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

By Jiyoung Park, Peter Gordon, James E. Moore II, and Harry W. Richardson

ABSTRACT

Relying on a wide array of data sources, we specify and apply what we believe to be the first operational interstate input-output (IO) model for the United States. The National Interstate Economic Model (NIEMO) provides results for 47 major industrial sectors (USC sectors) for all fifty states, the District of Columbia, and a residual (or leakage) region, "The Rest of the World." We use NIEMO to estimate industry and state-level impacts from the short-term loss of the services of three major U.S. Seaports – Los Angeles/Long Beach, New York/Newark and Houston, as a consequence of terrorist attacks. We treat the attacks on the three port complexes as alternatives rather than as simultaneous events. A one-month loss of the services of the Los Angeles/Long Beach port costs the U.S. economy approximately $21 billion. Corresponding impacts for the ports of New York-New Jersey and Houston are $14.4 billion and $8.4 billion, respectively. State-by-state impacts are a function of state size and distance from the site of attack.

I. Introduction

The Department of Homeland Security recently issued *Planning Scenarios* (Howe, 2004) that included preliminary estimates of the losses from various hypothetical terrorist attacks on selected major targets. There are three problems with many of these estimates:

- The orders of magnitude are often much too vague to be useful, e.g., "millions of dollars," "up to billions of dollars."
- The range and types of targets are too limited: Many more than a dozen or so scenarios pose a serious economic risk.
- The geographical incidence of losses is not made clear, probably on purpose because of a policy decision not to identify specific target sites. "All politics are local" may be a slight exaggeration, but decision makers have a keen interest in the spatial incidence of possible losses.

Our research addresses all three of these problems. We have created what we believe to be the first operational interstate input-output (IO) model for the United states. The National Interstate Economic Model (NIEMO) provides results for 47 major industrial sectors for all fifty states, the District of Columbia, and a leakage region: "The Rest of the World." In the application reported here, we use NIEMO to estimate industry-level impacts from the short-term loss of the services of three major U.S. seaports – Los Angeles/Long Beach, New York/Newark, and Houston – on the economies of all fifty states and Washington, DC, as a consequence of terrorist attacks. The Seaports of Los Angeles and Long Beach are treated as one complex, LA/LB. Seaports in New York and Newark are also treated as

a single port, NY/NJ. We treat the attacks on the three port complexes as alternatives rather than as simultaneous events.

In pursuing our research goals, the choice of approaches involved difficult trade-offs. The use of linear economic models is justified by various factors, including the richness of the detailed results made possible at relatively low cost. NIEMO, for example, includes approximately 6-million input-output multipliers. The principal insight that drives our research is that, with some effort, it is possible to integrate data from the Minnesota IMPLAN Group (MIG), Inc.'s IMPLAN state-level input-output models with commodity flow data from the U.S. Department of Transportation's Commodity Flow Survey and with data from various related sources, making it possible to build an operational multi-regional input-output model.

In the sections that follow, we describe the steps involved in reconciling the information content in these various data sources and making them compatible, integrating them to build NIEMO, and applying it to the problem at hand. The application also required the necessary multiplicands: What shares of local final demand do the temporary losses of port services involve? Finally, we discuss the nature of our results and some of the possible implications for homeland security policies..

II. Background to Multiregional IO Construction

Many economists and planners are interested in evaluating the socioeconomic impacts of various disruptions. Occasionally, they use geographically detailed input-output models. Isard demonstrated in 1951 that traditional (national) IO models are inadequate because they cannot capture the effects of linkages and interactions between regions. To examine the full, short-term impacts of unexpected events such as terrorist attacks or natural disasters on the U.S. economy, the economic links between states should be considered and accounted for. Multiregional input output models (MRIOs) include interregional trade tables and avoid some of the ecological fallacies associated with aggregation (Robison, 1950). Building an operational MRIO for all the states of the U.S., however, requires highly detailed interstate shipments data.

Although Chenery (1953) and Moses (1955) had formulated a relatively simplified MRIO framework in response to the earlier discussions by Isard (1951), data problems persisted, and have stymied most applications. The non-existence or rarity of useful interregional trade data is the most problematic issue. Intraregional and interregional data must be comparable and compatible to be useful in this context, yet the currently available shipments data between states are only sporadically available and difficult to use.

It is not surprising, then, that few MRIO models have been constructed or widely used. The best known are the 1963 U.S. data sets for 51 regions and 79 sectors published in Polenske (1980), and the 1977 U.S. data sets for 51 regions and 120 sectors released by

Jack Faucett Associates (1983), then updated by various Boston College researchers and reported in 1988 (Miller and Shao, 1990).

