Review of ECLAC damage and loss assessments in the Caribbean

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Economic Commission for Latin America and the Caribbean (ECLAC)

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Executive Summary

The objective of this study is to determine whether the assessments carried out by the United Nations Economic Commission for Latin America and the Caribbean (ECLAC) on the impact of disasters over the past decade accurately captured the extent of the damage experienced by caibbean states during this period, by comparing these estimates to actual recovery costs incurred by country. The study also seeks to determine the extent to which recovery efforts have closed the damage and loss gaps estimated by ECLAC. The study was undertaken at the request of the Caribbean Catastrophic Risk Insurance Facility (CCRIF), with the expectation that the results would inform any required adjustments to the premium payments calculations conducted by CCRIF, and would make recommendations to regional governments regarding insurance packages and premiums.

The approach to the study involved extensive literature review of damage assessment methodologies, comparing their results with the outcome of ECLAC's damage and loss methodology when applied to several natural events in the Caribbean. The study also reviewed the regime of insurance provisions in the Caribbean in order to better inform risk coverage for natural hazards in the subregion.

Among the key methodologies reviewed were the Hazus-MH Hybrid assessment model used by the United States Federal Emergency Management Agency (FEMA); the Australian Socioeconomic Impact Model (SEIA); and the Post-Disaster Needs Assessment Model (PDNA) as applied by the World Bank. Other approaches such as specialized Input-Output models as well as Econometric Models were also reviewed. Comparisons of ECLAC's damage and loss assessments were then made for Hurricane Ivan 2004, Hurricane Dean 2007, Hurricane Tomas 2010, and the Haiti Earthquake 2010.

The study showed ECLAC estimates to vary between 10 per cent and 22 per cent for these disaster events reflecting differences with respect to various methodological aspects of the analysis. Some methodologies were however not directly comparable given variations in data needs for the analyses.

With respect to insurance coverage for the Caribbean, the study revealed several deficiencies in the development of the regional insurance market, which have led to high insurance costs, as well as an insufficient level of subscription in order to cover catastrophic risks. Because of this, the report concludes that for the most part, only insured losses are covered by insurance providers. The economic losses and secondary effects that are typically accounted for in damage assessments are rarely compensated.

I.Introduction

The Caribbean is highly susceptible to natural hazards, specifically hurricanes, earthquakes, extreme flooding and volcanic eruptions. The economic toll of these disasters is often very high and recovery can take several years. Strobl (2012), for example, estimates that the average hurricane strike resulted in 1 percentage point fall in economic growth in the region, with the estimate rising based on the economic characteristics of the island and the time of year the strike ocurred. The United Nations Economic Commission for Latin America and the Caribbean (ECLAC) has been assessing the impact of these disasters since the 1990s and, using its Damage and Loss Assessment (DaLA) methodology, has provided estimates of the impacts of disasters on the economies, societies and environments of affected countries. The results of these assessments have provided governments with the estimates needed to secure donor financing and to formulate their recovery efforts.

Following an emergency meeting in 2004, CARICOM Heads of Government created the Caribbean Catastrophe Risk Insurance Facility (CCRIF) in 2007. CCRIF is a regional catastrophe fund aimed at limiting the financial impact of natural hazards by providing rapid financial liquidity. In 2010, CCRIF and ECLAC signed a Memorandum of Understanding to govern their collaboration when assisting governments in adopting disaster reduction and mitigation policies.

The aim of this study is to determine whether the assessments accurately captured the extent of the damage by comparing the ECLAC estimates to the actual recovery costs incurred by country and to assess the extent to which recovery efforts have closed the damage and loss gaps estimated by ECLAC. The results of this study will inform any potential adjustments to the premium payments calculations conducted by CCRIF and serve as a guide to regional governments regarding insurance packages and premiums.

Achieving the objectives of the study will require a combination of desk research and interviews with relevant stakeholders. The seven main components are listed below:

(i) Review all ECLAC DaLA reports in the Caribbean for the period 2005 – 2011;

(ii) Review all relevant literature on damage and loss assessments;

(iii) Review the costings of ECLAC assessments and other relevant assessments;

(iv) Determine the extent of current insurance coverage of Caribbean islands and the adequacy of this coverage in terms of recovery and more robust rebuilding;

(v) Consult with relevant disaster recovery stakeholders to verify recovery efforts and impacts;

(vi) Identify specific challenges which impact the implementation of recovery activities;

(vii) Determine the need for adjustment in insurance coverage for the Caribbean islands.

II. Post-disaster assessments methodologies

A. Introduction

Assessment of the impact of a disaster can be conducted either prior to or after the occurrence of the disaster. The analysis of the potential impact of disasters is typically found in development studies and insurance methodologies, and are forward-looking, risk-based approaches. This study, however, focuses on methodologies that estimate the damage done by a disaster that has already occurred, that is, those approaches that are most comparable to the ECLAC methodology and are used to inform emergency recovery efforts. Kelly (2008) provides a useful summary of the three main frameworks that have been used to estimate reconstruction costs in the aftermath of a disaster:

1. Damage assessments that estimate the physical, and sometimes the social and psychological damage and the resources needed for recovery. There are a number of methodologies used in this approach, varying by the type of disaster being investigated, the level of detail required and the intended use of the assessment (i.e. whether it is to source donor-financing post-disaster or to implement risk mitigation methods). The methodology used by ECLAC is an example of a damage assessment technique with the primary aim of providing the quantitative information necessary to support recovery efforts. The main criticisms of the damage assessment approach are that:

- Since the methodology begins assessment as the post-humanitarian phase, it usually ignores whether the resources are available for the recovery, thus leading to the possible over-provision of assistance;
- It does not adequately capture the social or psychological impacts,thereby increasing the likelihood of the under-provision of assistance; and,
- Post-disaster assistance based on damage assessments could result in communities that have the resources to fund their own recovery (assumed to be communities with higher asset values) receiving too much assistance while those with limited resources could receive too little assistance (Kelly, 2008).

With respect to the first criticism, the stated aim of most damage assessments is simply to estimate the total damage, not to provide an estimate of what is already available for recovery. The overprovision of assistance may therefore be due to lack of information on available resources, which forces governments to request funding to cover all of the damage, and not due to the methodology itself. In fact, ECLAC (1996) explicitly states that their approach 'provides the necessary information support for emergency decision makers, a specific user or group of users who are making decisions about emergency resource allocation in what is usually a fast-changing and stressful environment, in the immediate post-disaster phase' and 'identifying the losses and possibilities for facilitating the long-term recovery and development needs is perhaps understandably considered only as a secondary priority in this kind of situation' (ECLAC, 2009 pp. 4). Nonetheless, these criticisms are quite valid and the needs assessment approaches attempt to close these gaps.

2. Needs assessments build on damage assessments by also trying to determine what is actually needed for recovery by considering social and psychological effects. This approach also gets around the problem of possible overprovision of assistance to communities that can fund their own recovery efforts. Needs assessments are typically more structured sincethey estimate the cost to return 'basic needs' to the affected areas. Kelly (2008) uses the Sphere Standards[1] as the benchmark of minimum standards for water, food, shelter and health care and argues that despite the fact that the Sphere Standards were not designed for this purpose, the gaps between these needs and what is available post-disaster are easy to identify, analyse and present. This weakness also raises the question of what exactly is a 'need' and does not capture psycho-social wellbeing nor the stated needs of the disaster survivor. For example, a survivor who is a farmer may identify that he/she needs food to feed his/her animals as their stock was destroyed and their animals are the source of their livelihood.

3. Rights assessments are similar to needs assessments in that they try to estimate the cost to close gaps, rather than to estimate total damage. In this case, however, the aim is to ensure that post-disaster survivors have rights based on the United Nations Universal Declaration of Human Rights, which include not only the 'basic needs' identified in needs assessments, but also those rights that encompass all aspects of the disaster survivor's life, such as whether the disaster survivor lived free of violence prior to the disaster.

The main drawbacks of this approach are that: it requires much more detailed information than the other two approaches; it may involve issues that existed prior to the disaster (such as child labour or civil unrest); and, addressing the identified issues may require specialist knowledge and competencies that are typically beyond the scope of post-disaster operations. Kelly (2008) believes that rights-based assessments are not popular with donors because they do not wish to replace the duties of the government, (such as, providing water supply in an area where the government did not provide it prior to the disaster) donors also prefer to separate short-term disaster relief funding from long-term development assistance.

In the literature, there are numerous studies on estimating specific types of impacts including the direct, long-run, and economic impacts on particular sectors. There are also studies existing on the impact of specific types of disasters – such as flooding (see Jonkman et al, 2008, Dutta et al, 2003), droughts (Ding, 2011), hurricanes (see Strobl, 2008) or earthquakes. There are fewer methodologies that have been proposed to provide a holistic view of the impact of disasters. In this section, the study focus was only on these holistic methodologies, since they are believed to be the most comparable output to the ECLAC DaLA methodology and they are considered to be best practice in the area of disaster impact assessment.

[1] The Sphere Standards were developed by the Sphere Project, a voluntary initiative that brings together a wide range of humanitarian agencies to improve the quality of humanitarian assistance and the accountability of humanitarian actors. The standards refer to the minimum standards of humanitarian response and cover four life-saving areas of humanitarian aid: water supply, sanitation and hygiene promotion; food security and nutrition; shelter, settlement and non-food items; and health action.

