 60 percent of their household budget on food, on average (figure 22). This means that other vital expenditures, such as medical costs or school fees often have to be put off or eliminated altogether when households face shocks, such as a sudden spike in food prices or higher energy consumption needs (Dávalos et al. 2016).

39 The World Bank defines consumption groups based on global income distribution data. This means that while the 'poorest' group (also referred as 'extreme poor') earns US$2.97 per capita a day, the 'poor' group (also referred to as 'moderately poor') earns between US$2.97 and US$8.44 per capita a day (Hallegatte et al. 2016).

A man waits by the bus station in Sofia, Bulgaria. 2016. Credit: Ivelina Taushanova/World Bank

Box 6: Energy poverty affects tens of millions in the EU and is particularly prevalent in Bulgaria.

There are an estimated 50 million households living in energy poverty in Europe.[a] Energy poverty rates are highest in Southern and Central-Eastern European countries, but across the entire EU, those in the bottom 20 percent of the income distribution have considerably higher rates of energy poverty than national averages.[b] This difference is due to the limited disposable incomes of households in the bottom 20 percent, who spend a large share of their disposable income on heating their poor-quality, energy-inefficient homes. In other words, countries with low-quality housing tend to see higher levels of energy poverty, as well as higher at-risk-of-poverty rates, further food poverty (that is, the inability to afford basic food staples), and sometimes, higher rates of self-reported health issues. Unexpected and unpredictable energy costs in the winter can push more and more households below the poverty line during the winter season, and only some of them are able to receive a heating allowance.

Bulgaria has the largest percentage of energy-poor people in the EU: 34 percent of its population of 8 million struggled to keep their homes sufficiently warm during winter months in 2018. A significant part of the problem is related to the quality of buildings. According to the National Program for Housing Renewal in Bulgaria adopted in 2005, over 20 percent of buildings are panel buildings, most of them needing renewal. In Bulgaria, energy poverty itself has over time become a barrier to energy efficiency programs: since poor households often cannot afford credits, they are unable to invest in energy efficiency. To prevent low-income households from becoming too exposed to shifts in energy prices and stagnating wages, governments also need to ensure that buildings occupied by low-income families are able to generate 'positive energy'—produce more energy than they consume—to minimize low-income families' energy bills.

Sources : CEB 2019; Joyce 2017; Peneva 2019; Thomson and Bouzarovski 2018; World Bank 2020b.

a. The term 'energy poverty' has no universal definition, but it typically means that households spend an unreasonably high proportion of their income on energy or that households are unable to meet basic energy needs in both winter and summer. The causes of energy poverty can be multidimensional and usually include low-income, low-quality homes, and energy-inefficient appliances.

b. Nearly 85 percent of people in energy poverty can be found in 10 of 32 European states: Bulgaria, France, Germany, Greece, Italy, Poland, Portugal, Romania, Spain, and the United Kingdom.

Drainage improvements in Azerbaijan.
Credit: Allison Kwesell

ANNEX 2:

Methodological Summary

Data description

Asset loss exceedance curves are adapted from "Europe and Central Asia – Country Risk Profiles for Floods and Earthquakes" (World Bank 2017). These assessments were generated for a purpose, and technical documentation is provided in the technical annex of this report. Risk data are available upon request.

Socioeconomic microdata, including household income and expenditures, are from the World Bank's Global Monitoring Database (2019), a globally harmonized database of household income and expenditure surveys. Spatial resolution is determined by the representativeness of each country's most recent survey. These microdata cannot be made available directly, as they are subject to use agreements with the countries' respective statistical agencies.

Methodology and model description

The *Unbreakable* methodology combines conventional disaster risk assessments with social welfare theory. This approach is summarized here and described in full in Walsh and Hallegatte (2019) and in Walsh and Hallegatte (2020). Python scripts are provided on *Github*[40] and researchers are invited to contact the authors to discuss methodological details and potential adaptations of the simulations here presented.

Asset losses

A set of disaster events is defined, each parameterized in four dimensions: *country, hazard*:[flood, earthquake], *location*:[admin1|admin2], and *return period* (RP):[5,10,20,50,100, 500,1000,2000] years). PMLs expected from each of these events were reported by GFDRR in 2017 (World Bank 2017). These PML values are distributed among representative households according to the following expression, where the sum is over all households exposed to the disaster event:

$$PML(event) = \alpha_{event} \sum k_{eff} \cdot v$$

In this expression, α is the exposure (fraction of households affected), k_{eff} is the effective capital stock, v the vulnerability (fraction of assets lost, given household ⊆ affected). k_{eff} is defined for each household as earned income divided by the national average productivity of capital (Penn World Tables).

