On input-output economic models in disaster impact assessment

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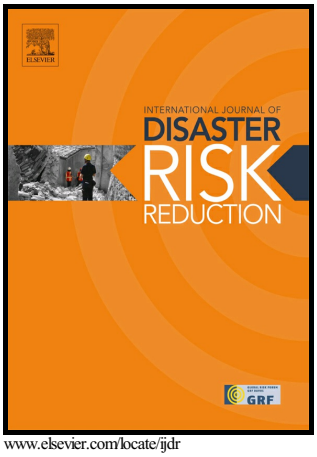

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Abstract

During the last decades, input-output (I/O) economic models have assumed a prominent role in disaster impact analysis and resilience assessment. Rooted in general equilibrium theory and economic production theory, they catalyze attention on the distinction between direct economic losses and ripple effects that may be generate inside a multi-industry system as a consequence of perturbations. Empowering the I/O analysis framework and overcoming some of its inherent limitations is crucial in order to successfully approach emerging disaster assessment challenges, such as multi-regional loss quantification and the investigation of shock responses in global supply chains. In this paper, we discuss how different disaster modeling aspects have been incorporated in recent contributions exploiting I/O techniques, taking into account both demand- and supply-sided perturbation triggers, static and dynamic representations, as well as the assessment of economic resilience.

Keywords: input-output economic models, disasters, cascading effects, economic resilience

1. Introduction

In [1], disaster has been defined as the set of "consequences of a natural or man made hazard". Considering the multi-faceted nature of primary triggers and outcomes encompassed by this definition, today one of the core research areas in disaster analysis is related to the assessment of resulting spillover effects in complex systems and societies. A critical review of the nature of cascading disasters and their fallouts was proposed in [2], pointing out factors of interest such as "interdependencies, vulnerability, amplification, secondary disasters and critical infrastructure". [3] introduces a magnitude scale for classifying incidents, disasters and catastrophic events. Dominoes are sometimes subtle to forecast and unexpected in magnitude and extent, when compared with causing factors. This is also the case as far as economic losses associated to disasters are concerned. In this domain, a quantitatively precise evaluation of indirect losses remains a challenge so far, considering the complexity of many economic environments, the diverse nature of disaster contingencies, data constraints (e.g. information availability, accuracy, resolution) and restrictions intrinsic to the analytic tools in use, which are often tailored to specific hazard types, geographical areas and/or historical moments.

In spite of that, economic theory has an ancient interest in the discipline of disaster impact assessment [4] and a number of principles have been determined towards sound economic loss estimation [5, 6, 7, 8, 9, 10], whereas many aspects remain open for debate and further inquiry. For instance, [11] observes how the very way of counting economic losses over time has been addressed quite variably in the literature. Clearly, different analysis frameworks can be more or less adequate to assess disaster consequences at the micro-, meso-, and macroeconomic scale. At the same time, objectives in their application can include both an ex post loss assessment and an ex ante risk evaluation, which in turn modulates the validity and effectiveness of specific techniques.

Three dominant classes of economic models are mentioned in [12] and a handful of other references towards disaster loss analysis: simultaneous equation econometric models; input-output (I/O) models; computable general equilibrium (CGE) models. These families of methods are gaining interest in time as within modern, strongly intertwined economies, indirect losses may outclass direct ones. Analyses and evidences about this aspect have been recently provided for a series of highly-disruptive events in terms of disaster impact multipliers, see for instance [13, 14] for discussion. An extended body of literature deals with comparative advantages and disadvantages of the three above-mentioned approaches in the context of disaster analysis [15, 7]. Also, reference [16] adds to the comparison Social Accounting Matrix (SAM) methods, while [11] considers cost-benefit analysis.

Many recent contributions primarily focus on I/O and CGE techniques, which [17] qualifies as "the most commonly used and well-documented approaches in disaster impact analysis". On one side, I/O models offer linearity as