B. ECLAC DaLA Methodology

The ECLAC DaLA methodology is an accounting framework that attempts to estimate the damage caused by disasters. It categorises the impact by different economic and social effects, and groups them into direct and indirect effects. The areas covered are:

- The affected population
  - Primary population (directly affected)
  - Secondary population (indirectly affected since they live near or in the path of the disaster or are family members of the directly affected and have been forced to become caregivers)
  - Tertiary population (outside of the disaster zone but may be affected through panic-induced damage, loss of social services or other severe inconvenience)
- Infrastructure (transportation, essential services, communication)
  - Transportation
  - Water and sanitation sector
- Coastal areas and infrastructure
  - Coastal roads
  - Harbours and marinas
  - Beach and shoreline erosion
  - Water intake and effluent outlet structures
- Terrestrial environments
  - Forest/watershed
  - Rivers/lakes
  - Aquifers
  - Wetlands
  - Scenic landscape
  - Wildlife species and habitat
  - Medicinal and wild plants
  - Soils
- Marine environments
  - Seagrass beds
  - Mangroves
  - Coastal Water Pollution
  - Coral reefs
  - Sandy shores (beaches)
- Tourism
  - Hotels and restaurants (direct impact)
  - Loss of business

- Employment and income
- Sectoral GDP
- Balance of Payments effects
- Government revenue and expenditures

• Agriculture and fisheries

- Farmland
- Physical infrastructure, including irrigation and drainage systems, stores and silos
- Machinery and farm equipment
- Loss of crops ready for harvesting
- Losses of stock (livestock, inputs and harvested products)
- Employment and income
- Sectoral GDP
- Balance of Payments effects
- Government revenue and expenditures

• The manufacturing and commercial sectors

- Building and installations
- Machinery and equipment
- Furniture and vehicles
- Inventories
- Employment and income
- Sectoral GDP
- Balance of Payments effects
- Government revenue and expenditures

• The social sector

- Housing
- Health
- Education

Within each category, there are worksheets that must be completed that facilitate estimating the damage and losses to the area being investigated. Damage is considered to be the negative effects that occur at the time of the disaster and typically include damage to physical assets. Losses refer to negative effects to income flows, whether through loss of income or higher operational costs. To collect the required information, the researcher is encouraged to meet with personnel from different Government Ministries, public sector agencies, non-profit organisations, specialists such as engineers and other agencies, as well as conduct desk research. The researcher is expected to begin assessing the damage within two to four weeks following the disaster to ensure that the country is no longer in the emergency phase of the recovery.

The ECLAC DaLA approach is detailed and covers the key areas of impact in the Caribbean. It focuses on the net impact, so positive impacts are also considered in the assessment. It is flexible and can be used for natural as well as man-made disasters, for sudden disasters and for slowly evolving disasters.

This approach is focused on estimating the cost of repairing or replacing damaged infrastructure as well as the impact on various social and economic sectors such as education, health, balance of payments, etc. The estimates assume that repairing/replacing the damaged item would return it to its pre-disaster state and reduce the risk of similar damage in the event of another disaster. It should be noted, however, that the long-term economic impact, such as the expected reduction/increase in output, employment and financial flows is not estimated. At a stakeholder workshop held in Saint Lucia, this was flagged as a shortcoming that could potentially lead to an underestimation of the recovery assistance needed. In April 2014 however, ECLAC launched an update of its DaLA methodology which seeks to address this deficiency, as well as to improve sector analysis of disaster impacts.

C. Hybrid Models - Hazus-MH

In the United States of America, one of the most popular hybrid models for estimating the cost of a disaster is Hazus, a software package distributed by the Federal Emergency Management Agency. It is based on geographical information systems (GIS) software and currently models four types of natural disasters: flooding, hurricanes, earthquakes and coastal surge. Since it is GIS-based, it also allows users to visually display hazards, impacts and vulnerabilities on maps of the affected areas. The latest version, Hazus-MH, has over 200 inventory layers that provide information on areas that are common to all hazards – such as general building types, building use, utility networks and transportation networks – as well as areas that are hazard-specific – such as whether a certain type of structure can withstand an earthquake, amount of rainfall, elevation information and other environmental information. The estimates of direct damages or losses are derived from repair and replacement costs, content values for different types of buildings, annual gross sales, relocation expenses and income by occupancy. Indirect economic losses are estimated using a computable general equilibrium model based on input-output modelling techniques.

Hazus has a number of advantages. The number of inventory layers included in Hazus allows users to create very detailed estimates of the cost of a natural disaster. For example, in addition to building, population and networks information, Hazus also includes detailed information on rivers, elevation, rainfall, coasts etc. that allow for more accurate estimates of potential damage. Further, in estimating the potential damage caused by a flood, information is presented on the depth of the water in the affected area and the buildings and populations exposed. These inventory layers allow users to identify vulnerable areas and the state of readiness prior to a disaster and estimate the potential losses. As such, Hazus is very useful when designing disaster mitigation measures and reducing risk.

Once a disaster has occurred, users can estimate direct physical damages, induced impacts and direct and indirect economic impacts. Direct physical damages can include general building stock losses (including square footage, economic impact to contents in the building, total number of buildings affected, etc.), and impact on the transportation and utility systems, while induced impacts cover areas such as fires following an earthquake. Direct economic impacts include the cost to repair damaged structures, damages to agricultural crops, estimates of the need for public shelter and the displaced population, while indirect economic impacts are usually long-term and refer to areas such as supply shortages, sales declines, opportunity costs, etc.

Another advantage of Hazus is that information on the impact of past hazards is stored and can be accessed through the software. This allows the user to potentially use information on the impact of a previous hazard to estimate the losses from the current hazard. For example, the user can estimate the potential damage to a particular type of building from wind of a certain speed, and how the risk of damage changes as different risk mitigation features are used. Users can combine some models within Hazus, so for example, the user can combine the hurricane and flooding models to estimate the damage done by a hurricane that led to severe flooding, whether due to coastal flooding or a river bursting its banks.

The main disadvantage of Hazus is that users are required to have knowledge of GIS in order to fully exploit its potential. Another disadvantage is the risk that some of the information in the inventory layers may be outdated and not all of the information can be modelled to estimate their losses. For the model to be maximised, it requires a great deal of detailed information that may not be available in less developed economies. Finally, the assumptions underlying the Hazus methodology are not very flexible and may not always be reasonable. For example, Hazus assumes stable demand and flexible producers, but this may not always obtain, especially post-disaster.

D. EMA Disaster Loss Assessment Guidelines

In Australia, the Queensland Department of Emergency Services, other Queensland agencies, Emergency Management Australia (EMA), the Bureau of Meteorology and the Centre of Risk and Community Safety at RMIT University developed the EMA Manual 27 Guidelines (EMA, 2002) to inform the assessment of disaster losses at the sub-national and local level. The aim of the effort was to produce guidelines that would not require specialist knowledge or training, but comprehensive enough to allow the estimation of direct and indirect losses for both tangible and intangible losses.

There are three general approaches: (1) averaging, (2) synthetic and (3) survey or historical. The averaging approach uses averages of pre-existing data on losses and therefore requires little experience, is inexpensive and is fast. The main cons are that due to data limitations, it may not yield reasonable estimates. The synthetic approach uses pre-existing databases of average building types and contents and is believed to be the most popular, while the survey approach relies on detailed surveys. Although this allows the user to capture event-specific attributes, it also makes it harder to compare disasters and it requires greater expertise to ensure accuracy.

Of note, the guidelines advocate estimating potential losses rather than actual losses on the basis that actual losses may have been minimised due to preventative efforts (for example moving valuable items to more secure locations) and therefore may result in discrimination against communities that were more or less prepared. This approach raises the issue of estimating potential losses rather than actual losses, which is a major criticism of most of the methodologies covered in this section and will be discussed in further detail in the concluding section of this chapter.

E. Socioeconomic Impact Assessment Models (SEIA)

The Socioeconomic Impact Assessment (SEIA) model was developed in Australia specifically to capture the socioeconomic impact for social well-being elements such as health, the environment and heritage assets (APEC, 2009). The main features of the model are: (1) a ‘with and without the emergency’ comparison; (2) a social and economic profile; and, (3) an ‘expected value procedure’ to capture the willingness to pay, household disruption and environmental loss and impact. The main weaknesses identified for this model are that it requires a coordinated approach across government departments and agencies and is data intensive.

F. Post-disaster needs assessments

Post-disaster needs assessments (PDNA) (World Bank, 2014) build on DaLAs by using the damage assessment to estimate the financial, technical and human resources needed to recover from, reconstruct and manage risk after a disaster. There are therefore two aspects of the PDNA: (1) conducting a DaLA to estimate the physical damages and economic losses of the disaster and (2) identifying the recovery needs of the society using a Human Recovery Needs Assessment (HRNA). As such, it covers both what is required for immediate/early recovery as well as the long-term development implications. The World Bank Handbook on Post-Disaster Housing and Community Reconstruction outlines the guidelines for conducting PDNAs.