This is interpreted as the value of assets necessary to generate each household's earned income, including assets not owned by the household (like roads and factories). k_{eff} generally includes privately owned assets, including housing and equipment used in family business or livestock; public assets, such as road and the power grid (and possibly the environment and natural capital); and some assets privately owned by others, such as factories. v represents a rudimentary vulnerability curve, equal to 70 percent, 40 percent, and 10 percent for households with fragile, moderate, and robust domiciles, respectively. In this way, the construction and condition of domiciles is used to proxy the vulnerability of all assets used by each household to generate income. This implies, for example, that the roads used by people who live in makeshift dwellings are equally vulnerable to flooding as are their homes. This assumption avoids significant increases in data requirements—indeed, global data on infrastructure vulnerability is not available—and is necessary to avoid overtly complex representations of economic interactions between each household and assets held in common.

40 Available at the following link: https://github.com/walshb1/hh_resilience_model.

Vulnerability modifiers: early warning systems and access to finance

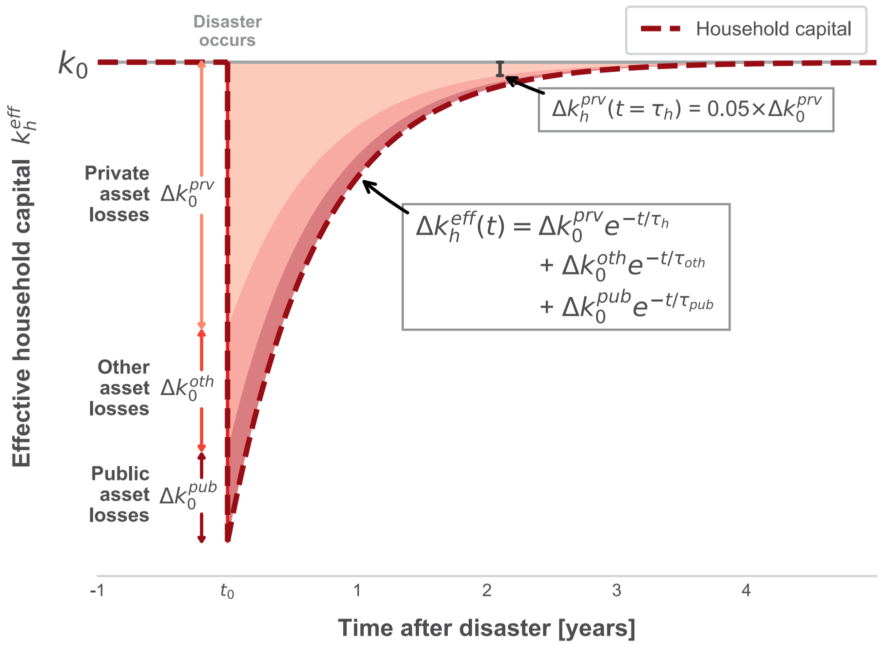
When available, data on the presence of early warning systems in affected regions is incorporated. This reflects the assumption that early warning systems allow exposed households to move, reinforce, or otherwise protect their most fragile or valuable assets, thus reducing their vulnerability to disaster. Using the same assumption as in the *Unbreakable* report (Hallegatte et al. 2017), it is assumed that households who receive a warning are able to reduce their vulnerability by 20 percent, relative to identical households without access to early warning systems, by moving valuable items (from important papers to car or motorbikes) and implementing other mitigating measures (for example, boarding windows, sandbagging doors).

Exposure

On these assumptions, the expression above can be solved for $\alpha_{event.}$ In this approach, household exposure is interpreted as the probability for any given household to be affected by an event, when it occurs. This probability is assumed uniform for all households, due to lack of an established empirical relationship between income and exposure. If low-income groups are found to be more likely to be affected, it is possible to introduce a 'poverty bias' in the form of a higher probability of being affected for households with lower income.

Two corollaries follow from the above: first, larger disasters affect greater numbers of people, with constant severity among the affected. Second, this definition of household income and assets implies that the total capital stock of any country is given by total effective capital of all households, although gross national income (GNI) is generally lower than GDP.

Figure 23: Each household's effective asset stock includes private, public, and other-owned assets. A fraction of these are damaged or destroyed in the event of a shock, and the household rebuilds its private stock exponentially, at a rate which maximizes utility of consumption during recovery.



Pre-disaster equilibrium

Households begin the simulation in equilibrium: without capital decay and consumption set equal to income. The survey is assumed to capture each household's annual income.[41] Earned income includes labor, capital, real estate, and in-kind sources and excludes public transfers (conditional, unconditional, and in-kind) and private remittances. Note that the value of housing services provided by owner-occupied dwelling is included in income data, so that the loss of housing services is recorded as an impact on income.[42]

41 In some countries, it may be necessary to infer household income from expenditures, whether because incomes are not reported, because consumption is more stable over time, or because official poverty statistics are calculated from consumption rather than income.

42 Similarly, services provided by other assets (for example, air conditioners, refrigerators) could be added as an additional income that can be threatened by disasters.

