Simulating the State-by-State Effects of Terrorist Attacks on Three Major U.S. Ports: Applying NIEMO (the National Interstate Economic Model)

Aug. 19, 2005

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Motivation

Problems with available preliminary estimates of terrorist threat:

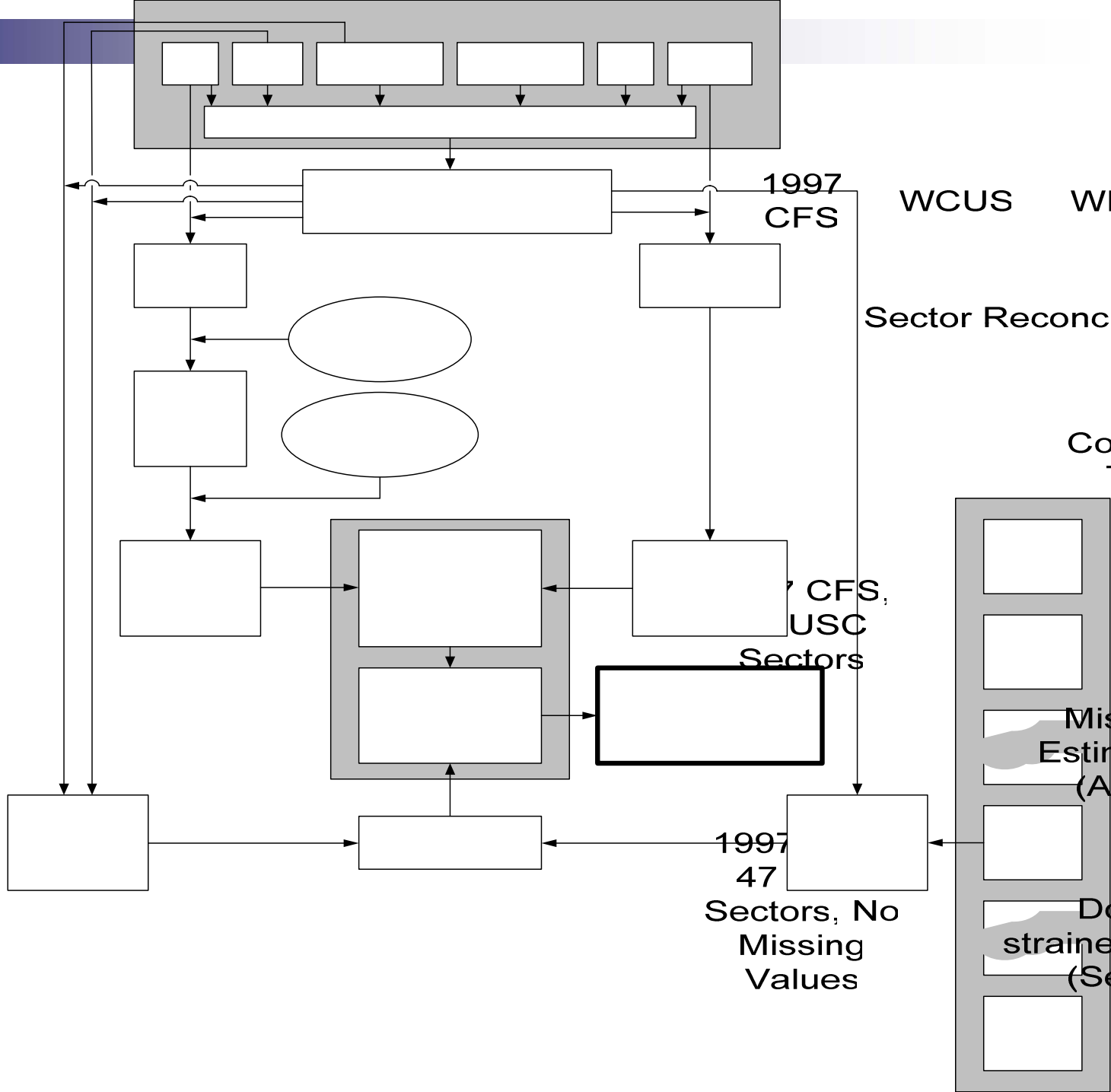
- The orders of magnitude are often much too vague to be useful ("millions of dollars", "up to billions of dollars");
- The estimates are too limited; there are many more than a dozen or so scenarios that pose a serious economic risk;
- The *incidence* of losses is not made clear. Decision makers have a keen interest in the spatial incidence of possible losses.