G. Input-Output Models

Input-output models provide inter-industry relationships and show how the output of one industry may be the input of another. This type of approach is especially useful in estimating indirect losses following disasters. Okuyama (2008) argues that though the input-output model is attractive for its simplicity and ability to combine with other models, its weaknesses include 'its linearity, its rigid structure with respect to input and import substitutions, a lack of explicit resource constraints, and a lack of responses to price changes' (pp. 5). To get around these issues, the IO framework has to be adjusted and aspects transferred to other models, such as computable general equilibrium models. Okuyama (2004) used two methods to estimate the impact of a disaster: 'Miyazawa's extended input-output framework (Miyazawa, 1976) for estimating the spatial impacts of an earthquake and its recovery process; and the sequential inter-industry model (SIM), introduced by Romanoff and Levine (1977) for example, for investigating the dynamic process of the impact paths of a disaster while maintaining the simplicity of the input-output framework' (pp. 298). The study concluded that modifying the input-output model using the Miyazawa extension and the SIM model increases the effectiveness of the input-output framework.

H. Econometric Models

Econometric models are more widely used to estimate long-run economic impacts. Eric Strobl has conducted numerous studies on the impact of hurricanes in the Caribbean by calculating a hurricane wind damage index, which is then used as a proxy for destruction in macroeconomic models. Mohan and Strobl (2013) estimated the impact of hurricanes on agricultural exports using a hurricane damages index and regression analysis and found that on average hurricanes resulted in a reduction in agricultural exports equivalent to 0.0068 tonnes in the year of the disaster and 0.0049 tonnes in the following year. Granvorka and Strobl (2013) investigated the impact of hurricane strikes on monthly tourist arrivals in the Caribbean by first developing a hurricane damages index and then regressing monthly arrivals on this index. They found that hurricanes have a statistically significant impact on tourist arrivals equivalent to an average two per cent loss in arrivals. In a similar approach, Ouattara and Strobl (2014) estimated the impact of hurricanes on the fiscal accounts of Caribbean countries using a hurricane damage index and a panel of Caribbean countries over 36 years. They used a panel VAR and impulse response framework to estimate the impact and found that governments increase expenditures in the year of the disaster but that effect dies out within two years, and there is no impact on revenues. They also found that there is no noticeable affect on government debt.

Heger et al (2008), focusing on the Caribbean, examine the factors that reduce the economic impact of natural hazards on small states in the region. Using the number of disasters that occurred as measure of the scale or impact of disasters, the authors investigate the impact of these events on GDP per capita, exports (percentage of GDP), imports (percentage of GDP) and debt (percentage of GDP) using a panel fixed effects and country-specific linear time trends. The results suggest that the main impact of disasters tend to occur contemporaneously (i.e. lower GDP and higher imports) with significantly smaller lagged effects, while for exports the main effect of disasters is to reduce future export performance. Indeed, the results suggest that in the year of the disaster, GDP per capita normally falls by 24 per cent of GDP, with subsequent increases of 11 per cent, 19 per cent and 13 per cent. Key factors moderating/magnifying these results were population density (the higher the level of population density the greater the impact of natural hazards) and the level of agricultural dependency (countries that are highly dependent on agricultural exports or imports are likely to see a significant increase in agricultural imports following a disaster). The findings from the study confirm that disasters tend to have significant economic impacts on small states in the Caribbean, but that these effects can be moderated somewhat by increasing the diversification of national production, exports and imports.

Loayza et al (2009) applied a Generalised Method of Moments panel estimator to a 1961 – 2005 cross-country panel and determined that: (1) the impact of disasters on economic growth is not always negative and varies by disaster and by economic sector; (2) catastrophic disasters do not have positive growth impacts but milder disasters could have a positive growth effect; and (3) developing countries are more sensitive to the impact of disasters on growth as more sectors are affected and the magnitudes of the impacts are 'non-trivial.'

McComb, Moh and Schiller (2011) used an intervention model to estimate the long-term impact of Hurricane Katrina on the Houston and Dallas economies. These economies were not directly affected by Hurricane Katrina – New Orleans suffered the brunt of the damage – and the authors tried to determine if neighbouring regions could also suffer macroeconomic effects. They found that in the short run, there was a positive impact on output in the adjacent regions, but the long-term impact was unclear.

Generally econometric models are only useful in situations with sufficient pre-disaster data for robust analysis. In many countries, however, this information is not available for indicators other than macroeconomic indicators. These approaches therefore are not often used for estimating the damages done to physical structures because the data required to conduct the analyses are not available. Additionally, it can be argued that econometric models will not outperform other methods for estimating direct damages, though there is scope for their use in estimating indirect losses and macroeconomic effects if the data are available.

I. Conclusion

Most of the approaches described in sections C-H above is based on predicted versus actual damage from disasters. The following key aspects represent the main differences between these types of assessments and ECLAC's DaLA methodology:

1. Likely impact vs the actual impact

The estimation method focuses on the likely rather than the actual impact. This makes them very different from the ECLAC methodology, which involves on site estimates using specialists from different fields. So, although there is a strong scientific basis for the application of these methods, they are all subject to a high probability of inaccuracy, though this cannot be verified due to the absence of information on the actual losses incurred.

2. Utility

Most of these models are most useful years after the disaster has occurred as they are very data intensive. Indeed, some methodologies, such as the econometric models, require the passage of time before the estimates can be derived. This makes them ill suited for informing the amount of recovery aid required.

3. Absence of social and psychological impacts

Despite the efforts made by PDNAs, the social and psychological impacts of disasters are difficult to estimate, yet they may have long-lasting economic and social consequences. For example, while most disaster assessments collect and report information on the number of fatalities and the size of the affected population, they do not provide a numerical estimate of this cost.

4. Quantifiction of human life

Arguably, there is no acceptable methodology for quantifying the value of a human life, yet if the number of fatalities is sufficiently high, or the affected population is critical for economic reasons, their loss can have long-term economic consequences such as sharp contractions in the labour market and/or the loss of skilled labour. If increased inbound migration is required to close labour market gaps, the 'new' cultures and practices will also influence the society at large in ways that existing disaster assessment methodologies do not capture. Furthermore, not estimating the cost of loss of life significantly underestimates the losses incurred by the countries, as human capital is also a resource.

5. Assesing the damage to historical and cultural assets as well as loss of leisure

A similar argument can be made when considering the damage done to historical monuments and other culturally significant assets (Cochrane, 2004). The heritage lost when these types of structures are damaged or destroyed cannot be adequately quantified, though the long-term impacts may affect the society and economy at large. For example, in those countries where historical monuments drive the tourism industry – such as the pyramids in Egypt – their loss has consequences to the economy at large that are difficult to estimate. The loss of leisure is also not accounted for in any of the approaches reviewed.

6. Valuation of disaster impact on asset prices

Another factor that has not explicitly been mentioned in disaster assessments is the impact of the disaster on asset prices, which in turn could potentially affect the wealth and assets of all households and businesses in the affected and surrounding areas. In the case of the Caribbean, given the small landmass of most of the islands, disasters could potentially affect real estate prices across the country. Consider the hypothetical example of a hurricane that destroys the capital city and main tourist hub. In most Caribbean countries, the most expensive real estate is typically located in or near to the capital city and tourist hub. If these properties are destroyed, there will be a spike in the demand for properties in the next most expensive tranche or in areas that were relatively less affected, potentially increasing their values to match or surpass that of the destroyed properties. Even after rebuilding, the demand for and value of property in the damaged areas may not return to pre-disaster conditions. For example, in the Weston area of St. James in Barbados there was severe flooding in 1995 that resulted in the death of a popular musician. Even though this area remains popular for tourism-related developments due to its location along the west coast, Barbadians are hesitant to move to the area because they are aware of the flooding risk. For most persons in the Caribbean, household wealth is rooted in property, possibly due to the relative stability of property markets and shallow financial markets. Damage to property can therefore change wealth status overnight, especially in the middle income and low income brackets.

Cochrane also noted that because most methodologies focused only on the time of the event and the reconstruction period (1 to 5 years in most approaches), they failed to take into account the impact that higher levels of debt have on long-term growth.

Cochrane argues that double accounting is a significant concern in damage assessment when both direct damages and their indirect effects are included in the total damage estimate. The argument is that value-added includes the 'services of capital' and that direct damage should be limited to the 'cost of replacing the undepreciated portion of such capital' (pp.291).

One of the main challenges with estimating the cost to the government of the affected country is deducting the costs that would be incurred directly by the private sector. For example, if a family loses its home, the cost of repair would be borne by the family. Only if the family cannot afford to rebuild the home would they potentially become the responsibility of the government. The ECLAC DaLA methodology does not explicitly differentiate between costs to be borne by the government and those to be borne by other players in the economy. While this is not important when determining the overall impact of the disaster, it becomes more critical when estimating how much the government should receive in aid financing as well as whether the private insurance coverage is adequate.

III. Accuracy of ECLAC DaLA assessments in the Caribbean

A. Background

Having critiqued the substrantive and procedural differences in the approach of the most popular holistic methodologies as compared with the DaLA methodology, the study will in this section compare the actual assessments undertaken using the DaLA as well as the assessments performed by ECLAC and other methodologies used to assess the same events .There were three main challenges in completing this section. The first challenge was estimating the actual cost of the disaster in order to determine if the assessments conducted by ECLAC were accurate. It appears that if a government requests an assessment from ECLAC, that becomes the official estimate that is used to secure donor funding and no other assessment is done. This sentiment was supported by all of the regional stakeholders at a workshop held in Saint Lucia. This is a major impediment to achieving one of the main aims of the study: estimating the accuracy of the ECLAC DaLA assessments.