This model assumes a closed national economy, meaning that 100 percent of household income is derived from assets located inside the country and that post-disaster reconstruction costs can be distributed to non-affected taxpayers throughout the country but not outside its borders (figure 23).

Precautionary savings

Precautionary savings play a key role in managing disasters, but savings microdata are unavailable. The difference between income and consumption, frequently used as a proxy, is highly variable and negative for many households (aggregate consumption greater than reported income), making it an uncertain indicator of savings at the household level. In this case, the average gap (income less consumption) by region and decile is calculated. It is assumed that each household maintains one year's

surplus as precautionary savings: separate from their productive assets and available to be spent on recovery or consumption smoothing.

Social transfers, taxation, and remittances

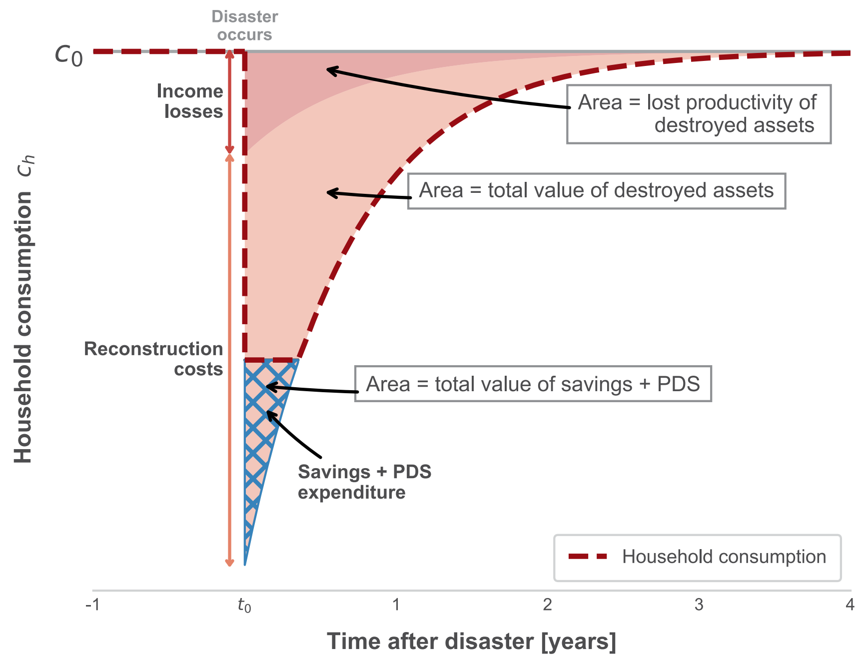
Reported incomes are assumed net of the income tax that finances general spending of the government and of an additional flat income tax that finances social programs.[43] Extraordinary or adaptive social transfers are represented as closed (revenue neutral) systems in the model, in that their costs are distributed to all households (debited from nominal income) nationally via flat tax.[44]

The household surveys provide estimates of the amount received, but it is impossible to represent the bilateral flows of resources among households. For this reason, remittances are modeled like an additional social protection scheme: the transfers received from friends and family are added to social transfers, and it is assumed that these transfers comes from a single fund, in which all households contribute proportionally to their income (like a flat tax). Under these assumptions, remittances can be aggregated with social protection and redistribution systems. This is of course a simplification, especially in that it does not account for international remittances, which have been shown to play a role in post-disaster contexts (Yang and Choi 2007).

43 Although a flat tax is assumed, the model is capable of handling more complicated tax regimes, including progressive taxation.

44 Administrative costs are not included in the assessment of the cost of the programs. When household data do not include the transfers, then transfers from social programs can be modeled on the basis of the actual disbursement rules that qualify households for participation in each program (for example, proxy means test score, household's number of dependents or senior citizens, employment status, and so on).

Figure 24: Consumption losses are defined as income loss, net of reconstruction costs. Disaster-affected households must decide which fraction of their post-disaster income to divert from consumption into reconstruction, in anticipation of recovery to their pre-disaster state. Consumption losses are offset by expenditure of savings and any post-disaster support a household may receive.



Income losses

When households lose assets, they lose the income these assets had generated unless and until the assets are restored to productivity. This includes the value households derive from their domicile; their appliances, vehicles, and livestock; and the infrastructure they use to commute to work or access markets. Income losses are defined for each household as asset losses times national average productivity of capital. From this initial condition, asset and income losses become time dependent. Initial losses decrease throughout the reconstruction and recovery process as houses, infrastructure (that is, roads or electric lines), and natural assets are repaired and replaced. Total asset losses are inclusive of all asset classes, irrespective of ownership (private, public, and other). These assets are rebuilt independently and at different rates.

Consumption losses

The reconstruction of private and public assets is not free: households and governments have to invest in the reconstruction, further reducing personal consumption and requiring authorities to reallocate or generate additional funds. The model represents these processes to estimate their longitudinal impacts on consumption, well-being, and poverty. It is important to note that the model assumes that households and governments aim at returning to the pre-disaster equilibrium described above.