More recently, there have been two attempts to estimate interregional trade flows using data from the 1997 Commodity Flow Survey (CFS). The U.S. Commodity Transportation Survey Data on interregional trade flows have been available since 1977, but reporting was discontinued for some years. For the years since 1993, this data deficit can be met to some extent with the recent (CFS) data from the Bureau of Transportation Statistics (BTS), but these data are incomplete with respect to interstate flows. Based on the currently available CFS data, Jackson *et al*. (2004) used MIG, Inc.'s IMPLAN data to adjust the incomplete CFS reports by adopting gravity models constrained via distance and by making various other adjustments.

Along similar lines and using the same basic data sources, we elaborate Park *et al.* (2004), who suggested a different estimation approach that relied on a doubly-constrained Fratar model (DFM). The Fratar model is an early transportation planning tool used to extrapolate trip interchange tables to reflect expected changes in trip ends. It is an intentionally naïve numerical method requiring a minimum of assumptions. To proceed in this way, it was first necessary to create conversion tables to reconcile the CFS and IMPLAN economic sectors. This approach is elaborated in the sections that follow.

III. Data

The primary requirements for building an interstate model for the U.S. of the Chenery-Moses type are two sets of data:

- regional coefficients tables, and
- trade coefficients tables (Miller and Blair, 1985).

Models of this type can be used to estimate interstate industrial effects as well as inter-industry impacts on each state, based mainly on the two data sources:

- regional IO tables that provide intra-regional industry coefficients for each state, and
- interregional trade tables to provide analogous trade coefficients.

This implies the creation of three types of matrices

- intraregional inter-industry transaction matrices,
- the interregional commodity trade matrix, and
- the combined interregional, inter-industry matrix i.e., a special case of an MRIO matrix, the core of the NIEMO model.

Before creating these matrices, however, the data reconciliation problem has to be addressed

The main steps involved in building and testing NIEMO are shown in Figure 1. We developed a set of 47 industries, we call them "the USC Sectors," into which many of the other economic sector classification systems can be converted. Figure 2 shows the state of our industrial code conversion matrix relative to the many data sources used in this study.

Table 1. Economic Data Sources and Associated Sector Classification Systems

	Economic Data Source					
Sector Classification System	1997 Commodity Flow Survey (CFS)	2001 IMPLAN	1997 Bureau of Economic Analysis (BEA) Benchmark	2001 WISERTrade	2001 Waterborne Commerce of the U.S. (WCUS)	2002 Economic Census
Standard Classification of Transported Goods (SCTG)						
Bureau of Economic Analysis (BEA)						
2001 IMPLAN						
North American Industry Classification System (NAICS)						
Harmonized System (HS)						
Standard International Trade Classification (SITC)						
Standard International Trade Classification (SITCREV3-C)						
Waterborne Commerce of the U.S. (WCUS)						

The detailed conversion processes occasionally involved case-by-case reconciliations of economic sectors. Inevitably, some conversions involved mapping one sector into more than one and vice-versa. The light-gray cells in Figure 2 represent one-to-one and many-to-one allocations. The dark-gray cells denote mappings modified with plausible weights extracted from ancillary data sources on a case-by-case basis.