The second major challenge is the absence of a baseline estimate of the situation that prevailed before the disaster. While this information would not provide an indication of whether the ECLAC DaLA assessments were accurate, it would provide valuable context to compare the ECLAC assessments with other assessments done for the same disaster. The existence of a baseline estimate would allow us to compare the damage estimates to the baseline value, and then compare the ECLAC and other assessments using those comparisons rather than simply comparing the two approaches to each other. For example, we could state that one approach resulted in an estimate equivalent to x per cent of the baseline value, while the other approach resulted in an estimate equivalent to y per cent of the baseline value. This approach provides valuable context and grounds the estimates.

The third challenge was finding more than one assessment for the same disaster. There appear to be very few further holistic studies done by any other party after any of the the ECLAC DaLA assessments. The only other institution that consistently estimates damage losses is the CCRIF which employes it's Hazard and Loss Modelling Framework to estimate loss probalilities for selected hazards based on an indexed parametric estimate of losses, thus affording an assessment of potential loss before the actual disaster event. The CCRIF model also allows for estimation of site specific hazard levels and losses for specific events with these estimates forming the basis for the fixing of insurance contracts. While the model is flexible and scalable to a number of modelling situations for hurricanes and earthquakes, todate it does not include parameters for modelling the potential impacts from rainfall. In this study, to the extent that this is possible, some of CCRIF's model output will be compared to ECLAC's assessments. Additionally, wherever possible, ECLAC's estimates will be compared to econometric studies conducted years after the disaster, which unfortunately means that only the indirect/economic effects will be compared. It must be noted that severe data challenges have hindered the depth of analysis possible in this section.

The following case studies have been selected based on the following criteria:

- Ability to compare ECLAC's results to another assessment
- Offer a range of disasters (hurricanes, flooding and earthquakes)
- Disasters that affected one country as well as disasters that affected a number of countries

For each case study, the final estimates will be compared and an explanation for the differences provided. After the case studies, the concluding section will summarise the relative strengths and weaknesses of the assessments.

B. Comparing holistic damage and loss assessments

Case Study 1: Hurricane Dean in Belize, 2007

Hurricane Dean made landfall in Belize as a Category 5 hurricane 43 miles northeast of Corozal Town and near to Majahual, a coastal community in Mexico, on 21 August 2007. The speed of the hurricane limited the amount of rainfall but led to high winds. The emergency response included teams from the Caribbean Disaster Emergency Response Agency (CDERA), the National Emergency Management Organisation (NEMO) of Belize, the Ministry of Health of the Government of Belize and the Pan American Health Organisation/World Health Organisation.

NEMO provided a preliminary damage and needs assessment in August 2007 using DANA Field Team reports, Aerial Reconnaissance reports, data collected from NEMO's National Emergency Operating Centre and official sectoral reports from the government and non-governmental organisations.

To estimate the extent of the damage, ECLAC used both a DaLA and a limited Sustainable Livelihoods Approach (SLA), which is based on the concepts of sustainability and livelihoods. 'Livelihoods refer to the capabilities, assets and activities required for a means of living', while to be sustainable, livelihoods should demonstrate: 'resilience in the face of external shocks and stresses; capacity to maintain the long-term productivity of natural resources; and, ability not to undermine the livelihoods of, or compromise the livelihood options open to others' (pp. 7). The stated aims of the SLA study were to determine:

(i) Where were the affected communities located;

(ii) Which households were affected (how many and to what extent);

(iii) What were the damage and losses suffered by each household with regard to their assets;

(iv) How were their income-earning activities affected;

(v) What would it take to get them back up and running;

(vi) What assistance was required to build resilience and reduce future risk; and,

(vii) What would it take to make the livelihoods of the affected households sustainable.

This approach differs from the DaLA methodology in that more emphasis is placed on the human element of the disaster, rather than the physical. This fact makes it challenging to compare it to the assessment conducted by NEMO, which focused on the physical impact. As a result, the following analysis is limited to comparing only the DaLA findings with the NEMO estimates.

TABLE 1
SUMMARY OF DIRECT DAMAGES AND LOSSES FROM HURRICANE DEAN
(Million of United States dollars)

	Direct Damages			Indirect Losses		
	ECLAC	NEMO	Diff.	ECLAC	NEMO	Diff.
Housing	16.6	10.2	4.4	0.0	Not stated	n.a.
Commercial buildings	Not stated	2.4	-2.4	Not stated	Not stated	n.a.
School buildings	0.4	0.2	0.2	0.0	Not stated	n.a.
Health sector	Nil	Nil	-	0.2	Not stated	n.a.
Agriculture	21.2	20.2	1.0	32.6	45.4	-12.8
Tourism	0.7	2.9	-2.2	4.0	Not stated	n.a.
Fisheries	0.7	0.7	-	4.1	4.0	0.1
Environment	3.3	Unknown	n.a.	0.7	Unknown	n.a.
Transportation	4.7	1.6	3.1	0.2	Not stated	n.a.
Utilities	1.5	0.5	1.0	0.2	Not stated	n.a.
Total	47.4	38.7	8.7	41.9	49.4	-7.5

Source: ECLAC, Nemo (2007) and author's estimates.

ECLAC's methodology in this case yielded a much higher estimate of total direct damages and a much lower estimate of indirect losses. The main contributors to the higher direct damages were ECLAC's estimates of the direct damages to housing, the environment and transportation. ECLAC estimated that Hurricane Dean damaged 1,175 houses (2 per cent of the national stock), with 29 per cent of these houses completely destroyed. NEMO, on the other hand, estimated 1,070 damaged houses, with 32 per cent of these houses total destroyed. It is not clear why the two studies estimated a difference in the number of houses damaged of more than 100 houses. Furthermore, NEMO estimated replacement and repairs costs of BZ$19.6 million compared to ECLAC's replacement and repair estimates of BZ$27.7 million, plus an additional BZ$5.4 million to account for the damage to household furnishings. With respect to the other two main causes of ECLAC's higher direct damages, NEMO did not provide an estimate of the damage to the environment, while ECLAC estimated high structural damages to the transportation infrastructure (BZ$2.15 million) and NEMO did not.

The differences in the estimates for indirect losses were due to NEMO's significantly higher estimates of indirect losses to the agriculture sector, which outweighed the fact that NEMO did not provide estimates of indirect losses for most of the sectors reviewed. In the agricultural sector, NEMO produced higher estimates of indirect losses in the Corozal and Orange Walk districts.

The methodologies for these two approaches are quite similar, yet they yielded estimates that were significantly different. If we assume that a variance of more than 10 per cent is statistically significant, it can be argued that although the total estimates of damages and losses were not statistically significant, the individual estimates for each component were. For example, total direct damages varied by 22.5 per cent, while total indirect losses varied by 17.9 per cent. Furthermore, in the sub-categories, only the estimates of direct damages to the agriculture sector and indirect losses to the fisheries sector varied by less than 10 per cent (5 per cent and 3 per cent, respectively).

C. Comparing estimates of macroeconomic impacts

In the literature, there appear to be two main approaches to estimating the macroeconomic impacts of disasters. The first approach relies on estimates of direct losses, which are then used to generate the macroeconomic impact estimates; while the second observes the impact from changes in macroeconomic variables, such as inflation, external trade, fiscal indicators, etc.

Freeman et al (2004) is an example of the first approach. They use their estimates of direct losses as inputs into a macroeconomic model to determine the macroeconomic effects. The model used is the World Bank's Revised Minimum Standard Model (RMSM), which uses flow-of-funds accounting, which is then extended by a catastrophe module. It uses the direct loss estimates to identify reconstruction and emergency requirements and Monte Carlo simulations to adjust the RMSM depending on whether those funds are available. This approach is sensitive to the assumptions made about the country's ability to absorb the cost of the catastrophe.

The International Monetary Fund (IMF) typically uses the second approach, or a hybrid of the two approaches depending on the macroeconomic variable being estimated. In this section, we will compare ECLAC's macroeconomics assessments with the estimates that the IMF created in their first macroeconomic review after the disaster. These two estimates are comparable because while both methodologies utilise historical economic information – such as GDP, inflation, balance of payments information, etc. – they approach the estimation in different ways. The IMF depends on the financial programming model developed for the country to run scenarios on the potential macroeconomic impact. This model is based on statistical and econometric techniques and was not developed for the purpose of estimating disaster impacts. The main inputs are historical relationships and assumptions about how the damages would have affected these relationships. ECLAC's approach, on the other hand, uses their estimates of direct damages and indirect losses as inputs into their macroeconomic estimates, and their model has been developed specifically to estimate the losses from disasters.

Case Study 2: Hurricane Tomas in Saint Lucia, 2010

Hurricane Tomas passed south of Saint Lucia on 31 October 2010, killing seven people, injuring 36 people and resulting in another five people missing. Official estimates from national authorities suggest that 5,952 persons, or 3.5 per cent of the population, were severely affected. ECLAC estimates that the total cost of the damage and losses was US$ 336.2 million, including macroeconomic impacts. Hurricane Tomas was particularly damaging because the rainfall over the 24-hour period covering its passage was estimated to be a 1 in 180-year event. Prior to the passage of the hurricane, Saint Luciawas experiencing a drought and the severe rain resulted in landslides and flooding.