Focus

- Develop and test NIEMO (the National Interstate Economic Model)
- Simulate the economic impacts of terrorist attacks on 3 major U.S. seaports, by applying NIEMO

Modeling Process

Figure 1.
NIEMO Simulation Steps



Data

Figure 2.
Industrial Code Conversions
(current $)

Sector System	USC	SCTG	BEA	NAICS	IMPLAN (2001)	SIC	HS	SITC	WCUS
USC									
SCTG	*C, E*								
BEA	*C, E*	*C, E*							
NAICS	*C, E*	*C, E*	*A*						
IMPLAN (2001)	*C, E*	*C, E*	*A*	*A*					
SIC	*C, W*	*P*	*P*	*C, W*	*P*				
HS	*C, E*	*C, E*	*A*	*C, E*	*C, E*	*P*			
SITC	*C, W*	*C, W*	*P*	*P*	*P*	*P*	*C, W*		
WCUS	*C, W*	*C, W*	*P*	*P*	*P*	*P*	*C, W*	*C, E*	

Notes*:*

***C*: Complete mapping**

A: Available from other sources

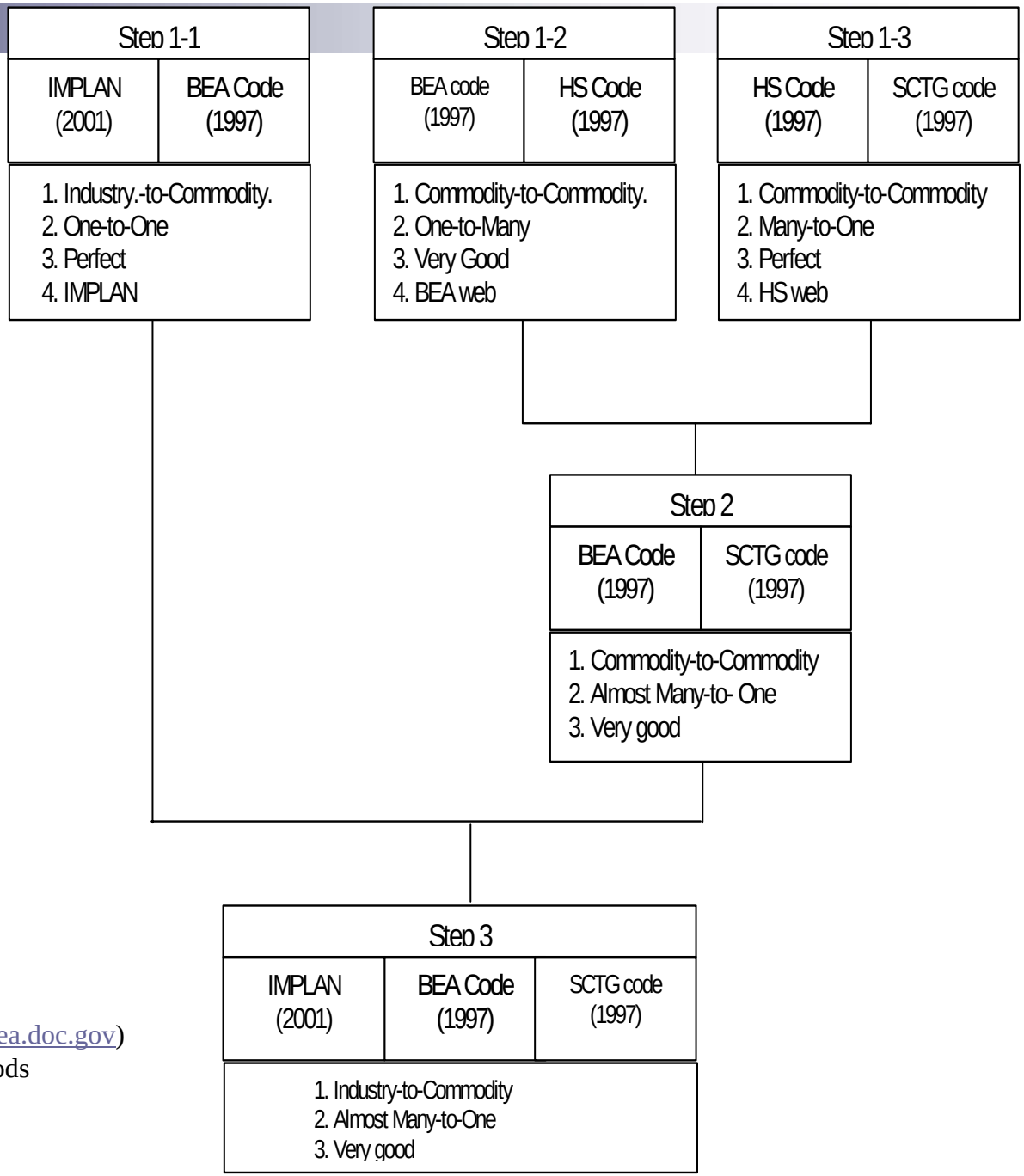
P: Possible to create mapping

E: Mappings constructed without any weights (Bayesian allocations)

W: Mappings constructed with plausible weights informed by additional data sources

Data (Continued)

Figure 3.
Data Reconciliation Steps, SCTG and IMPLAN



Notes:
Bold: Used as Reconciliation Code
1: Sector type
2: One = One sector, Many = Multiple Sectors
3: Quality of Reconciled Data
4: Sources and Abbreviations:
IMPLAN
BEA: Bureau of Economic Analysis (http://www.bea.doc.gov)
SCTG : Standard Classification of Transported Goods (http://www.bts.gov/cfs/sctg/welcome.htm)
HS : Harmonized System (http://www.statcan.ca/trade/htdocs/hsinfo.html)

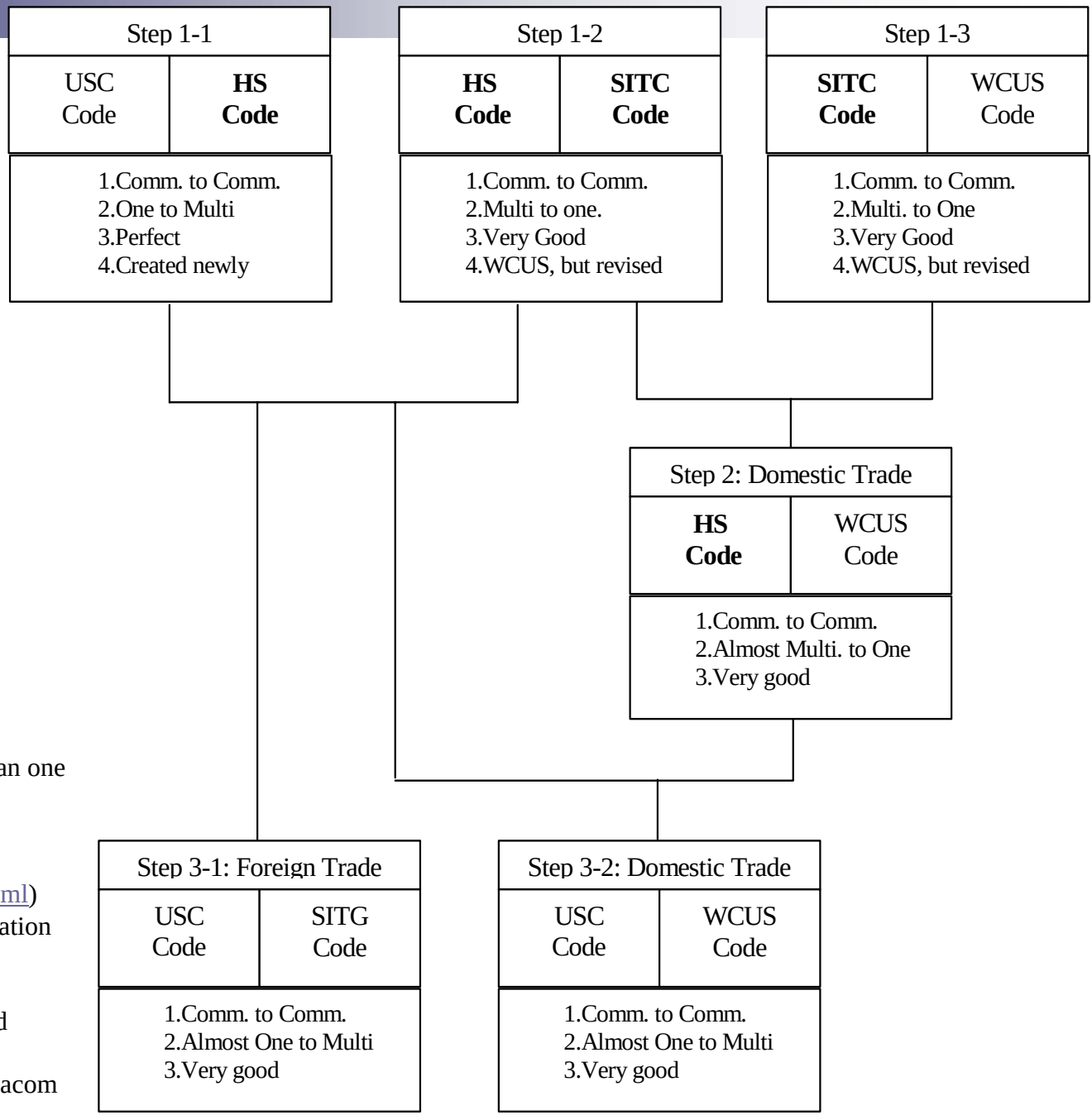
Data (Continued)