Figure 1. NIEMO Data and Modeling Steps

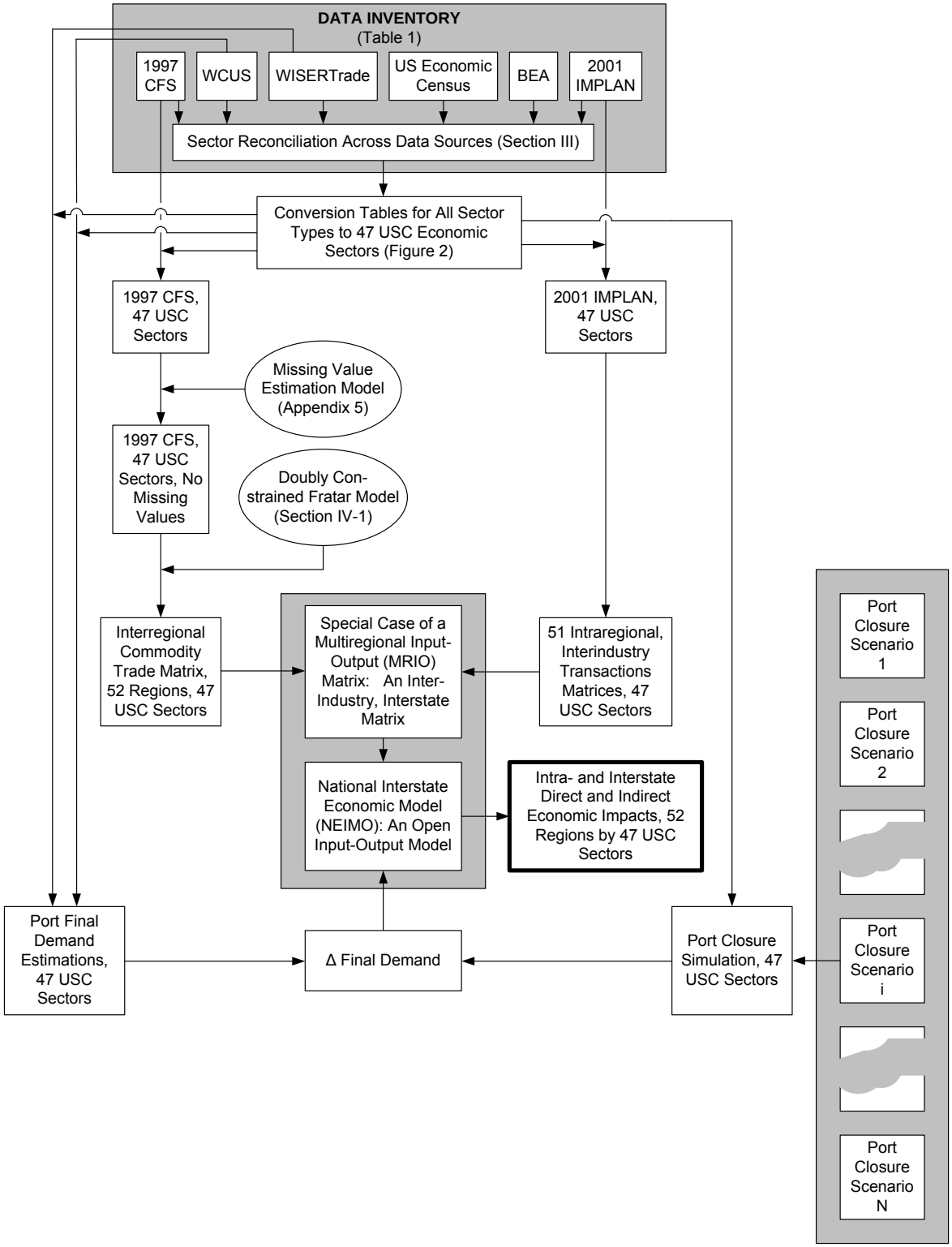


Figure 2. Economic Sector Classification System Conversions (Current $)

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

Sector Classification Systems:

USC: USC sectors newly created
SCTG : Standard Classification of Transported Goods (http://www.bts.gov/cfs/sctg/welcome.htm)
BEA: Bureau of Economic Analysis (http://www.bea.doc.gov)
NAICS : North American Industry Classification System (http://www.census.gov/epcd/www/naics.html)
2001 IMPLAN: IMPLAN 509-sector codes
SIC : Standard Industrial Classification (http://www.osha.gov/oshstats/sicser.html)
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)

III-1. Data for NIEMO Construction

The major problem in developing an interstate, inter-industrial model stems from the fact that it is difficult to obtain data describing trade flows between the states (Lahr, 1993). Since 1993, however, CFS data have been used in this role. Remaining problems with these data include high sampling variability or values omitted to avoid disclosure of individual company status. The existence of many unreported values has required relying on other data sources to approximate completeness of the CFS. It is not surprising, therefore, that since the work by Polenske (1980) and Faucett Associates (1983), there has been no comprehensive inventory of MRIO flows.

The 1997 CFS reports trade flows between states for 43 SCTG sectors while the IMPLAN Total Commodity Output data file includes their 509 sector values, available for all states. CFS includes the movement of foreign imports in its data as domestic movements. This means that all commodities coming into a U.S. port are listed as *outbound from that port* and inbound to the next destination. Likewise, all commodities flowing to a port from anywhere in the U.S. are outbound from the origin and inbound to the port. For these reasons, foreign imports in the 2001 IMPLAN data, which are available separately from domestic movements, are added to the IMPLAN Total Commodity Output tally.

NIEMO's inter-industry coefficient matrix is based on the commodity-by-industry version of the IMPLAN model. This is because the CFS trade matrix double- (or multiple-) counts commodities due to the movements of foreign imports to other states. We corrected these CFS multiple counts by using the IMPLAN separate foreign imports movements values for

commodities to improve the marginal distribution of the CFS matrix, and then re-estimated CFS entries to eliminate double- and multiple-counts. Thus, NIEMO relies on an industry-based, commodity-by-commodity total requirements matrix (Miller and Blair, 1985: p167).