ECLAC produced its macro socioeconomic and environmental assessment in February 2011 at the request of the Government of Saint Lucia. ECLAC estimated that the total damage and loss caused by Hurricane Tomas was US$ 336.2 million, with 67 per cent representing damage to capital assets and stock. Furthermore, ECLAC concluded that the fact that it occurred late in the year would limit its impact on GDP for 2010, and that there should be limited carry-over to production in 2011 (mainly in the agriculture industry). The main reason for this conclusion is that though the agricultural sector was severely affected, the tourism sector, the other mainstay of the economy, suffered minimal damage.

In September 2011, the IMF issued a staff report on Saint Lucia's request for assistance under the IMF's Rapid Credit Facility and Emergency Natural Disaster Assistance. In the report, the IMF presents its estimates on how the economy was performing prior to the disaster and the economic impact of the hurricane, as well as their thoughts on the policy response and the ability of the country to repay the IMF if funding was approved. Given the timing of their report, the IMF would have had access to more detailed economic information than ECLAC, and may reflect official numbers in some cases (such as nominal fiscal accounts, number of tourist arrivals and tourism expenditure). Their estimates of the economic impact of the hurricane will be compared to ECLAC's estimates in this case study, and the discussion will focus only on those areas for which both teams provided estimates.

ECLAC estimated that real GDP would grow by 1.0 per cent in 2010 rather than the pre-hurricane estimate of 1.7 per cent . The IMF had a similar pre-hurricane estimate for real GDP growth, but was much more pessimistic about the fall-out, and anticipated that growth would slow to 0.5 per cent in 2010, mainly due to a significant slowdown in tourism sector activity and the negative impact that the severe damages to the road network, utilities and agricultural sector would have on overall economic activity.

According to ECLAC, the growth in value-added of the agriculture sector would decline by 32.3 per cent, significantly worse than the original forecast of -16.7 per cent, while the tourism sector was expected to grow by 8.0 per cent rather than the original projection of 12.9 per cent. The IMF, on the other hand, had a pre-hurricane forecast of -8.6 per cent growth in agriculture value-added, which they revised to -17.7 per cent after the hurricane. Despite the vastly different initial forecasts, both teams expected the decline in growth to roughly double in the aftermath of the disaster, and they based their expectations on the significant damage to the banana industry, which was severely affected by flooding and wind damage. ECLAC estimated that the losses to the tourism industry were mainly indirect losses due to loss of business and visitor expenditure, while the IMF mentioned damage to some of the hotels, though they did not expect this to affect tourist arrivals in 2011. For the impact on the agriculture sector, therefore, the estimates could be considered to be similar, while a numerical comparison of the impact on the tourism sector was not possible due to limited information on the sector from the IMF.

ECLAC estimated that the overall fiscal deficit would rise from 4.0 per cent of GDP in FY2009/10 to 4.6 per cent of GDP in FY 2010/11, and the primary deficit was expected to increase from 0.5 per cent of GDP in FY2009/10 to 1.1 per cent of GDP in FY2010/11. The IMF was much more pessimistic, and reduced their expectations for the overall fiscal deficit to 6.3 per cent of GDP in FY2010/11 and the primary deficit to 2.4 per cent of GDP. ECLAC estimated that the impact on total public debt was an increase of EC$116 million to bring the total public debt to GDP ratio to 75 per cent by the end of 2010, while the IMF estimated an increase in the total public debt from 74.4 per cent of GDP in FY2009/10 to a revised 78.8 per cent in FY2010/11 (their original FY2010/11 estimate was 79.1 per cent, so this revision reflected an improvement in their debt ratio) and an estimated 80.6 per cent of GDP in FY2011/12.

The main reasons for the difference in ECLAC's and the IMF's fiscal ratios are the differences in the GDP estimates and different views on the revenue and expenditure performances. Since the IMF was much more pessimistic about the reduction in economic activity, the GDP base used in their estimates is lower than ECLAC's, resulting in deteriorating fiscal ratios. Additionally, the IMF expected much larger variations in the revenue and expenditure outturns than ECLAC. As such, while they both estimated nominal overall fiscal deficits of EC$103.6 million in FY2009/10, ECLAC expected a deterioration to EC$124.8 million in FY2010/11 while the IMF expected a deterioration to EC$170.2 million in FY2010/11 (see table 2 below). This is a statistically significant variance of 36.4 per cent. The main drivers of the differences were vastly different estimates of Other Revenue and Grants and Capital Expenditure. The differences in the other revenue and expenditure estimates were not statistically significant since they fell below 10 per cent.

TABLE 2
COMPARISON OF ECLAC AND IMF FISCAL ESTIMATES OF IMPACT OF HURRICANE TOMAS
(Millions of Eastern Caribbean dollars)

	FY2009/10	FY2010/11		
		ECLAC	IMF	Difference
Total revenue and grants	809.1	854.0	907.7	53.7
Tax Revenue	702.8	737.9	746.8	8.9
Non-tax revenue	53.6	38.4	41.0	2.6
Other (incl. grants)	52.7	77.7	119.9	42.2
Total expenditure and grants	912.7	978.8	1,077.8	99.0
Current expenditure	671.1	722.6	735.5	12.9
Capital expenditure	241.6	256.2	342.3	86.1
Primary balance	-13.9	-30.3	-64.9	-34.6
Overall balance	-103.6	-124.6	-170.2	-45.6

Source: ECLAC, IMF (2011) and author's estimates.

ECLAC stated that prior to the hurricane, tax receipts had increased substantially and following the hurricane the government received 30.8 per cent additional grant receipts, so the expectation for the fiscal year was for continued growth of over 5 per cent. On the expenditure side, 6per cent growth in capital expenditure was expected to underpin a 7 per cent increase in total expenditure. While some of the EC$14.6 million increase in capital expenditure was related to recovery activities, the government had increased capital spending prior to the hurricane to improve the roads and other public infrastructure. The main impact of the hurricane on current expenditure was expected to be due to assistance and relief to affected citizens. ECLAC noted that this spending was expected to continue in 2011 but did not provide any estimates. The IMF did not provide as much information on their assumptions, but as we can see in table 3, they expected a much stronger increase in capital expenditure than ECLAC, and that is the main reason for their stronger expected deterioration in total expenditure.

Hurricane Tomas was expected to increase the current account deficit of the balance of payments from 18.3 per cent of GDP to 25.9 per cent of GDP (ECLAC estimate), due to deterioration in both the goods and services accounts. Although this is significant, ECLAC expected that the external current account would deteriorate even further in 2011 when the bulk of the rebuilding would take place. In contrast, the IMF expected the external current account deficit to improve from their original estimate2 of 21.2 per cent of GDP to 16.7 per cent of GDP, though this represents a widening deficit from their 2009 estimate of 14.4 per cent of GDP. The IMF expected higher rebuilding-related imports and lower exports of bananas in 2011, which would widen the deficit even further to 25.4 per cent of GDP. The historical figures used to generate the estimates are very different, though the sources appear to be similar,[3] and this may partially explain the differences in the estimates. Additionally, it seems that the while ECLAC expected some negative fallout in 2010, the IMF did not. The differences in the external account estimates, therefore, were also statistically significant.

[2] The original estimates of the IMF are those presented in the staff report and were taken from their Article IV report published in April 2010.

[3] Both state that they sourced their historical numbers from the Saint Luciaauthorities and the Eastern Caribbean Central Bank.

TABLE 3
SUMMARY OF MAIN DIFFERENCES BETWEEN ECLAC AND IMF ESTIMATES OF THE MACROECONOMIC IMPACT OF HURRICANE TOMAS

	ECLAC 2010			IMF 2010		
	Original	Post-Tomas	Diff.	Original	Post-Tomas	Diff.
Annual percentage change						
Real GDP	1.7	1.0	-0.7	1.7	0.5	-1.2
Agriculture value-added	-9.6	-17.7	-8.1	-8.6	-17.7	-9.1
Tourism value-added	12.9	8.0	-4.9	15.5	8.0	-7.5
In percent of GDP						
Primary fiscal deficit[a]	-0.5	-1.1	-0.6	-0.5	-2.4	-1.8
Overall fiscal deficit[b]	-4.0	-4.6	-0.6	-4.0	-6.3	-2.0
Public debt[1]	74.4	75.0	-0.6	74.4	78.8[2]	0.3
External current account deficit (Millions of United States dollars)	-18.3	-25.9	-7.6	-21.2	-16.7	4.4
Exports of goods and nonfactor services				51.0	58.6	7.6
Imports of goods and nonfactor services				-65.8	-70.7	-4.9
Overall external balance				0.3	-0.3	-0.6

Source: ECLAC, IMF (2011) and author's estimates.
[a] The FY2009/10 are presented as the original estimates.
[b] In FY2011/12 expected to rise to 80.7 per cent of GDP.

Case Study 3: Hurricane Ivan in Jamaica, 2004

Hurricane Ivan passed close to Jamaica on September 11, 2004 as a Category 4 hurricane, though its effects were felt from September 9, 2004 until September 12, 2004. The rainfall experienced during that time resulted in severe flooding, as many rivers burst their banks and landslides occurred. The island also experienced winds up to 340 km/h and storm waves and surge above 20 metres in some areas. Hurricane Ivan was directly responsible for 17 deaths and indirectly responsible for 14 deaths. It is estimated that 5,624 homes were completely destroyed, 46,971 were severely damaged and 8,836 experienced minor damage.