Appendix 1e includes definitions of the 47 USC Sectors, 29 of which are commodity sectors.

Other appendices will be available on the CREATE website.

Data (Continued)

Appendix 4.
Data Reconciliation Process for NIEMO Tests



Bold: Used as Bridge Code
1: Comm.= (Commodity)
2: One =One sector, Multi. =Sectors more than one
3: (Merged) Data Status
4: Source and Abbreviation
HS : Harmonized System (http://www.statcan.ca/trade/htdocs/hsinfo.html)
SITC: Standard International Trade Classification available from WISERTrade (http://www.wisertrade.org/home/index.jsp)
WCUS: Waterborne Commerce of the United States (http://www.iwr.usace.army.mil/ndc/data/datacomm.htm)

Data (Continued)

Table 2. Top Ten U.S. Ports: Foreign Exports and Imports (Current $Millions, 2001)

2001 Rank	Ports	Exports	Ports	Imports
1	LOS ANGELES / LONG BEACH, CA	33,222	LOS ANGELES / LONG BEACH, CA	164,578
2	NEW YORK, NY / NEWARK, NJ	21,378	NEW YORK,NY / NEWARK, NJ	64,009
3	HOUSTON, TX	21,241	HOUSTON, TX	23,539
4	CHARLESTON, SC	12,836	SEATTLE, WA	23,209
5	NEW ORLEANS, LA	10,951	CHARLESTON, SC	20,876
6	NORFOLK, VA	10,892	OAKLAND, CA	16,021
7	OAKLAND, CA	9,194	BALTIMORE, D	15,686
8	MIAMI, FL	8,846	TACOMA, WA	13,943
9	SAVANNAH, GA	6,544	NORFOLK, VA	13,052
10	SEATTLE, WA	5,483	PHILADELPHIA, PA	11,877
	TOP TEN U.S. PORTS	140,587	TOP-TEN PORTS	366,790
	ALL U.S. PORTS	198,841	ALL U.S. PORTS	519,607
	TOTAL U.S. GOODS TRADE	718,762	TOTAL U.S. GOODS TRADE	1,145,927

Model: Estimation of Trade Flows

Completing 1997 CFS data: AFM (Adjusted Flow Model)

- 1997 CFS includes unreported values for various commodities, including some:
  - total originating shipments in some states
  - total destined shipments for some states
  - cells representing trade flows between pairs of states
- AFM used to estimate of unreported 1997 values

Model: Estimation of Trade Flows (Continued)

Updating 1997 data to 2001: DFM (Doubly-Constrained Fratar Model)

- Based on 1997 trade tables completed via AFM, a new Fratar model used to estimate diagonal values for 2001.
- Traditional Fratar model used to calibrate non-diagonal interregional cells, constrained on diagonal values.
- DFM estimates diagonal values and non-diagonal values simultaneously by combining new Fratar model and traditional Fratar model.

