



Vulnerability of Economies to Climate Change: The Case of London

Policy summary

A variant of the Adaptive Regional Input-Output model has been developed to explore the vulnerability of the London economy to climate related damage. The model uses an Event Accounting Matrix (EAM) to specify initial damage following extreme weather, and then follows this damage through direct and indirect losses in the economy. Results show that indirect losses are a significant component of total losses, with a multiplier of between 1.3 and 2 depending on the scale of initial damage.

The Setting

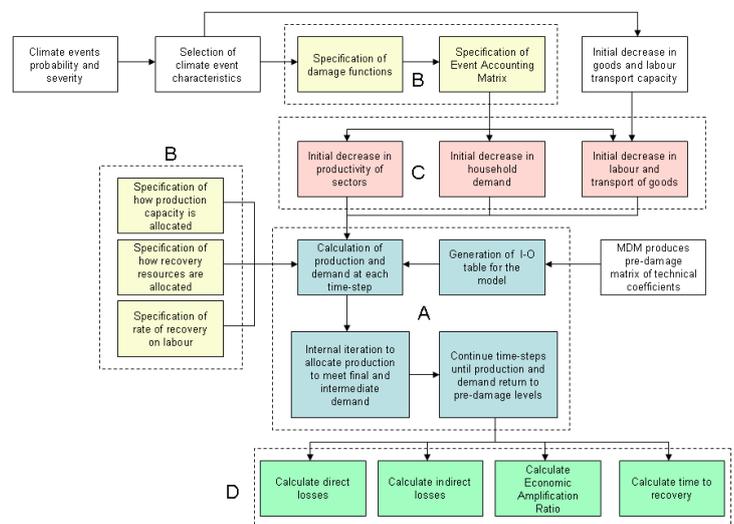
Assessments of the impacts of climate change on cities have traditionally focused on the initial damage from extreme weather and on the costs of lost assets, declines in service, changes in public health, etc. These initial estimates are useful in understanding the short-term implications of damage, and in marshalling the pools of capital and supplies required for re-building after an event, including via insurance claims.

Since economies are coupled, in the sense that changes in production and consumption in one sector of the economy have follow-on effects throughout the other sectors, this initial damage may be multiplied throughout the economy. The multiplier is usually found to be greater than 1, meaning the total economic impact on measures such as GDP, per capita GDP, or GDP growth is larger than the initial damage estimate.

The ARCADIA (Adaptation and Resilience in Cities: Analysis and Decision-Making using Integrated Assessment) project was developed to assess the impact of extreme weather events on assets, infrastructure and health in UK cities, assess the vulnerability of local economies to these impacts, and help decision makers identify where limited adaptation and recovery resources might be directed to reduce these vulnerabilities most effectively. The coupled modelling suite (i) downscales global and regional climate change to changes in weather in London (as the initial case study); (ii) provides probabilistic estimates of the magnitude of extreme weather events (primarily heatwaves, rainfall and droughts); (iii) estimates initial damage caused by these events to buildings, infrastructure, transport, production capacity and health; (iv) summarises these in damage functions that reflect direct losses; and (v) uses these damage functions as input to a macroeconomic model of London's economy to estimate the macroeconomic multiplier. This Briefing Paper focuses on step (v) only.

The Briefing Papers series by 4CMR provides policy makers, organisations, communities and citizens with advanced research on the roles of economic, energy and environmental strategies for reducing the risk of climate change.

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The flow of calculations in the macroeconomic modelling of ARCADIA. The boxes in colour are those produced as part of the economic analysis.

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The Solution

The macroeconomic analysis of ARCADIA uses an Adaptive Regional Input-Output model (ARCADIA-ARIO) of London's economy, with parameter values for the model taken from the MDM (UK Multi-Sectoral Dynamic Model). ARCADIA-ARIO is used to explore the vulnerability of the London economy to climate change related damage. The model uses an Event Accounting Matrix (EAM) produced by climate and engineering teams within the ARCADIA project to specify a range of initial damage scenarios, and then follows this damage through direct and indirect losses in the economy. Outputs from the model are used to assess the relative vulnerability of London's economy to these scenarios in each of 42 economic sectors, for purposes of identifying where to allocate resources to climate change adaptation strategies or to recovery operations. Measures of impact related to GDP loss, recovery time and the ratio of indirect to direct losses are developed for these scenarios.

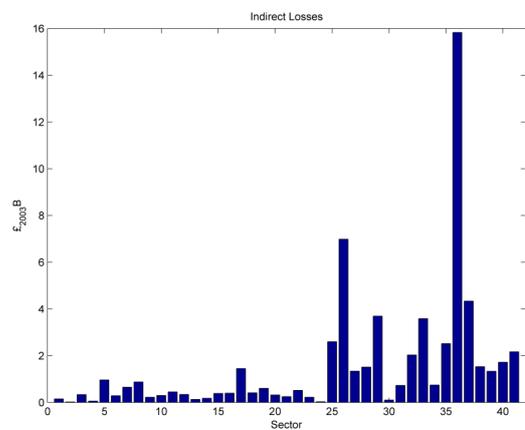
The Results

Results show that indirect losses are a significant component of total losses, with a multiplier of between 1.3 and 2 depending on the scale of initial damage. Economic Sectors 26 (Distribution) and 36 (Professional Services) dominate with respect to vulnerability of the London economy, with sector 29 (Land Transport) also being significant, as might be expected due to impacts on Distribution and Labour. The analysis of Recovery Period

(length of time for production of the economy to return to pre-damage conditions) shows the same three sectors dominating the resilience of the economy; additionally sectors 3 (Oil and Gas), 37 (Other Business Services) and 38 (Public Administration and Defence) play significant roles in the time required for production and demand to return to pre-disaster conditions.

Conclusion

In regard to reduced vulnerability, adaptation strategies that either reduce the damage inflicted on sectors 26 or 36, or that improve recovery in those sectors, will reduce the vulnerability of London's economy most effectively, with sectors 29, 3, 37 and 38 being important as well. These findings are consistent with London having a strong services economy, including financial services, and being the seat of national government.



The relative vulnerability of London's economy to the same amount of damage induced in each of the 42 sectors, one at a time.

The Cambridge Centre for Climate Change Mitigation Research (4CMR) studies the interconnected economic, energy and environmental policies at the heart of climate change policy.

This Briefing Paper was developed from research by Doug Crawford-Brown, Mark Syddall and Jun Li of 4CMR, and Dabo Guan of University of Leeds. The ARCADIA project is led through the Environmental Change Institute at the University of Oxford.



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