ECLAC was asked by the Government of Jamaica to work with the United Nations Development Programme and the Planning Institute of Jamaica to provide an assessment of the socioeconomic and environmental impact of Hurricane Ivan on Jamaica. In its October 2004 report, ECLAC estimated that Hurricane Ivan caused damage and loss equivalent to 8 per cent of Jamaica's current GDP in 2003 (US$ 580 million). Despite the extent of the damage and loss, ECLAC did not expect the hurricane to adversely affect the country's ability to achieve the macroeconomic targets it had set prior to the disaster, though there would be a decline in GDP growth.

The IMF published an Interim Staff Report Under Intensified Surveillance for Jamaica in February 2005, making this report the first IMF report since the passage of Hurricane Ivan. Similar to the previous Saint Lucia case, the IMF report was produced after the ECLAC report, implying that the IMF team would have had more up-to-date information than the ECLAC team.

Both the ECLAC and IMF reports point to a slower GDP growth in the wake of Hurricane Ivan, though the IMF reduced their projection by a slightly larger margin. ECLAC expected inflation to increase from 10 per cent to between 11 per cent and 12 per cent, while the IMF expected inflation to rise to 10.5 per cent. ECLAC's higher expected inflation rate was due to their projection of higher imports. Despite the increases expected due to the disaster, both teams note that inflation would still remain below the previous year's rate (16.8 per cent).

The IMF expected a much larger fiscal deterioration than ECLAC. The IMF anticipated that the primary balance would worsen from 13 per cent of GDP to 11.3 per cent of GDP, while the overall budgeted deficit would deteriorate from -3.5 per cent of GDP to -4.6 per cent of GDP. On the other hand, ECLAC expected that both ratios would worsen by roughly 0.5 per cent of GDP. The IMF estimated that hurricane-related expenditure and lower than expected indirect taxes contributed to the reduction in the primary surplus and that the deterioration in the overall balance would have been worse without the higher grants the country received. The public debt-to-GDP ratio remained stable despite the government taking over some of the domestic debt of the National Water Commission and the University of the West Indies because of faster growth in GDP relative to the growth in the nominal public debt.

It is difficult to compare the estimates of the external current account and its components because the IMF has included the impact of higher oil import prices and the explosion in the PetroJam refinery in October 2004. Therefore, even though the numbers incorporate the impact of Hurricane Ivan – higher imports of food, raw materials and capital goods as well as flat tourism receipts – it was not possible to isolate the hurricane impacts to compare them to the ECLAC estimates. This is possibly one of the main drawbacks of using IMF reports as estimates of disaster impacts, which is that the IMF would usually consider all macroeconomic developments and present a net figure unless explicitly stated otherwise.

The differences in the estimates are statistically significant for real GDP, the primary fiscal balance and the external current account balance.

TABLE 4
SUMMARY OF THE MAIN DIFFERENCES BETWEEN ECLAC AND IMF ESTIMATES OF THE MACROECONOMIC IMPACT OF HURRICANE IVAN

	ECLAC 2004			IMF 2005		
	Original	Post-Ivan	Diff.	Original[a]	Post-Ivan	Diff.
Annual percentage change						
Real GDP	2.6	1.9	-0.7	2.5	1.5	-1.0
Consumer prices, end of period	10.0	11.0[b]	1.0	9.9	10.5	0.6
In percent of GDP						
Primary fiscal balance, excluding grants	13.4	12.8	-0.6	13.0	11.3	-1.7
Overall budgeted fiscal balance	-3.8	-4.2	-0.4	-3.5	-4.6	-1.1
Public debt	136.0	n.a.	n.a.	136.4	136.6	0.2
Millions of United States dollars						*%*
External current account deficit	-722	-757	4.8	-1,178	-923	-21.6
Merchandise balance	-1,992	-2,103	9.4	-2,103	-2,129	1.2
Services balance	605	576	-4.9	542	520	-4.1
Other	664	769	15.9	383	687	79.4

Source: ECLAC, IMF (2005) and author's estimates.
[a] The IMF's original estimates reflect the targets from the Government of Jamaica's Medium-Term Program, which was determined jointly with the IMF.
[b] Mid-point of the range suggested by ECLAC (11 per cent – 12 per cent).

D. Comparing estimates of direct and indirect losses

In the literature, there are a number of methodologies used to estimate direct losses. Freeman et al (2004) estimate direct losses by calculating existing capital stock, then apply a loss frequency distribution to estimate the direct damages. To calculate the existing capital stock, they use three independent models: (1) World Bank's estimate of the previous year's output and capital-to-output ratios from the Penn World tables; (2) historical time series data on depreciated real gross fixed income investment (World Bank World Development Indicators); and, (3) data from third parties. The loss frequency distribution is derived from the results of scenario analyses conducted by the Swiss Reinsurance Company. On the other hand, unit loss models, like that developed by White (1964) and Kates (1965) and adopted by Parker and Penning-Roswell (1972) and Smith and Greenway (1988), involve conducting a property-by-property assessment of potential damage.

These approaches all consider the impact of the disaster to inform national recovery efforts. There are other approaches being used in insurance companies, for example, that may also be useful in estimating direct damages. For example, Guin and Saxena (2000) outline the methodology being used by Applied Insurance Research in the the United States of America to estimate the potential losses from earthquakes, tropical cyclones and extra-tropical cyclones. In estimating the probability of an event of a particular severity occurring, they mainly use parameterised and physical models to generate a catalogue of simulated events. They then estimate the potential damage to different types of structure based on their construction types and occupancy using various engineering methodologies, structural calculations and expert opinion.

Estimates of direct damages/losses are very sensitive to: (1) the assumptions underlying the models, such as the price of materials, and whether the estimate should cover returning the structure to its pre-disaster state or replacing it with a new structure; (2) the availability of the detailed data required for accurate estimates; and (3) the knowledge, skill and experience of the team conducting the assessment.

Estimating indirect losses is much more difficult and this is the area that is most contested in disaster assessments. Much of the criticisms raised in Chapter 2 of this study are really criticisms of the methodologies used to estimate indirect losses. This discussion is important because, unlike most direct damages, indirect losses are usually not covered by insurance and the costs must be borne by the government and the society at large. Furthermore, indirect losses typically are key drivers of the estimates of macroeconomic losses.

Case Study 4: Caribbean Catastrophe Risk Insurance Facility 2G Model

At the end of the 2010 hurricane season, CCRIF commissioned an assessment of the performance of their Second-generation Hazard and Loss Estimation Model (2G Model) and the Facility Loss Model (FLM) component (CCRIF, 2011). The goals of the assessment were to determine: (1) how closely the CCRIF wind footprints matched the National Hurricane Centre's (NHC's) H*WIND and other modelled footprints; (2) how well ground meteorological data fit with the CCRIF model wind footprints; (3) how closely the final losses generated by the model matched the government and independent estimates; and, (4) how the breakdown of impact costs affect what can be considered government losses. The analysis covered four events: Tropical Cyclone Earl, Tropical Cyclone Richard, Tropical Cyclone Tomas and Tropical Depression 16.

For Tropical Cyclone Earl, the report concluded that the model performed very well. The CCRIF model estimated total losses in Anguilla of approximately US$ 38 million. For Tropical Depression 16, the Jamaica Government estimated that the associated floods cost the government at least US$ 150 million, but it did not meet the minimum criteria for CCRIF to estimate losses. CCRIF was created to provide liquidity in the event of much larger catastrophes (such as hurricanes and earthquakes) and at that time CCRIF did not have an instrument to address damages and losses from severe rainfall alone. Tropical Cyclone Richard also did not trigger a payout from CCRIF, but their model's output (US$ 19.5 million) was lower than the Government of Belize's direct loss estimates

(US$ 25.2 million). For Tropical Cyclone Tomas, the impact on Barbados was officially estimated at US$ 17.7 million, while no official total estimates were available for Saint Lucia, Haiti and Saint Vincent and the Grenadines.

Case Study 5: Caribbean Catastrophe Risk Insurance Facility Estimates vs. ECLAC Estimates

Under the CCRIF, payouts in response to a natural event are triggered when the loss estimate excceds a predetermined level as established in the Hazard and Loss Modelling Framework. The CCRIF shared their estimates of all of the disasters that they have modelled since 2007, irrespective of if the estimate triggered a payout. As such, it includes many of the disasters for which ECLAC provided DaLAs. Unfortunately, the estimates obtained were not broken down into categories, so only total estimates can be considered. It should also be noted that these assessments are for direct damages and do not include indirect losses, and will therefore be compared to only the direct damages estimates prepared by ECLAC.

As noted in table 5, ECLAC's estimates of direct damages are consistently and substantially higher than those prepared by CCRIF. The main reason for the differences in the estimates appears to be the absence in the CCRIF model of damage estimates for rainfall for the disasters noted. The hurricane model estimates damages caused by wind, wave and storm surge in coastal areas. If the hurricane also resulted in heavy rainfall and flooding, the damages from these effects are not included. In 2010, CCRIF switched to its second-generation parametric model, which allows CCRIF to estimate damages across the entire country, rather than at distinct points as done in the previous model. In an effort to address the absence of estimates of damages from rainfall, in 2013 CCRIF introduced an excess rainfall product to estimate the impact of rainfall disasters.

Another important difference is the how the estimates are developed. CCRIF estimates damages by simulating the expected damage to the structure based on the vulnerability of its physical characteristics (type of walls, type of roof, distance from the sea, etc.) to the type of disaster (wind, storm surge, etc.). As such, it is not based on the actual damage incurred. On the other hand, ECLAC's methodology requires on the ground assessments of the damage incurred, and includes any destruction that resulted from the disaster, irrespective of which feature of the disaster caused the damage.