Total reconstruction costs are equal to the reduction in consumption needed to rebuild households' asset stock, plus the increase in taxes needed for the government to rebuild public assets such as roads and water infrastructure. The contribution of reconstruction costs to consumption losses at

each moment depends on the ownership of the damaged assets and on reconstruction rate (figure 24). These two dimensions will be discussed next. Consumption losses due to reconstruction costs vary by asset type (that is, private, public, or other).

a. Affected households pay directly and entirely the replacement of the lost assets that they owned.

b. All households pay indirectly and proportionally to their income for the replacement of lost public assets through an extraordinary tax.

c. Households do not pay for the replacement of the assets they use to generate an income but do not own (such as the factory where they work).

Savings and post-disaster support

Households' precautionary savings increase with post-disaster support, potentially including cash transfers to affected households, increases in social protection transfers, help through informal mechanisms at the community level, potential increases in remittances, and other exceptional cash transfers to households following a disaster. When available, these resources help households smooth their consumption over time and decrease consumption losses.

Private asset reconstruction

To recover their pre-disaster incomes, affected households pursue exponential asset reconstruction pathways. Each diverts income, plus savings and post-disaster support, into reconstruction at a rate that maximizes its expected well-being over the 10 years following the disaster. In this way, households use their income, savings, and post-disaster support to smooth consumption and maximize utility, subject to the constraint of avoiding subsistence if possible. If households cannot avoid having their consumption level below the subsistence line (for instance because consumption is below the subsistence level even without repairing and replacing lost assets), then it is assumed that reconstruction takes place at the pace possible with a saving rate equal to the average saving rate of people living at or below subsistence level in each country.

Public asset reconstruction

When disasters occur, governments borrow externally to finance the cost of public asset reconstruction and recover these costs through a general flat tax when recovery is complete. Through this mechanism, all households throughout the country share the cost of public asset reconstruction in the affected area. It is assumed that that the government does not collect the special tax at any point during recovery but rather covers the cost of public asset reconstruction for the duration of reconstruction and collects taxes to fund this process many years later, after full recovery.

Well-being losses

Finally, consumption losses are translated into utility (U) using a constant relative risk aversion (CRRA) welfare function (η=1.5). This concave function accounts for the fact that each unit of consumption loss affects poor households more severely than wealthy ones:

$$U(t) = {c(t)^{1-\eta}}\big/{1-\eta}$$

Well-being losses (W) are defined as the future-discounted time integral of utility over 10 years after a disaster. Expressed as currency, where $\bar{c}$ is national mean consumption,

$$W = \frac{\int_0^{10} Ue^{-\rho t}dt}{\partial U / \partial \bar{c}}$$

Following from this construction, each household reconstructs at a rate which maximizes its well-being. The optimal value of τh satisfies the following and can be found numerically:

$$\frac{\partial W}{\partial \tau_h} = 0$$

Replenishment of household savings and the taxes that fund public asset reconstruction and post-disaster support are assumed widely distributed and far in the future, so they reduce consumption only after reconstruction is complete. Therefore, the well-being impact of savings expenditures and taxes related to post-disaster support can be estimated using the marginal utility of consumption of each household. Total well-being losses of a household are equal to the sum of the loss along the reconstruction path and the long-term losses.

Robustness assessment

This analysis relies on many simplifying assumptions. While these facilitate suggestive inter-comparisons among countries, they limit the scope and precision of its conclusions, particularly at sub-national scales. Analytics presented here are intended to illustrate relevant dynamics and considerations and to provide a starting point for strategic and technical decision processes.

Many significant uncertainties need to be incorporated for robust decision making, including the following:

- Public/private asset allocation;
- Poverty bias of exposure;
- Asset-vulnerability catalogue;
- Survey recency, accuracy, and representativeness
- Precautionary savings and informal coping mechanisms
- Income substitution;
- Non-ergodicity of stochastic idiosyncratic/compound shocks;
- Macroeconomic dynamics.

Potential applications

The primary use of the *Unbreakable* methodology is to synthesize risk and socioeconomic data for disaster response targeting. Many significant indicators of individual frailty and systems failure are visible ex ante, before a catastrophe occurs, and the benefits of contingency planning and risk management far exceed their costs. Social registries, employment programs, beneficiary lists, and budget allocations can all be set in advance, triggering as soon as possible to help communities and nations cope and recover efficiently and equitably.