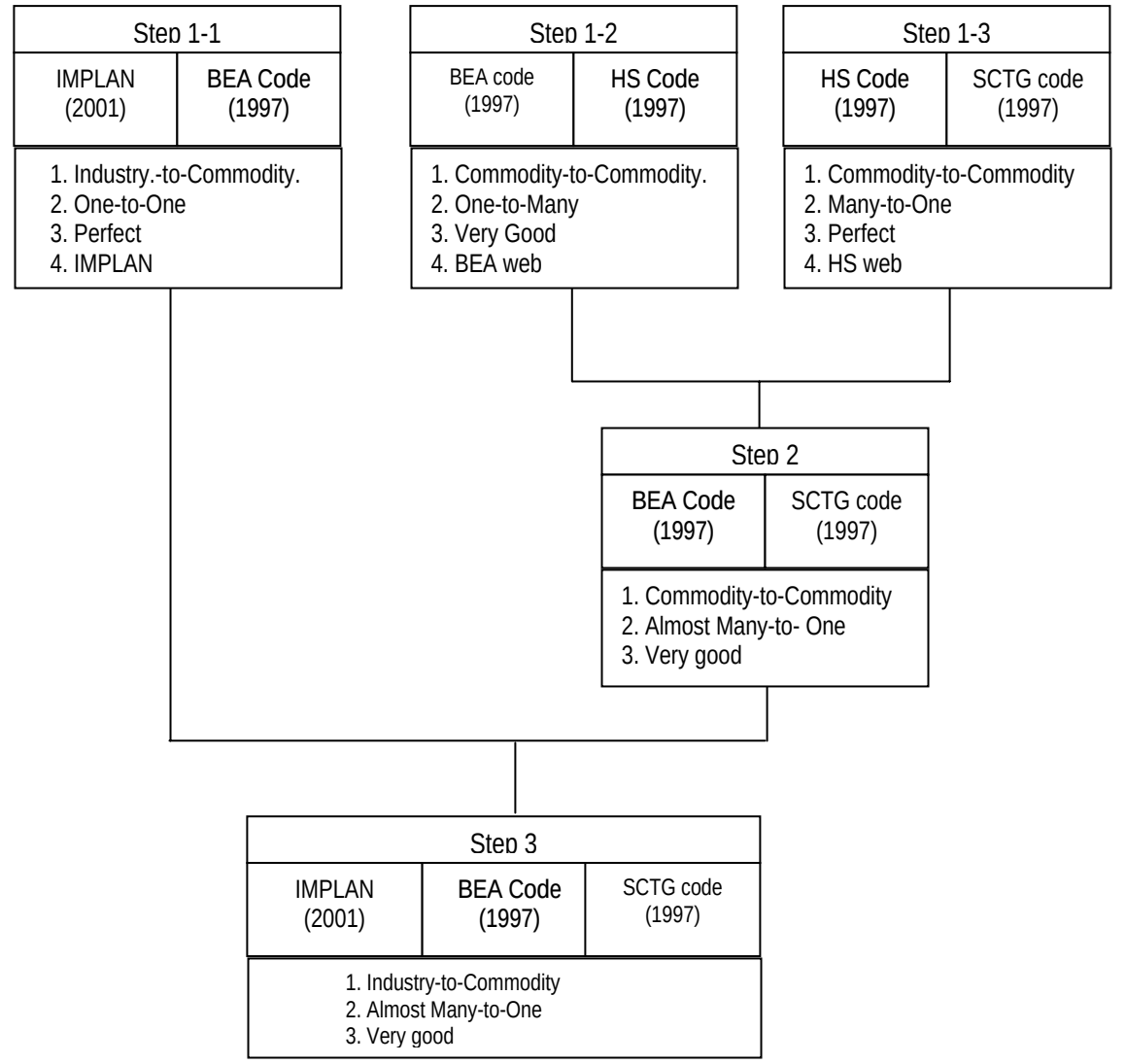
In the current application, the 1997 CFS data were used as a baseline and updated to estimated 2001 values using 2001 IMPLAN data. The recent release of 2002 CFS data, to be matched to 2002 IMPLAN data, will simplify this approach in the near future.

Differences between various industry classification systems from different data sources makes data reconciliation especially difficult in the absence of standardized and tested conversion procedures. The estimation of 2001 trade flows from 1997 CFS, therefore, required various intermediate conversion steps between the SCTG code system used in the 1997 CFS and the IMPLAN system of sectors, not always one-to-one matched pairs. Figure 3 shows the data reconciliation steps enabling the aggregation of 509 IMPLAN sectors to 43 SCTG sectors. The steps involved in data reconciliation, the definition of USC sectors, and the quality of results are described in Appendix 1.

III-2. Multiplicands and NIEMO Tests

After estimating all the values needed to invert the 2444-by-2444 matrix, NIEMO can be used to simulate the loss impacts from hypothetical attacks on any major U.S. target. In

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)

this research, we considered attacks on the three top U.S. ports: the combined ports of Los Angeles-Long Beach (LA/LB), the combined ports of New York/Newark (NY/NJ) and the Port of Houston. Together, these three facilities account for 38.1 percent of all foreign goods exports and 48.5 percent for foreign goods imports. See Table 2.