TABLE 5
COMPARISON OF DIRECT DAMAGES ESTIMATES PREPARED BY CCRIF AND ECLAC
(Millions of United States dollars)

Disaster	Country	ECLAC	CCRIF	Difference
Hurricane Paloma, 2008	Cayman Islands	149.4	25.7	123.7
Hurricane Ike, 2008	Turks and Caicos Islands	119.5	51.2	68.3
Hurricane Tomas, 2010	Saint Lucia	225.2	7.7	217.5
	Saint Vincent and the Grenadines	37.8	3.9	33.9
Earthquake, 2010	Haiti	4,302.0	171.2	4,130.8

Source: ECLAC reports, CCRIF and author's estimates.

E. Conclusions

The preceding case studies have highlighted a number of areas that must be borne in mind when attempting to compare ECLAC's estimates of the damage and losses caused by disaster:

(i) Only Post-Disaster Needs Assessments (PDNA) present similar information to what is provided in ECLAC DaLA reports. PDNAs are less popular in the region, however, though it is generally accepted that they produce better estimates of the societal impacts of the disaster.

(ii) IMF estimates of the macroeconomic impacts of disasters are not always comparable to ECLAC’s macroeconomic impact estimates due to timing differences and the fact that the IMF may take into consideration other, non-disaster influences on the estimates that ECLAC may not.

(iii) The IMF typically only produces reports on member countries, which excludes some of the countries for which ECLAC would provide disaster assessments, such as Cayman Islands and the Turks and Caicos Islands.

(iv) CCRIF’s 2G Model has similar emphases as the ECLAC model, which makes it a good model to compare. Unfortunately, CCRIF estimates do not yet include the effects of rainfall since their excess rainfall product was only introduced in 2013.

The preceding analysis compared the output of the various models used to estimate damage and loss from disasters in the Caribbean since the authors could not access the underlying assumptions and specific methodologies (especially in the case of macroeconomic models). As a result, it was difficult to point to the underlying reasons for the differences and to determine which model may have produced superior results for a specific case. This is an important weakness of the study, since the absence of this type of assessment hinders ECLAC’s ability to potentially improve its methodologies and overall approach. A follow up study focusing solely on methodologies should therefore be considered. This type of study would require the support of all institutions that model the impact of disasters in the region, as it would require access to potentially confidential details on assumptions and methodologies.

IV. Insurance coverage in the Caribbean

A. Background

While risk mitigation is a popular theme in the disaster literature, there are few studies that examine insurance coverage and its effects on recovery efforts. One of the contributing factors may be the difficulty in accessing data on insurance coverage for catastrophe risk from insurance companies. Unfortunately, data on insurance coverage in the Caribbean are almost non-existent. This makes it very difficult to assess whether the existing coverage is adequate. The two main studies on catastrophe insurance coverage in the Caribbean are quite dated (the most recent was done in 2003). Nonetheless, many of the observations and findings noted in these studies may still be relevant today and are discussed below.

Auffret (2003) provides a good overview of the catastrophe insurance market in the Caribbean and this study will form the basis of this section. Before discussing the insurance coverage in the region, it is useful to first examine the risk. Auffret (2003) defines risk management as ‘reducing risk to an acceptable level and coping with the consequences of risk once it materialises’ (pp 5) and further explains that there are two types of risk management activities: risk reduction activities and risk coping activities. Risk reduction activities include risk identification, mitigation and preparedness, while risk coping activities attempt to limit the negative consequences of disasters once they have occurred. Insurance is therefore a type of risk coping activity. Households and small/medium-sized companies typically access traditional insurance in the event of a natural disaster, while governments, reinsurers and large companies may be able to also use catastrophe bonds and liquidity funds like the CCRIF.

In reviewing the insurance market for catastrophic risk in the Caribbean, Auffret (2003) noted that catastrophic risk is usually included in non-life insurance aimed at households (specifically property; marine, aviation and transport; motor vehicle; and, pecuniary loss) and is grouped with other potential sources of loss such as fire, explosion, riots and accidents. The study estimates that ‘about 45 percent of non-life premiums corresponds to insurance against natural hazards … (though) most Caribbean insurance companies do not routinely split the catastrophe elements of their premiums’ (pp. 9). In the case of reinsurance companies, Auffret states that ‘on average about 25 percent of premiums in the property class correspond to insurance against earthquake, 20 percent against hurricanes and the remaining 55 percent against other perils including fire’ (pp. 9).

Auffret's study also found that the prices of catastrophe insurance in the Caribbean are high, given that premiums are estimated at 1.5 per cent of GDP while average annual losses (insured and uninsured) represent approximately 0.5 per cent of GDP for the 1970 – 1999 period. If the prices were 'fair' premiums and average annual losses would be equal. The study posits that there may be eleven reasons for high prices and low quantities of risk transfer. Six of these reasons may be relevant in the Caribbean case and are explained below.

First, Auffret suggests that risk identification and forecasting may not be sufficiently developed in the Caribbean due to lack of appropriate technology, underdeveloped disaster research and prevention institutions, and limited research. This results in reinsurers using premiums that are close to those applied in developed countries, with premiums in the Caribbean reflecting losses experienced in other parts of the world rather than just in the Caribbean. Since the Auffret study was conducted, the Caribbean Catastrophe Risk Insurance Facility was created to provide rapid liquidity to governments whose countries were negatively impacted by a disaster. Importantly, it should be noted that since CCRIF allows regional governements the opportunity to pool catastrophic risks, it is able to provide insurance at lower cost than would have been available to individual governments.

Second, insurers do not discriminate by zone of risk or the implementation of risk reduction measures, which amplifies adverse selection and moral hazard. Third, the demand for catastrophe insurance is low due to the infrequent nature of severe disasters. Fourth, land-use regulations and building codes either do not exist or are not enforced. Fifth, although the insurance regulation in the Caribbean is seen as adequate, the limits on investments in foreign financial markets leads to lower profits in the Caribbean, which in turn encourages insurance companies to set higher prices than otherwise would be required. Finally, the provision of international aid after a disaster acts as a disincentive to obtain private insurance because there is the belief that the government and international organisations will help those impacted by the disaster.

OAS (1996) argued that Caribbean insurance companies do not have sufficient motivation to lower premiums. Caribbean insurance companies are able to access the global reinsurance markets, where companies have longer and broader expertise and are willing to shoulder the majority of the catastrophe risk. As such, Caribbean companies are only exposed to 15 per cent of the catastrophe and the reinsurer covers the remaining 85 per cent. Since the reinsurers cover the bulk of the risk, they are able to design and impose policy coverage restrictions which the regional companies then pass on to their customers. As Auffret (2003) noted, these global reinsurers do not create Caribbean-specific prices and the product available to Caribbean markets is based on the worldwide catastrophe experience.

B. Government and essential services

Government assets and essential services are probably the two areas that receive the highest priority in disaster recovery. Despite their importance to the country's recovery efforts, many governments do not insure their physical assets. OAS (1996) found that: 'For the most part, government physical assets such as buildings, schools, libraries, roads, and some hospitals appear to be underinsured or uninsured. Exceptions include Barbados and the (then) government-owned Insurance Corporation of Barbados responsible for insurance of public assets. Additional exceptions are thought to include properties owned by statutory corporations such as port and airport authorities, as well as utility companies that have independent access to the insurance markets'. Auffret (2003) queried whether this practice may not be the best approach. The study argued that securing a line of credit prior to the disaster could be more cost effective than paying 'high' insurance premiums. Furthermore, insurance potentially creates a moral hazard risk, i.e. the risk that the insured undertakes activities with even greater risk because they are insured.

Insurance for essential services appears to depend on whether the utility company is independent of the government. Where the company is government-managed, the risks remain similar to the preceding discussion on government assets. When the company is independent of government, there appears to be a greater likelihood that there may be catastrophe insurance. OAS (1996) noted that 'individual utility companies are examining ways in which they themselves can reduce insurance costs and/or increase available coverage levels' (paragraph 47).

C. Productive industries

Private companies in the tourism sector typically seek their own catastrophe insurance. In an attempt to assist its members to reduce the cost of insurance, OAS (1996) reported that the Caribbean Hotel Association (CHA) hired a U.S.-based risk management firm to assess the risk of windstorms to its approximately 1,000 members and determine if there was a way to reduce the cost of insurance. The company found that there was sufficient risk diversification to develop a regional insurance company for CHA properties, which they subsequently created and managed in Bermuda. Though the company's clients are exclusively CHA members,[4] CHA members are not obligated to seek insurance from the company and can shop around. It should also be noted that neither CHA nor its members own the company. This approach appears to be attractive not only for customers, but also for international institutional investors, portfolio managers and venture capitalists, all of which participated in the firm. Furthermore, the company was able to secure multi-year reinsurance support from the global reinsurance community.

In the agriculture sector, the banana growers in the Eastern Caribbean can access Windward Island Crop Insurance Ltd. (WINCROP). WINCROP provides insurance against damage from windstorms and volcanic eruptions, and by 2007 insured 63 per cent of all banana growers in Dominica, Saint Vincent and the Grenadines and Grenada. Due to the losses in the sector and a smaller population of growers, the premium income of WINCROP has declined. In Jamaica, on the other hand, the coffee insurance scheme offered by the Coffee Industry Board was discontinued in 2006, though efforts are underway to establish wind-index based insurance. The experiences of the tourism and agriculture industries suggest that sector-specific insurance schemes could be successful in the region.