Search and Rescue team search for the wounded in Van (Turkey) after the October 2011 earthquake. Source: hasanucarphotography/Shutterstock.com

References

- Agrawal, Raj, Stephen Findley, Sean Greene, Kathryn Huang, Aly Jeddy, William W. Lewis, and Markus Petry. 1996. "Why The US Leads and Why It Matters". *The McKinsey Quarterly* Summer 199, Number 3. http://www2.lawrence.edu/fast/finklerm/McKinsey_cap_prod_9603.pdf.
- Anton, Simona, Koo Bryan, Man Titus-Cristian, Sandu Ciprian Moldova, Manuela Sofia Stanculescu, and Robertus A. Swinkels. 2014. *Elaboration of Integration Strategies for Urban Marginalized Communities: The Atlas of Urban Marginalized Communities in Romania*. Washington, DC: World Bank. http://documents.worldbank.org/curated/en/668531468104952916/Elaboration-of-integration-strategies-for-urban-marginalized-communities-the-atlas-of-urban-marginalized-communities-in-Romania.
- Bogaerts, Vica Rosario. 2020. *Project Information Document – Earthquake Recovery and Public Health Preparedness Project – P173998 (English)*. Washington, D.C. : World Bank. http://documents.worldbank.org/curated/en/208431590094404051/Project-Information-Document-Earthquake-Recovery-and-Public-Health-Preparedness-Project-P173998.
- Bussolo, Maurizio, Maria Eugenia Dávalos, Vito Peragine, and Rayma Sundaram. 2018. *Toward a New Social Contract: Taking on Distributional Tensions in Europe and Central Asia*. Washington, DC: World Bank. http://documents.worldbank.org/curated/en/569321538150509492/Toward-a-New-Social-Contract-Taking-on-Distributional-Tensions-in-Europe-and-Central-Asia.
- Carter, Michael R., and Christopher B. Barrett. 2006. "The Economics of Poverty Traps and Persistent Poverty: An Asset-Based Approach." *Journal of Development Studies 42* (2).
- Carter, Michael R., Peter D. Little, Tewodaj Mogues, and Workneh Negatu. 2007. "Poverty Traps and Natural Disasters in Ethiopia and Honduras." *World Development* 35 (5).
- CEB (Council of Europe Development Bank). 2019. Energy Poverty in Europe: *How Energy Efficiency and Renewables Can Help*. Paris: Council of Europe Development Bank. https://coebank.org/en/news-and-publications/news/ceb-publishes-study-energy-poverty-europe/.
- Chakraborty, Tirthankar, Angel Hsu, Diego C. Manya, and Glenn Sheriff. 2019. "Disproportionately Higher Exposure to Urban Heat in Lower-Income Neighborhoods: A Multi-City Perspective." *Environmental Research Letters* 14 (10). https://iopscience.iop.org/article/10.1088/1748-9326/ab3b99#erlab3b99app1.
- Daniell, L., and A. Schaefer. 2014. *Eastern Europe and Central Asia Region Earthquake Risk Assessment Country and Province Profiling*. Final report to GFDRR.
- Dávalos, María E., and Thomo, Ledia. 2016. "Portraits of Poverty and Inequality in Albania (English)." Washington, DC: World Bank. http://documents.worldbank.org/curated/en/659991480409319302/Portraits-of-poverty-and-inequality-in-Albania.
- Dávalos, María E., Giorgia Demarchi, Indhira Vanessa Santos, Barbara Viony Kits, and Isil Oral Savonitto. 2016. *Voices of Europe and Central Asia : New Insights on Shared Prosperity and Jobs*. Washington, DC: World Bank. http://documents.worldbank.org/curated/en/372521478680637391/Main-report.
- EEA (European Environment Agency). 2019. "Economic Losses from Climate-Related Extremes in Europe." EEA, Copenhagen. https://www.eea.europa.eu/data-and-maps/indicators/direct-losses-from-weather-disasters-3/assessment-2.
- Erdik, M., Y. Fahjan, O. Ozel, H. Alcik, A. Mert, and M. Gul. 2003. "Istanbul Earthquake Rapid Response and the Early Warning System." *Bulletin of Earthquake Engineering* 1: 157–63. https://link.springer.com/article/10.1023%2FA%3A1024813612271.
- ESA (European Space Agency). 2019. "Extreme Heatwave." July 26, 2019. https://www.esa.int/ESA_Multimedia/Images/2019/07/Extreme_heatwave.
- Euronews. 2019. "Faced with Increasing Heat Waves Frequency, European Cities Need to Adapt." November 22, 2019. https://www.euronews.com/2019/09/23/faced-with-increasing-heat-waves-frequency-european-cities-need-to-adapt.
- Farole, Thomas, Soraya Goga, and Marcel Ionescu-Heroiu. 2018. "Rethinking Lagging Regions: Using Cohesion Policy to Deliver on the Potential of Europe's Regions: Overview." World Bank, Washington, DC. http://documents.worldbank.org/curated/en/636851525400071277/Overview.
- Fuchs Tarlovsky, Alan, Cesar A. Cancho, Ana Maria Munoz Boudet, Sailesh Tiwari, Natsuko Kiso Nozaki, Moritz Meyer, Xinxin Lyu, Maria Fernanda Gonzalez Icaza, Osman Kaan Inan, Akhmad Rizal Shidiq, Matias Ignacio Morales Cerda, Vikram Srinivas, and Isaura Espinosa De Los Monteros. 2019. *South Caucasus in Motion (English)*. Washington, DC: World Bank. http://documents.worldbank.org/curated/en/614351556553124178/South-Caucasus-in-Motion.
- Guha-Sapir, D., R. Below, and Ph. Hoyois – EM-DAT: The CRED/OFDA International Disaster Database – www.emdat.be – Université Catholique de Louvain – Brussels – Belgium.
- GFDRR (Global Facility for Disaster Reduction and Recovery). 2014. *Understanding Risk in an Evolving World.* Global Facility for Disaster Reduction and Recovery, World Bank, Washington, DC. https://www.gfdrr.org/sites/gfdrr/files/publication/Understanding_Risk-Web_Version-rev_1.8.0.pdf.
- Government of Albania, World Bank, United Nations Development Programme, and European Commission. 2020. *Albania: Post-Disaster Needs Assessment. Volume A Report*. https://eeas.europa.eu/delegations/albania/74065/release-post-disaster-needs-assessment-albania-recovery_en.

