

## **Expansion, Testing, Application of the National Interstate Economic Model (NIEMO)**

**Peter Gordon, James Moore, Harry Richardson, University of Southern California**

**pgordon@usc.edu, jmoore@usc.edu, hrichard@usc.edu**

The purpose of this research is to expand and expand and test the capabilities of the National Interstate Economic Model (NIEMO). We will also use it to estimate the economic impacts of new scenarios.

Brief Description - The NIEMO model has been applied to the study of state-by-state economic impacts (for 47 industrial sectors) of various shocks to the economy, including hypothetical terrorist attacks and natural disasters. In recent work, we have elaborated NIEMO in two directions. We have had some success placing the portion of interstate trade that uses trucks onto the nation's highway network (TransNIEMO). We have also considered dynamic applications (FlexNIEMO) that can be used to estimate the economic impacts if the 9/11 attack.

NIEMO's uniqueness is that it makes explicit the two-way commodity trade between all of the 50 states (and the District of Columbia) by major industrial sector. We have modeled the allocation of truck-borne freight to the highway network and have had some success with a regional subset of the nation's network links. Algorithms that can efficiently handle the national network have yet to be developed and tested. However, this is certainly within the grasp of current theory.

Specifically, we will address various aspects of our modeling project, as follows:

- We have begun econometric work to measure the economic impacts of the 9/11 attacks. We will use these results to test FlexNIEMO and assess economic resilience. The market economy is expected to soften impacts via the discovery of efficient substitutions. Developing procedures whereby standard linear input-output models can include such flexibility would be a significant methodological advance. We will develop and test FlexNIEMO in light of our econometric findings
- NIEMO's interstate trade flows have been loaded onto the national highway network, producing the TransNIEMO formulation. Data from the national bridge inventory have also been added next. Algorithms to determine shortest paths (before and after a disruption) have been developed and tested. TransNIEMO has been used to estimate the full economic impacts of a disruption caused by an attack in various bridges that now serve California-Arizona and California-Nevada trade.. Two follow-up steps will be developed in YEAR 5: (i) Algorithmic changes to improve computational efficiency and further testing are required; and (i) We will investigate freight mode choice and develop a multi-modal capability for NIEMO.
- We plan to apply NIEMO and TransNIEMO to estimate impacts associated with attacks against (i) a major sports stadium; (ii) an urban center; (iii) an airport; (iv) the romaine lettuce crop. This leverages aspatial modeling already completed in CREATE's collaboration with Battelle.

Objectives – (a) study the details of economic resilience via FlexNIEMO; (b) assign NIEMO trade flows to networks and study possible losses from network vulnerabilities; (c) Test TransNIEMO by applying it to plausible scenarios of terrorist attacks.

Interfaces to other Center Projects - The proposed NIEMO work relates to the resilience research being carried on by Professor Adam Rose.

Interfaces to non-Center Projects - Many other groups, including staff at Battelle, have been retained to conduct detailed impact studies. Our research would support this work.

Major Products and Customers - Project deliverables will consist of research reports and published papers. We will also add to the CREATE's RAW capabilities.

Technical Approach - Model extension, elaboration and testing consisting of:

- assigning interstate commodity trade to networks; this involves the inclusion and integration of several data files (national highway network, FAF data, national rail network, national bridges networks)
- algorithmic improvements intended to identify and overcome computational constraints.
- identification and application of mode split models to account for represent intermodal shifts in TransNIEMO.
- detailed year-to-year study of the post-event evolution of selected technical and trade coefficients; this will involve hypothesis formulation and testing.
- developing plausible terrorist attack scenarios and studying the detailed economic consequences.

Major Milestones and Dates

- Develop and test efficient shortest path algorithms for TransNIEMO.
- Investigate freight mode choice so that some truck traffic can be diverted to other freight modes.
- Test econometric findings from econometric work on the impacts of 9/11 by applying FlexNIEMO.
- Apply NIEMO and TransNIEMO to various terrorist attack scenarios.
- Papers will be submitted for publication as the relevant work is completed.