Over the past two years, CCRIF has also partnered with the Munich Climate Insurance Initiative (MCII), to provide a Livelihood Production Policy (LPP) for coverage of vulnerable low-income individuals by providing simplified cash payouts following extreme weather events. A similar product – the Loan Portfolio Cover (LPC) - is also provided for portfolio level protection against weather related loan default for small lending institutions. These products have so far been implemented in Jamaica, Saint Lucia and Grenada since 2013.

D. Homeowners

Statistics on homeowner catastrophe insurance are not available, and the OAS (1996) report stated that 'it is recognised that most homeowners, except perhaps in Barbados, do not carry insurance except when required to do so by lending institutions' (paragraph 45). Auffret (2003) reported a similar finding: to secure mortgage financing, most property owners are required to obtain catastrophe insurance. This is only applicable however to persons who access the formal mortgage market and thus omits the poor. Additionally, both studies found that underinsurance is also a problem. Both of these issues appear to be because insurance premiums are beyond the financial reach of many homeowners in the Caribbean. This results in a small proportion of disaster losses being effectively insured in the event of a disaster. Auffret (2003) estimates that between 1985 and 1999 only 3.8 per cent of damages from natural hazards in Latin America and the Caribbean were insured. The 2012

[4] However, it can seek other clients.

Financial Stability Report issued by the Bank of Jamaica confirms that in Jamaica, gross non-life premiums as a percentage of GDP only represented 2.3 per cent of GDP in 2012. In a workshop held February 25 - 26, 2014, a representative from the Caribbean Catastrophe Risk Insurance Facility noted that they were working on a parametric insurance product aimed at low income individuals and small farmers. This type of facility would assist the most vulnerable in the society to recover from disasters.

E. Conclusions

Lack of data prevents detailed assessment of whether the insurance coverage in the Caribbean is adequate, but the preceding discussion suggests that it may not be sufficient. Despite this observation, comparing the level of insurance coverage with the damage estimates is potentially misleading. As noted by Cochrane (2004), ‘insurance companies only have an interest in insured loss’ (pp. 291) and not the economic losses and secondary effects that are usually accounted for in damage assessments.

V. Challenges affecting recovery activities and possible solutions

This section provides a summary of the main challenges affecting recovery activities that were raised by participants of the OECS Lessons Learned Seminar: UN-ECLAC/SIDS Methodology for Damage & Loss Assessments, which took place in April 2011, and the Evaluation of ECLAC Post-Disaster Assessments in the Caribbean workshop held on February 24-25, 2014.

A. Background

The main concern raised was inadequate data to determine the baseline as well as to form the basis of the damage and loss estimates. Participants were concerned that often the data required to conduct the assessment as recommended by the DaLA manual were either non-existent, dated, incorrectly formatted, improperly managed or potentially inaccurate. Furthermore, even where the data existed, sometimes there were challenges accessing it due to institutional tensions. In preparing the disaster assessments, there were often data gaps that limited the analysis. Moreover, these gaps often were in existence at the time of the last disaster assessment and were not closed. One of the reasons noted for this problem is that often the persons submitting the data are unaware of how the data fit into the final report and do not see the final report. As such, they are unaware of the gaps and do not put mechanisms in place to address them. It was recommended that where data gaps were discovered, they were noted and shared as part of the final report so mechanisms could be put in place to rectify the problem. Additionally, efforts should be made to always have a baseline estimate of the value of all of the sectors covered in the report. For example, regardless of if there is a disaster, teams should be consistently updating the data needed for the disaster assessment and should therefore be able to quickly generate a baseline estimate of the situation that prevailed immediately preceding the disaster.

B. Under-developed capacity

The level of capacity development embodies a number of weaknesses in the Caribbean institutional framework around disaster management. First, the pool of local technical resources is small and not always trained in disaster assessments. This contributes to the uncertainty that most local teams feel on how to proceed with the assessment. This then results in them playing a secondary role to the international team when they arrive on scene and losing credibility internationally. One possible explanation for this weakness is similar to one noted in the previous section: often the local teams do not see the final report prepared by ECLAC. They are therefore unaware of the gaps in the report and are unable to close them. ECLAC has in the past provided training to local teams as part of its DaLA assessments, as well as at least annual training workshops to help build capacity. However this does not appear to be sufficient and the human capacity challenges are made worse by the high turnover rate of personnel trained at the national disaster response agencies. Another challenge is that the necessary institutional arrangements are not always in place to support a speedy, accurate assessment. Often, there is lack of ownership of the process and it is unclear which ministry/department is responsible for which areas of the assessment, which may also explain why the international team takes over. Without the necessary institutional framework, there may be uncertainty around whether sensitive data may be shared with the team and who signs off on the assessment.

C. Concerns about assessment valuations

While the DaLA was praised for its comprehensiveness, there were concerns about some of the valuation approaches. The estimate of environmental losses was considered to be incomplete, especially in the case of forestry resources, where the DaLA recommends estimating losses using the market value of timber and ignored the importance of the forests for eco-tourism and the provision of other eco-system services. ECLAC noted that there is a risk of double counting when assessing environmental losses because the environment feeds into many different sectors. Nonetheless, they are revising their methodology to address this weakness and would like to work with more skilled national experts to conduct the environmental assessments.

The valuation of housing losses was also considered to be incomplete because it did not take into account the loss of collateral – many homeowners use their mortgage as collateral to back loans for other areas of their lives – and the loss of secondary income for those homeowners that operate an informal business from their homes (such as growing produce for sale in a local market, making crafts, offering personal services, etc.). The DaLA does not provide estimates of the cost of looting post-disaster, which could potentially affect a larger proportion of the population than would be identified in the DaLA. Generally when estimating the cost of replacing a damaged building, it was recommended that two estimates be presented: one for replacing the building on the existing site and another for relocating the building to a less vulnerable location.

In the case of the macroeconomic assessments, timing differences could have significant implications for the final value of the impact of the disaster. For example, a disaster that occurs before the start of the tourism season could have a significantly larger impact than one that occurs at the end of the season.

The psychological impacts of the disasters are not accounted for in the ECLAC methodology but could potentially have tangible effects. For example, one participant at one of the workshops noted that following a disaster the student performance at one rural school declined dramatically. The social impacts could also be underestimated. For example, there was a decline in the number of persons accessing health care following a disaster due to damage to their local health facility and the unwillingness to travel long distances to other facilities.

D. Non-implementation of DaLA recommendations

All of the DaLA recommendations are not implemented in the recovery phase mainly due to lack of political will, the feasibility of the recommendations and the lack of an appropriate recovery framework. Lack of political is usually raised as a concern when allocating resources, and post-disaster recovery is no different. One participant gave the example of the DaLA recommending moving a public hospital that was located in a vulnerable area, yet months later the government approved spending to repair the hospital rather than relocate it. This example could also demonstrate that some of the recommendations may not feasible. There may not have been another suitable location for the hospital, or it may not be cost effective. Finally, because there is no recovery framework, recovery teams often complete the tasks that are easiest rather than the ones that are most critical. This practice comes with the risk of some tasks not being completed at all, and is related to lack of sufficient capacity.

The non-implementation of DaLA recommendations could result in donors being unwilling to provide aid in the event of a subsequent disaster because the country does not appear to be making an effort to become more sustainable, especially when the same areas of the country are affected. To ensure that the recommendations are feasible and, where possible, implemented, there should be greater coordination between the donors, the Ministry of Finance and the national disaster agencies. This may reduce the likelihood of political interference in the recovery process as well as ensure that the donors and the government are in agreement with the recovery priorities.

E. Challenges determining priorities post-disaster

The structure of the DaLA does not lend itself to identifying priorities. There is no executive summary, and each section appears to have equal weight. For disaster management professionals, this presents a challenge when advising policymakers on what actions to take first. This challenge does not appear to refer to the immediate post-disaster period, when the priority is preserving human life, but rather to the months following the disaster when the government has to request long-term financial assistance and develop a long-term recovery plan.

F. Absence of a final disaster impact assessment

Finally, one of the most significant challenges – which also presented a challenge when developing this report – is the absence of a final assessment of the impact of the disaster. The aim of the ECLAC DaLA is to provide a rapid assessment of the impact of the disaster and, as such, it is generally conducted within one month of the disaster. At that time, however, all of the impacts are not yet known. For example, the impact on some trees and crops may not be evident for many months after the ECLAC DaLA has been completed. The initial ECLAC study often then becomes the only assessment of the damage done by the disaster. In addition to potentially missing some of the impacts, it also makes it very difficult to reconcile the expenditure of the government with the recovery efforts and to estimate the long-term impact of the disaster. Unfortunately, after the initial assessment has been completed, there is a higher risk of lack of demand and buy in for an updated report. A possible solution would be to consider a phased approach to disaster assessment, where there would be a number of reports (for example, an initial report, an updated report and a final report) that would be produced over a number of years.

G. Other challenges

Conducting a disaster assessment is often very challenging for the local team following a disaster because the capital and labour resources may not be available and there is limited use of technology such as hazard maps and early warning systems. Not only should the use of technology be improved, but the data should be substantially improved so that fewer resources are required to estimate the impact post-disaster.

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