Model: Construction of NIEMO

- Estimated Interstate Trade Flows using AFM and DFM.
- Created 51 Interindustry Input-Output Tables from 509 IMPLAN sectors, aggregated to 47 USC sectors.
- Inverted (52x47) x (52x47) matrix.

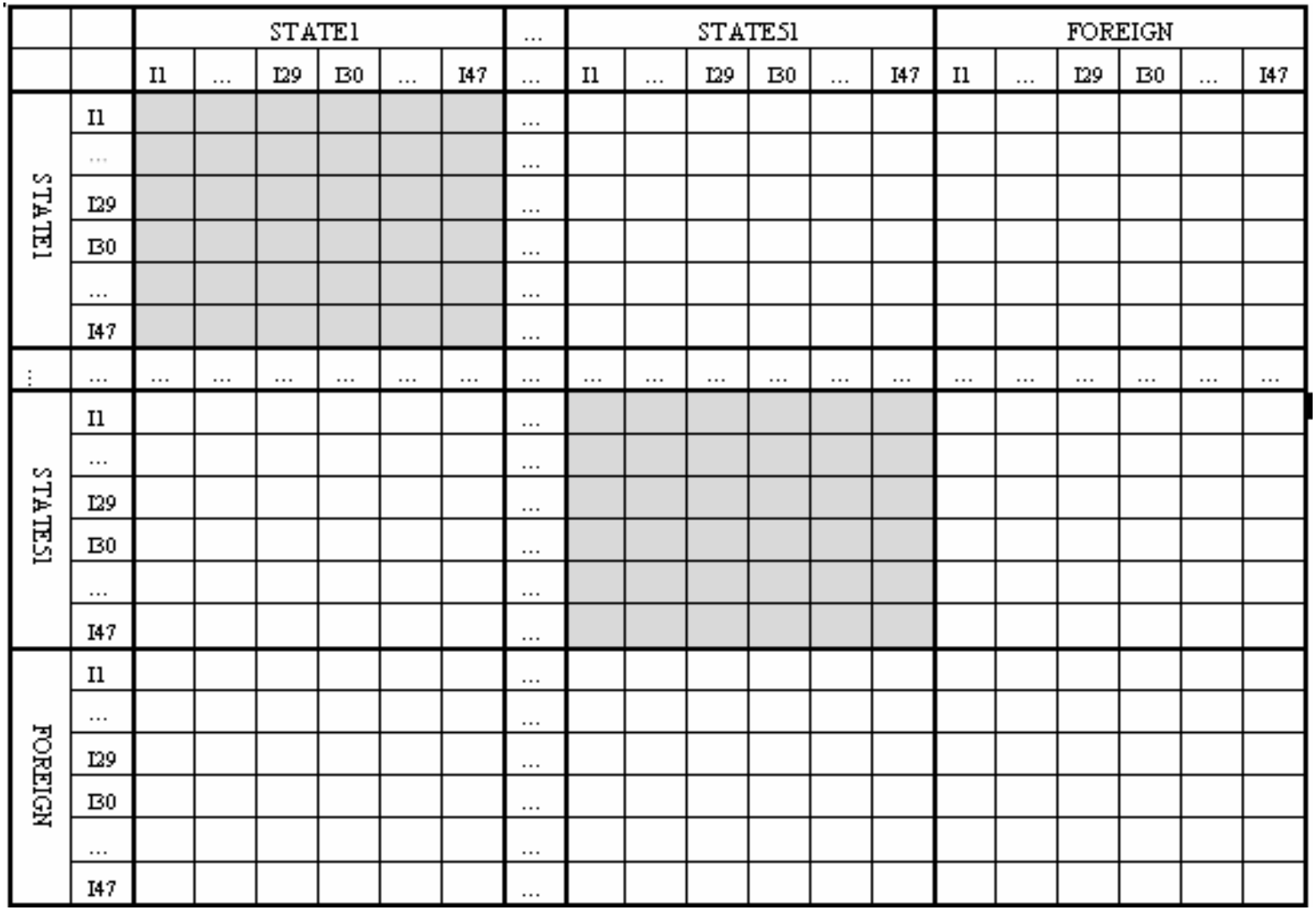
Model: Construction of NIEMO (Continued)

