Economic Impact Analysis Capability

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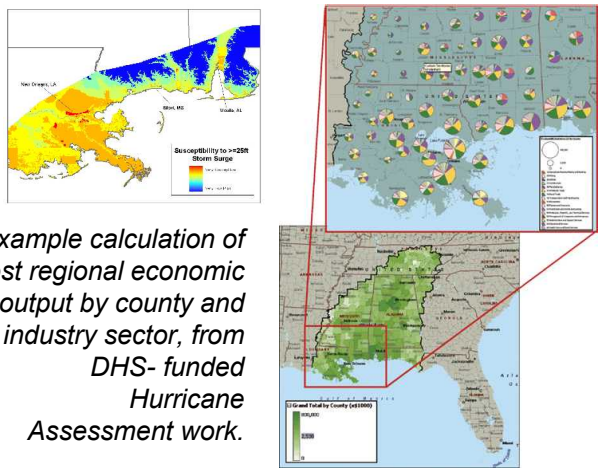
Introduction

Commercial nuclear power reactor events leading to release of radioactive materials could result in significant economic losses. Due to internal and significant investments from the Department of Homeland Security, Sandia National Laboratories has substantial experience developing estimates of the economic impact for similarly catastrophic events (Radiological Dispersion Devices, Toxic Inhalation Hazard chemical releases, and hurricanes). This overview of the three main approaches used in current state-of-the-art economic modeling tools highlights their applicability to such events.



Example calculation of lost regional economic output by county and industry sector, from DHS- funded Hurricane Assessment work.

Input-output (IO) Models

A widely-used technique that captures the engineering/economic interrelationships characteristic of an industrialized economy is the input-output (IO) model. An industry's output may be an intermediate input to several other industries and/or a good sold for its final consumption purpose. These inter-industry relationships constitute the "production function" of the economy. Current IO models represent this production function as a matrix of supply relationships at the level of up to almost 500 industries. Some such models also have geographic detail down to the level of over 3,000 counties that comprise the US map. IO models have been used for many homeland security type economic modeling exercises.

Three Mile Island Nuclear Generating Station

Extensions of the basic framework have been developed, among the most practical of which is the use of an IO core to represent the economy's production function inside a shell that permits capital and labor to respond to regional differences in wages and interest rates making the model dynamic and responsive. These models are supply oriented in that they show in detail how final demand for goods and services is satisfied by the economy's production function.

Computable General Equilibrium Models

Computable general equilibrium (CGE) models tend to be more aggregate and focus on price adjustments and market dynamics more than on the economy's production function as with IO models. They are more complete in the sense that they allow demand and supply to endogenously determine prices. These models are evolving and becoming more detailed both in their industry and geographic detail. CGE models also have a stronger basis in economic theory, and are more complicated. CGE is based on essentially the same data structure as IO models, with an additional household component. Unconstrained by a linear structure, CGE models often use nonlinear functions for production and household utility.

Econometric Forecasting Models

Econometric forecasting models can be national in scope but can be and often are disaggregated to regions. These are often very useful tools to understand short-term dynamics because they can readily accommodate existing market conditions

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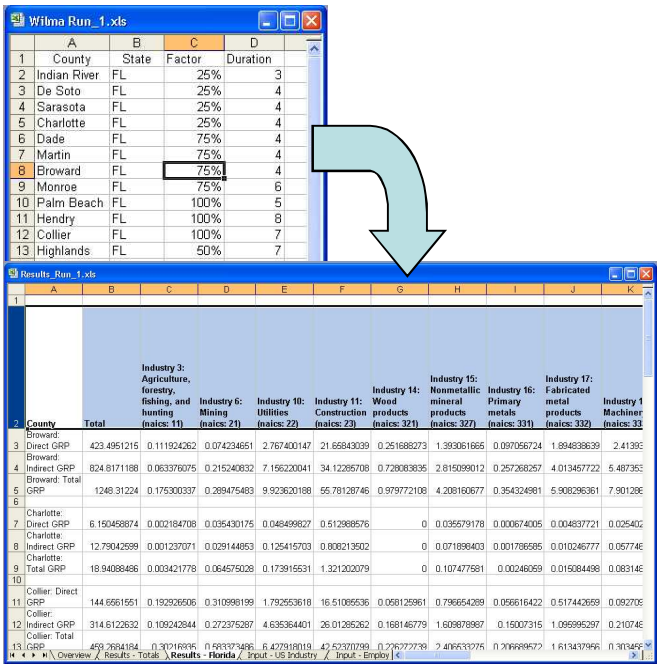
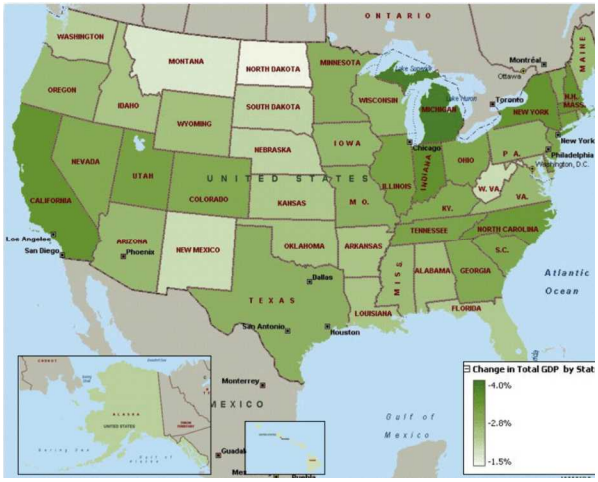
that are represented in the data. For example, econometric models of the national economy typically employ a quarterly time dimension. The use of real data to estimate the model's parameters and variable values is an advantage; this advantage comes at a cost, however, in that data availability and maintenance can present problems.

Estimating the Economic Impacts

At Sandia, these approaches are used regularly in several existing models that span the range from micro- to macroeconomics. The models germane to estimating the economic impact of a nuclear release include the commercial-off-the-shelf (COTS) REMI (Regional Economic Models, Inc.) software— a state-level dynamic IO-type model, IMPLAN (Institute for Minnesota Planning) software— a pure county-level IO COTS model, and the Sandia-developed REAcct (Regional Economic Accounting) software used for short-term, order of magnitude impact analysis.



Sandia's REAcct Software reads from and writes to spreadsheets to facilitate further economic analysis. REAcct calculates the direct and indirect impacts, by county and economic sector, for non-structural impacts to the economy.



REMI combines IO and CGE approaches in calculating state-level impacts.

Summary

As this short overview indicates, economic tools, and their methodological approaches, range in complexity and serve slightly different purposes. Sandia has the skilled economists, a range of COTS and in-house specialized tools, and the demonstrable operational expertise necessary to apply the right tool for difficult nuclear-related cascading consequence and restoration questions.

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