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

Sources: WISERTrade data for ports and No.1277 in 2002 Statistical Abstract of the United States for Total U.S. Goods Trade

The trade activities for the three ports, foreign and domestic by USC Sector had then to be estimated. WISERTrade processes and supplies data on foreign waterborne exports and imports for each U.S. port, based on raw Census data. They do not include information on domestic waterborne exports and imports. Because WISERTrade uses SITC codes for its seaport data, it was necessary to reconcile the USC Sectors and the SITC Sectors. A USC-

SITC conversion table was created on the basis of three other conversion tables: USC-SCTG, SCTG-HS, and HS-SITC. The USC-HS conversion was easily accomplished because the USC-SCTG and SCTG-HS conversion tables were already available from the NIEMO construction process. See again Figure 3.. The process is shown in Appendix 4, where only the HS-SITC conversion is added. After obtaining a conversion table for 5-digit SITCREV3_C codes and 6-digit HS codes from the Waterborne Commerce of the U.S. (WCUS), and modifying the SITCREV3_C codes to 4-digit SITC codes for each port, we created a new, weighted table converting 4-digit SITC codes to 6-digit HS codes. This enabled us to complete and use the USC-SITC conversion table.

Domestic seaborne exports and imports data are available from the WCUS files, which use their own classification code system based on SITCREV3_C codes. A limitation of theWCUS data is that the units reported are in short-tons instead of dollars. We first changed the kilogram magnitudes in the WISERTrade data to short tons. Second, we created a conversion between WCUS and SITC using short ton values. Third, we created dollars-per-ton conversion tables for each port. We were then able to reconcile all the necessary seaborne trade data.

The results of these various reconciliations can be corroborated through foreign trade data comparisons between WCUS and WISERTrade. We found that foreign trade for each port to be almost the same for each USC sector, regardless of data source. The results of our efforts to document all goods trade for the three ports are shown in Tables 3-5. These are

the bases for our final demand calculations for each port in Section V. In Section IV, we return to the construction of NIEMO

IV. Constructing NIEMO

As noted above, constructing NIEMO required two basic tables:

- tables of intraregional industrial commodity trade coefficients, and
- a table of regional inter-industry transaction coefficients, as shown Figures 4 and 5 respectively.

While trade tables by industry are hard to create because of incompleteness or unavailability of data, inter-industry tables are relatively easy to identify because reliable data are available from IMPLAN at the state and industry levels. To estimate NIEMO, we used the 1997 CFS data plus missing value estimates, (all updated to estimate 2001 values), which includes interstate shipments data for the 43 SCTG commodity sectors; and the corresponding IMPLAN inter-industry coefficients tables for each state.

IV-1. Constructing Interstate Trade Flow Coefficients

Estimated 2001 commodity trade flows between all 50 states plus Washington, D.C. and the rest of the world were developed from the original 1997 CFS for 29 USC Commodity Sectors. We had to deal with the unfortunate fact that the 1997 CFS includes unreported values for a variety of commodities, including some marginal values such as total shipments originating in state *i* and total shipments destined for state *j*, and various matrix cells representing commodity trade flows between pairs of states. The 2001 IMPLAN data

reports total origin and destination values by state. Hence it follows that the 2001 commodity trade flows could be estimated with a Fratar model. However, the missing values in the 1997 CFS must be estimated first. Excel Visual Basic was used to develop the model used to estimate these missing values, and to execute the Fratar updates. . The procedure used to estimate missing values reported in Appendix 5. In the future, we will develop an updated version of NIEMO based on CFS an IMPLAN data for the same year (2002).

Fratar models are useful for estimating updated commodity trade flows, The starting matrices include numerous estimated values for missing entries in the CFS data. However, the traditional Fratar model calibrates only off-diagonal interregional cells. In this application. though, new diagonal values accounting for intrastate trade flows also had to be estimated.

We developed the doubly-constrained Fratar model (DFM), a new forumulation that updates the diagonal values in the CFS matrix, and used the traditional Fratar model to estimate the off-diagonal values. Combining these two operations, the DFM iteratively estimates all the updated CFS values simultaneously and consistently. The estimated values for each USC sector are the base values for the next iterative step of the DFM.

Define ETO_i and ETD_j as the estimated values of TO_i, the Total Origin (Output) value for state i, and TD_j, the Total Destination (Input) values for state j respectively. These estimates are provided by the procedure used to estimate missing values in the 1997 CFS

data. Define IND_{ii} be diagonal entries in a matrix consisting of IMPLAN's Net Domestic Products (*NDP*) plus Remaining IMPLAN Foreign Imports (*RIFI*, See Appendix 5) for each state *i*, The double subscript identifies diagonal entries.

$$IND_{ii} = NDP_{ii} + RIFI_i \quad (1.)$$

This makes it possible to define the variables shown in equations (2.1) through (5.2).

$$INTO_i = ITO_i - IFE_i \quad (2.1)$$

$$= (IND_{ii} + IFE_i + IDE_i + OIFI_i) - IFE_i \quad (2.2)$$

$$= NDP_{ii} + IDE_i + RIFI_i + OIFI_i \quad (2.3)$$

$$= NDP_{ii} + IDE_i + AFI_i \quad (2.4)$$

Where $INTO_i$ = 2001 IMPLAN Net Total (Outputs) Originating in state *i*;

ITO_i = 2001 IMPLAN Total(Outputs) Originating in state *i*;

IFE_i = 2001 IMPLAN Foreign Exports from state *i*;

IDE_i = 2001 IMPLAN Domestic Exports from state *i*;