- Government of Bulgaria. 2018. "Advisory Services on a Climate Change Adaptation Strategy and Action Plan— Assessment of the Disaster Risk Management Sector (Draft Version)." Sofia, Bulgaria. https://www.moew.government.bg/static/media/ups/articles/attachments/DRM%20-%20Full%20Report%20-%20First%20Draft%20(2018-04-27)%20-%20EN%20-%20for%20printing%20v2675c5b0db190d4aa5dae48daf147c909.pdf.
- Government of Serbia, World Bank, United Nations Development Programme, and European Commission. 2014. *Serbia Floods: Recovery Needs Assessment*. July. https://www.recoveryplatform.org/assets/publication/Serbiafloods2014/serbia-rna-report.pdf.
- Guerreiro, Selma B., Richard J. Dawson, Chris Kilsby, Elizabeth Lewis, and Alistair Ford. 2018. "Future Heat-Waves, Droughts and Floods in 571 European cities." *Environmental Research Letters* 13 (3): 034009. https://iopscience.iop.org/article/10.1088/1748-9326/aaaad3.
- Hallegatte, Stephane; Bangalore, Mook; Bonzanigo, Laura; Fay, Marianne; Kane, Tamaro; Narloch, Ulf; Rozenberg, Julie; Treguer, David; Vogt-Schilb, Adrien. 2016. *Shock Waves : Managing the Impacts of Climate Change on Poverty*. Climate Change and Development;. Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/22787
- Hallegatte, Stephane, Adrien Vogt-Schilb, Mook Bangalore, and Julie Rozenberg. 2017. *Unbreakable: Building the Resilience of the Poor in the Face of Natural Disasters*. Climate Change and Development, Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/25335.
- Hallegatte, Stéphane, Jun Rentschler, and Brian Walsh. 2018. *Building Back Better : Achieving Resilience through Stronger, Faster, and More Inclusive Post-Disaster Reconstruction*. World Bank, Washington, DC. https://openknowledge.worldbank.org/handle/10986/29867.
- Ionova, Mariana. 2014. "Lost in the Floods." *Transitions Online*, July 24, 2014. https://www.tol.org/client/article/24397-lost-in-the-flood.html?print.
- Joyce, Adrian. 2017. "Energy Poverty: A Blight on the EU." *Euractiv*, April 6, 2017. https://www.euractiv.com/section/energy/opinion/energy-poverty-a-blight-on-the-eu/.
- Joyce, Adrian. 2019. "Time to Address Europe's Hot and Cold Homes Crisis." *Euractiv*, February 20, 2019. https://www.euractiv.com/section/energy/opinion/time-to-address-europes-hot-and-cold-homes-crisis/.
- Kahn, Matthew .2005. "The Death Toll from Natural Disasters: The Role of Income, Geography, and Institutions." *Rev Econ Stat* 87 (2): 271–284.
- Markhvida, Maryia, Brian Walsh, Stephane Hallegatte, and Jack Baker. 2020. "Quantification of Disaster Impacts through Households Well-being Losses". *Nature Sustainability*, March 30, 2020. https://www.nature.com/articles/s41893-020-0508-7
- Mathema, Ashna, and Alanna Simpson. 2018. "On Shaky Ground: Housing in Europe and Central Asia." *Eurasian Perspectives* (blog), August 23, 2018. https://blogs.worldbank.org/europeandcentralasia/shaky-ground-housing-europe-and-central-asia.
- McGregor, Glenn, Mark Pelling, Tanja Wolf, and Simon Gosling. 2007. "The Social Impacts of Heat Waves." Science Report–SC20061/SR6. Environment Agency, Almondsbury, Bristol, UK. https://www.researchgate.net/publication/45513548_The_Social_Impacts_Of_Heat_Waves.
- Michelon, T., P. Magne, and F. Simon-Delavelle. 2005. "Lessons of the 2003 Heat-Wave in France and Action Taken to Limit the Effects of Future Heat-Waves." *In Extreme Weather Events and Public Health Responses*, edited by W. Kirch, R. Bertollini, and B. Menne. Berlin, Heidelberg: Springer. https://link.springer.com/chapter/10.1007/3-540-28862-7_13.