- Estimated Interstate Trade Flows : C matrix

		STATE1						…	STATES1						FOREIGN					
		I1	…	I29	I30	…	I47	…	I1	…	I29	I30	…	I47	I1	…	I29	I30	…	I47
STATE1	I1							…												
	…							…												
	I29							…												
	I30				1.0			…												
	…					1.0		…												
	I47						1.0	…												
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
STATES1	I1							…												
	…							…												
	I29							…												
	I30							…				1.0								
	…							…					1.0							
	I47							…						1.0						
FOREIGN	I1							…												
	…							…												
	I29							…												
	I30																			
	…																			
	I47																			

Model: Construction of NIEMO (Continued)

- Created 51 Interindustry Input-Output Tables: A matrix



Model: Construction of NIEMO (Continued)

- Inverse (52x47) x (52x47) matrix (= $(I - C\,A)^{-1}$)

		STATE1						...	STATES1						FOREIGN					
		I1	...	I29	B0	...	I47	...	I1	...	I29	B0	...	I47	I1	...	I29	B0	...	I47
STATE1	I1							...												
	...							...												
	I29							...												
	B0																			
	...																			
	I47																			
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
STATES1	I1							...												
	...							...												
	I29							...												
	B0																			
	...																			
	I47																			
FOREIGN	I1							...							1.0					
	...							...								1.0				
	I29							...									1.0			
	B0																	1.0		
	...																		1.0	
	I47																			1.0

NIEMO Test

- We have compared results from simulations involving NIEMO and an aggregated (to USC sectors) IMPLAN model.
- In the aggregate, the total output results for the two models differ by 0.92%.
- Sector-by-sector, most differences are between zero and 6%, most of them at the lower range.
- Seven sectors showed errors greater than 10%.
- But some of the error is attributed to the use of a final demand change that was specific to just one state, California.

Results

- Seaports Final Demand Estimations
  -LA/LB
  -Houston
  -NY/NW

- Terrorist Attack Simulations
  -Sum of Intra- and Inter-state Effects
  -Sectoral Effects

Results: Seaport One Month Final Demand Loss Estimates

- Table 3. Port of Los Angeles/Long Beach Final Demand Loss Estimates ($Millions) , p. 29
- Table 4. Port of Houston Final Demand Final Demand Loss Estimates ($Millions) , p. 30
- Table 5. Port of New York/Newark Final Demand Final Demand Loss Estimates ($Millions) , p. 31

Results: Modeling Assumptions

- Loss of export opportunities set off backward-linkage multiplier effects.
- Loss of import opportunities are simply added as additional direct impacts.

Results: Terrorist Attack Simulations

- Table 6a. Sum of Intra- and Inter-state Effects: Individual Three Port, Shutdowns One Month, p.33.
- Table 6b. USC24 (Electronic and Other Electrical Equipment) Sectoral Effects: Individual Three Port, Shutdowns, One Month, p.34.
- Table 6c. USC25 (Motorized Vehicles, Including Parts) Sectoral Effects: Individual Three Ports, Shutdowns, One Month, p.35.

Results: Terrorist Attack Simulations (Continued)

- Table 6d. USC10 (Coal and Petroleum Products) Sectoral Effects: Individual Three Port, Shutdowns, One Month, p.36.
- Table 6e. USC29 (Miscellaneous Manufactured Products) Sectoral Effects: Individual Three Ports, Shutdowns, One Month, p.37.
- Table 6f. USC23 (Machinery) Sectoral Effects: Individual Three Ports, Shutdowns, One Month, p.38.

Results: Terrorist Attack Simulations (Continued)

- As expected, state-by-state impacts are a function of size of state and distance from the attack.

Discussion

- Short-term-impact analyses only.
- Mainly demand-driven effects of a cessation of imports.
- No induced effects via the household sector are measured.

Discussion (Continued)

- However, the results provide a guide to the prioritization of port security expenditures
- In a federal system, state-by-state impacts are useful for developing nationwide support for preventive investments at ports in distant states.