$OIFI_i$ = 2001 Outbound IMPLAN Foreign Imports (Transhipped) from state *i*;and

AFI_i = 2001 IMPLAN Adjusted Foreign Imports to state *i*.

$$INTD_j = ITD_j - OIFI_j, \quad (3.1)$$

$$= (IND_{ii} + IDI_j + IIFI_j) - IIFI_j \quad (3.2)$$

$$= NDP_{ii} + IDI_j + RIFI_j \quad (3.3)$$

Where $INTD_j$ = 2001 IMPLAN Net Total (Inputs) Destined for state j;

ITD_j = 2001 IMPLAN Total (Inputs) Destined for state j;

$IIFI_j$ = 2001 Inbound IMPLAN Foreign Imports (Transhipped) to state j; and

IDI_j = 2001 IMPLAN Domestic Imports to state j.

We did not account for foreign exports in the estimation of each trade flow in the definitions of $INTO_i$ and $INTD_j$. This is because the foreign exports data in IMPLAN identify foreign exports from each state. This presents two problems. First, it is not possible to separate out the quantities that go to the rest of the world from those that go first to the CFS "outbound" category and then on to the rest of the world. And second, foreign exports directly to the rest of the world are associated only with the industry "Transportation Services." Therefore, we assumed foreign exports are shipped directly from each state.

Net_INTO_i and Net_$INTD_j$ exclude corresponding diagonal outputs IND_{ii} and IND_{ii}..

$$Net\_INTO_i = INTO_i - IND_{ii} \quad (4.1)$$

$$= IDE_i + OIFI_i \quad (4.2)$$

$$Net\_ INTD_j = INTD_j - IND_{jj} \quad (5.1)$$

$$= IDI_j \quad (5.2)$$

Net_ETO_i and Net_ETD_j also exclude corresponding diagonal outputs IND_{ii} and IND_{ii}. See Appendix 5 for definitions.

$$Net\_ETO_i = ETO_i - IND_{ii} \quad (6.)$$

$$Net\_ ETD_j = ETD_j - IND_{jj} \quad (7.)$$

The growth factors for origin states i and destination states j, G_i and G_j, are calculated from equations (8.) and (9.),

$$G_i = Net\_INTO_i / Net\_ ETO_i, \quad (8.)$$

$$G_j = Net\_INTD_j / Net\_ETD_j. \quad (9.)$$

These growth factors are substituted into equations (10.) and (11.).to obtain balance factors L_i and L_j, which are used to iteratively update off-diagonal CFS entries.

$$L_i = \frac{Net\_ETO_i}{\sum_j (MV_{ij}^* \times G_j)}. \quad (10.)$$

$$L_j = \frac{Net\_ETD_j}{\sum_i (MV_{ij}^* \times G_i)}. \quad (11.)$$

The observerd and estimated cell values MV_{ij}^{*} for the 1997 CFS data are the starting values to estimate the 2001 CFS off-diagonal flows ij, FV_{ij}^{1}. This is a standard application of the traditional Fratar model that relies on the calibrated factors provided by equations (8.) to (11.).

$$FV_{ij}^{1} = MV_{ij}^{*} \times G_i \times G_j \times \left\{ \frac{(L_i + L_j)}{2} \right\} \qquad \text{for all } i \neq j. \tag{12.}$$

Equations (13.) to (14.) define DG_i and DG_j, diagonal entry growth factors for origin states i and destination states j.

$$DG_i = ITO_i / ETO_i. \tag{13.}$$

$$DG_j = ITD_j / ETD_j. \tag{14.}$$

Equations (15.) and (16.) define DL_i and DL_j, Diagonal entry balance factors used to iteratively update the diagonal (intrastate) entries of the CFS matrix.

$$DL_i = \frac{ETO_i}{\sum_j (MV_{ij}^{*} \times DG_j)}. \tag{15.}$$

$$DL_j = \frac{ETD_j}{\sum_i (MV_{ij}^{*} \times DG_i)}. \qquad (16.)$$

Estimated Diagonal Values (DV_{ii}^{1}) are calculated via equation (17), which defines a second Fratar model estimating trade flows within each state i. These results also account for new foreign imports remaining within each state.

$$DV_{ii}^{1} = MV_{ii}^{*} \times DG_i \times DG_j \times \left\{ \frac{(DL_i + DL_j)}{2} \right\}, \qquad \text{for all } i = j. \qquad (17.)$$

These initial estimates of the updated diagonal values, DV_{ii}^{1}, the diagonal entry growth factors, DG_i and DG_j, and the Diagonal entry balance factors, DL_i and DL_j, are all updated iteratively until they converge to consistent values across equations (13.) to (17.).

$$DV_{ij}^{T} = DV_{ij}^{T-1} \times DG_i^{T-1} \times DG_j^{T-1} \times \left\{ \frac{(DL_i^{T-1} + DL_j^{T-1})}{2} \right\} \qquad \text{for all } i = j. \qquad (18.)$$