- Minority Rights Group International. 2018. "World Directory of Minorities and Indigenous Peoples—Bulgaria: Roma Populations." July. https://www.refworld.org/docid/49749d463c.html.
- Morduch, Jonathan. 1995. "Income Smoothing and Consumption Smoothing". Journal of Economic Perspectives 9 (3): 103–14.
- Naydenova, Violeta. 2014. "A Flood Lays Bare Inequality in Bulgaria." *Voices* (blog). July 14, 2014. https://www.opensocietyfoundations.org/voices/flood-lays-bare-inequality-bulgaria.
- Peneva, Teodora. 2019. "Energy Poverty in Bulgaria." *Annual of University of Sofia* 17 (11): 187–210. http://www.feba.uni-sofia.bg/sko/yrbook/Yearbook17-11.pdf.
- Pollner, John Daniel, Jolanta Kryspin-Watson, and Sonja Ingrid Nieuwejaar. 2008. *Climate Change Adaptation in Europe and Central Asia (ECA) : Disaster Risk Management (English)*. Washington, DC: World Bank. http://documents.worldbank.org/curated/en/699781484888380512/Climate-change-adaptation-in-Europe-and-Central-Asia-ECA-disaster-risk-management.
- Restrepo Cadavid, Paula, Grace Cineas, Luis E. Quintero, and Sofia Zhukova. 2017. "Cities in Europe and Central Asia: A Shifting Story of Urban Growth and Decline." World Bank, Washington, DC. http://documents.worldbank.org/curated/en/319131510892209158/Cities-in-Europe-and-Central-Asia-a-shifting-story-of-urban-growth-and-decline.
- Saheb, Yamina. 2018. "Keeping Cool in a Warming World Is Not a 'Luxury' for the Rich". *Euractiv*, August 6, 2018. https://www.euractiv.com/section/energy/opinion/keeping-cool-in-a-warming-world-is-not-a-luxury-for-the-rich/.
- Saheb, Yamina. 2019. "Heatwaves Hurt the Poor Most: Time for An EU Plan". *Euractiv*, July 17, 2019. https://www.euractiv.com/section/energy/opinion/heatwaves-hurt-the-poor-most-time-for-an-eu-plan/.
- Sandu, Dumitru D., Bogdan Corad, Cătălina Iamandi-Cioinaru, Titus-Cristian Man, Monica Marin, Ciprian Moldovan, Georgiana Neculau, Emil Daniel Tesliuc, Vlad Alexandru Grigoras, and Manuela Sofia Stanculescu. 2016. "Atlas Marginalized Rural Areas and Local Human Development in Romania (English)." Washington, DC: World Bank. http://documents.worldbank.org/curated/en/847151467202306122/Atlas-marginalized-rural-areas-and-local-human-development-in-Romania.
- Stadtherr, Lisa, Dim Coumou, Vladimir Petoukhov, Stefan Petri, and Stefan Rahmstorf. 2016. "Record Balkan Floods of 2014 Linked to Planetary Wave Resonance." *Sciences Advances* 2 (4). https://advances.sciencemag.org/content/2/4/e1501428.
- Schumacher, I., and E. Strobl. 2011. "Economic Development and Losses Due to Natural Disasters: The Role of Hazard Exposure. *Ecol Econ* 72: 97–105.
- Townsend, Robert M. 1995. "Consumption Insurance: An Evaluation of Risk-Bearing Systems in Low-Income Economies." *Journal of Economic Perspectives* 9 (3): 83–102.
- Thomson, Harriet, and Stefan Bouzarovski. 2018. *Addressing Energy Poverty in the European Union: State of Play and Action*. EU Energy Poverty Observatory. August. https://www.energypoverty.eu/sites/default/files/downloads/publications/18-08/paneureport2018_final_v3.pdf.
- United Nations. 2015. *Sendai Framework for Disaster Risk Reduction 2015-2030*. Available via UN Office for Disaster Risk Reduction: https://www.undrr.org/implementing-sendai-framework/what-sf.