DV_{ii}^{T} replaces IND_{ii} if and only if $DV_{ii}^{T} > IND_{ii}$. The final values DV_{ii} replace the diagonal values IND_{ii} in the CFS matrix if and only if $DV_{ii}^{*} > IND_{ii}$. The 2001 CFS totals for states i and j are decremented by the difference between corresponding values DV_{ii} original the original diagonal values IND_{ii}

These initial estimates of the updated off-diagonal CFS flows, FV_{ij}^{1}; the growth factors for origin states i and destination states j, G_i and G_j ; and the balance factors, L_i and L_j, are all updated iteratively until they converge to consistent values across equations (8.) to (12.).

$$FV_{ij}^{T} = FV_{ij}^{T-1} \times G_i^{T-1} \times G_j^{T-1} \times \left\{ \frac{(L_i^{T-1} + L_j^{T-1})}{2} \right\} \qquad \text{for all } i \neq j. \qquad (19.)$$

The stopping rule to identify the optimal values of FV_{ij}^{T} from equations (18.) and (19.) is shown in equation (20.). The stopping condition is met by maximizing

$$\sum_i \sum_j FV_{ij}^{T} \qquad (20.)$$

subject to

$$0.999 < \left(\sum_i Net\_ITO_i \Big/ \sum_i \sum_j FV_{ij}^{T} \right) < 1.001, \text{ and} \qquad (21.1)$$

$$0.999 < \left(\sum_i Net\_ITD_j \Big/ \sum_i \sum_j FV_{ij}^{T} \right) < 1.001; \text{ or, alternatively,} \qquad (21.2)$$

$$0.999 < \left(\sum_i \sum_j FV_{ij}^{T-1} \Big/ \sum_i \sum_j FV_{ij}^{T} \right) < 1.001. \qquad (22.)$$

There is only limited information available about interstate trade in services. The 1977 MRIO interregional flow data set on service sectors is reported to be problematic (Miller and Shao, 1990, p.1652). Consequently, trade in services between states was assumed to be negligible. Further, given our focus on seaports, we also neglect foreign trade in services. The first step in constructing a NIEMO-type MIRO matrix is to create a set of 29, 52-State-by-52-State trade matrices, one for each of the various commodity sectors; and define 18, 52-State-by-52-State identify matrices, one for each of the various service sectors. These 47 final estimated trade flow matrices are combined into the MRIO format as shown in Figure 4. These trade values are producer values. To compare these matrices of estimated trade results with the original CFS trade tables, these producer values must be converted to purchaser values using the appropriate price ratios given in Appendix 1b.

Denote the interstate flows appearing in the 1997 CDS data as V_{ij}. Denote the unreported value of Total output Originating in state *i* as TO_i, and the unreported value of Total output Destined for state *j* as TO_j. For each state for which 1997 CFS data have been estimated,

Figure 4. Interregional Trade Coefficients Based on Commodity Trade Flows

		STATE 1						...	STATE 51						FOREIGN					
		I1	...	I2	I3	...	I4	...	I1	...	I2	I3	...	I4	I1	...	I2	I3	...	I4
STATE 1	I1							...												
	...							...												
	I2							...												
	I3				1.0			...												
	...					1.0		...												
	I4						1.0	...												
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
STATE 51	I1							...												
	...							...												
	I2							...												
	I3							...				1.0								
	...							...					1.0							
	I4							...						1.0						
FOREIGN	I1							...												
	...							...												
	I2							...												
	I3																			
	...																			
	I4																			

Note: 1. White cells identify zero values
2. Service sectors have no trade coefficients: Diagonal entries are 1.

the ratios, $\sum_i V_{ij} / TO_i$ (or $\sum_j V_{ij} / TD_j$), are close to unity.. Also, referring to the DFM estimates, the state sums of updated trade flows between states ($\sum_i FV_{ij}^T$ or $\sum_j FV_{ij}^T$) and the IMPLAN total values ($INTO_i$ or $INTD_j$) are very close to unity. These comparisons provide a basic quality check for the estimates presented here: All such estimates are plausible (Park *et al*, 2004). Detailed trade flow estimates by USC sectors are available upon request.

IV-2. Constructing Inter-Industry Trade Flow Coefficients

47 USC Sector inter-industry input-output tables were created from the 509-sector 2001 IMPLAN inter-industry table, and then recombined as shown in Figure 5. These estimates required various intermediate to steps process the IMPLAN data, and are described in Appendix 6.

Figure 5. Inter-Industry Technology Coefficients for 47 USC Sectors Based on IMPLAN

		STATE1						...	STATE51						FOREIGN					
		I1	...	I2	I3	...	I4	...	I1	...	I2	I3	...	I4	I1	...	I2	I3	...	I4
STATE1	I1							...												
	...							...												
	I2							...												
	I3							...												
	...							...												
	I4							...												
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
STATE51	I1							...												
	...							...												
	I2							...												
	I3							...												
	...							...												
	I4							...												
FOREIGN	I1							...												
	...							...												
	I2							...												
	I3							...												
	...							...												
	I4							...												