- UNDP (United Nations Development Programme). 2016. *Risk-Proofing the Western Balkans: Empowering People to Prevent Disasters. Human Development Report*. http://hdr.undp.org/sites/default/files/risk_proofing_the_western_balkans.pdf.

- UNDRR. 2018. *Technical Guidance for Monitoring and Reporting on Progress in Achieving the Global Targets of the Sendai Framework for Disaster Risk Reduction*. https://www.undrr.org/publication/technical-guidance-monitoring-and-reporting-progress-achieving-global-targets-sendai.

- UNECE (United Nations Economic Commission for Europe). 2016. *Housing and Urban Development in the Economic Commission for Europe Region: Towards a City-Focused, People-Centered and Integrated Approach to the New Urban Agenda*. Habitat III Regional Report. https://www.unece.org/fileadmin/DAM/hlm/projects/HIII_Regional_Report/HabitatIII-Regional-Report-Europe-Region.pdf.

- UNEP (United Nations Environment Programme). 2004. "Impacts of Summer 2003 Heat Wave in Europe." *Environment Alert* Bulletin 2. http://www.grid.unep.ch/product/publication/download/ew_heat_wave.en.pdf.

- Walsh, Brian, and Stephane Hallegatte. 2019. "Measuring Natural Risks in the Philippines: Socioeconomic Resilience and Well-being Losses." Policy Research Working Paper 8723, World Bank, Washington, DC. https://openknowledge.worldbank.org/handle/10986/31227.

- Walsh, Brian, and Stephane Hallegatte. 2020. "Measuring Natural Risks in the Philippines: Socioeconomic Resilience and Wellbeing Losses." *Economics of Disasters and Climate Change* (2020): 249–293. https://link.springer.com/article/10.1007/s41885-019-00047-x.

- World Bank. 2012. *Turn Down the Heat: Why a 4°C Warmer World Must Be Avoided*. Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/11860.

- World Bank. 2014a. *Turn Down the Heat: Confronting the New Climate Normal. Vol. 2: Main Report*. Washington, DC: World Bank. http://documents.worldbank.org/curated/en/317301468242098870/Main-report.

- World Bank. 2014b. "The Face of Poverty in Europe and Central Asia." February 10, 2014. https://www.worldbank.org/en/news/feature/2014/02/10/face-of-poverty-in-europe-and-central-asia.

- World Bank. 2017. "Europe and Central Asia – Country Risk Profiles for Floods and Earthquakes (English)." Washington, DC: World Bank. http://documents.worldbank.org/curated/en/958801481798204368/Europe-and-Central-Asia-Country-risk-profiles-for-floods-and-earthquakes.

- World Bank. 2019. "Poverty and Equity Brief–Albania." World Bank, Washington, DC. https://databank.worldbank.org/data/download/poverty/33EF03BB-9722-4AE2-ABC7-AA2972D68AFE/Global_POVEQ_ALB.pdf.

- World Bank. 2020a. *Analysis of Heat Waves and Urban Heat Island Effects in Central European Cities and Implications for Urban Planning*. Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/34335

- World Bank. 2020b. *Earthquake Risk in Multifamily Residential Buildings in the Europe and Central Asia Regions*. Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/34439

- World Bank. 2020c. *Croatia March 2020 - Earthquake Rapid Damage and Needs Assessment 2020 (English).* Washington, D.C. : World Bank Group.

- World Bank. 2021. *Croatia December 2020 Earthquake Rapid Damage And Needs Assessment (English).* Washington, D.C. : World Bank Group.

- Yang, Dean, and HwaJung Choi. 2007. "Are Remittances Insurance? Evidence from Rainfall Shocks in the Philippines." *The World Bank Economic Review* 21 (2): 219–248. https://www.jstor.org/stable/40282243

FACING PAGE

Rescue workers searching through assorted debris after floods in Tbilisi, Georgia in 2015. Credit: Dmytro Vietrov

ABOUT THIS REPORT

This report presents a disaster risk assessment model for economic impacts of disasters in select countries in the Europe and Central Asia region—Albania, Armenia, Bulgaria, Croatia, Georgia, Greece, Romania, and Turkey. This disaster risk assessment approach adds a new dimension—that is, socioeconomic resilience—to the conventional risk assessment framework—which consists of hazard, exposure, and vulnerability. The socioeconomic resilience represents the ability of affected households to cope with and recover from disasters.

The results indicate that the economic well-being of citizens in all these countries is affected far more than the estimated cost of physical damages to buildings and public infrastructure. This study also shows that the recovery and reconstruction process depends not only on the extent of damages due to disasters but also on the economic structure of each country and the level of socioeconomic resilience of its citizens.

ABOUT GFDRR

The Global Facility for Disaster Reduction and Recovery (GFDRR) is a global partnership that helps developing countries better understand and reduce their vulnerabilities to natural hazards and adapt to climate change. Working with over 400 local, national, regional, and international partners, GFDRR provides grant financing, technical assistance, training, and knowledge sharing activities to mainstream disaster and climate risk management in policies and strategies. Managed by the World Bank, GFDRR is supported by 34 countries and 9 international organizations.

www.gfdrr.org

THE WORLD BANK
IBRD • IDA | WORLD BANK GROUP

GFDRR
Global Facility for Disaster Reduction and Recovery