Note: 1. White cells identify zero values

IV-3. Assembling NIEMO

The NIEMO version of an MRIO coefficient matrix is created by taking the product of the two matrices in Figures 4 and 5. The model includes no inter-industry data for trade between foreign countries, so the off-diagonal cells representing trade between locations in the rest of the world are necessarily zero. The coefficients for diagonal cells in the foreign-to-foreign region are one.

The NIEMO inverse matrix can be computed from this product as a special case the Leontief inverse matrix (= $(I- C A)^{-1}$), as shown in equation (23). The structure of this inverse matrix is shown in Figure 6. In our applications, we used equation (28.) to consider the impact of final demand changes, denoted as *Y*, occurring in any given state.

$$X = (I - C A)^{-1} Y \quad , \tag{23.}$$

where X = the output vector,

Y = is the final demand vector,

A =is the matrix of inter-industry technology coefficients, and

C = the matrix of interstate trade flows.

NIEMO accounts for the commodity effects of changes in trade with one region on services consumed only within other regions. Therefore, the darker colored cells in Figure 6 are the only ones that are nonzero.

Figure 6. Final Interregional, Inter-Industry Coefficients: Inverse Matrix $(I\text{-}CA)^{-1}$

		STATE1						...	STATE51						FOREIGN					
		I1	...	I2	I3	...	I4	...	I1	...	I2	I3	...	I4	I1	...	I2	I3	...	I4
STATE1	I1							...												
	...							...												
	I2							...												
	I3																			
	...																			
	I4																			
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
STATE51	I1							...												
	...							...												
	I2							...												
	I3																			
	...																			
	I4																			
FOREIGN	I1							...							1.0					
	...							...								1.0				
	I2							...									1.0			
	I3																	1.0		
	...																		1.0	
	I4																			1.0

Note: 1. White cells identify zero values

Since A, C and Y are known, X can be calculated via NIEMO. The vector Y captures projected changes in final demand. For this study, we consider the direct impacts resulting from hypothetical attacks on three major U.S. seaports. The Leontief inverse matrix will consist of $(52 * 47)^2 = 5{,}973{,}136$ cells. Given Y^*, hypothesized perturbations defined by interruptions in port services, new outputs X^* are estimated from equation (23.). All of the required calculations were conducted using the MATLAB™ program.

V. Seaport Final Demand Estimates

The trade activities by USC Sector for the Los Angeles/Long Beach, New York/Newark, and Houston seaports are shown in Tables 3-5. These figures are based on the reconciled data from section III-2. Each table shows foreign exports/imports (second column), domestic exports/imports (third column), and the sum of the two (fourth column). In the simulations reported here, we assumed that terrorist attacks would close the ports for one month. Because our data are for one year, we created one-month losses by dividing the elements of the Sum column by twelve. The hypothesized one-month final demand (direct) *losses* are shown in the fifth (FD LOSS) column. As expected, the LA/LB ports would experience the largest final demand losses ($18.3 billion),, while the ports of NY/NJ and Houston incur $10.4 billion and $6.3 billion of direct losses respectively. NIEMO is a linear model and extrapolations to other time periods are straight forward. The caveat is that as the periods studied become longer, the assumption of constant, fixed coefficients becomes more problematic.

As inputs into the NIEMO simulations, FD LOSS data (Y^*) for each port were used as follows: Export losses are presumed to have the standard demand-driven multiplier effects. Import losses are less likely to have such effects and only their direct impacts are included in total effects. It could be argued that the loss of intermediate imports can initiate demand-driven multiplier effects, and that there could be substitutions from other domestic sources. Given the multiple assumptions underpinning this research, we prefer on this point to err on the conservative side. All the results are discussed in Section VI.

Table 3. Port of Los Angeles/Long Beach Final Demand Estimates ($Millions)

USC Sectors	2001_ WISERT	2001_WCUS	SUM	FD LOSS
EXPORT	LA+LB/F/EXP	LA+LB/D/EXP	LA+LB/EXP	LA+LB/EXP
1	1,266.907	60.587	1,327.494	110.624
2	1,841.898	72.392	1,914.290	159.524
3	1,947.819	57.233	2,005.052	167.088
4	103.623	14.076	117.699	9.808
5	932.228	69.476	1,001.705	83.475
6	115.775	99.710	215.484	17.957
7	341.525	0.872	342.397	28.533
8	142.763	4.601	147.365	12.280
9	66.424	0.000	66.424	5.535
10	668.976	4,668.766	5,337.743	444.812
11	2,562.233	44.491	2,606.724	217.227
12	489.963	21.007	510.970	42.581
13	26.460	0.000	26.460	2.205
14	2,090.564	762.382	2,852.947	237.746
15	3,445.487	18.766	3,464.254	288.688
16	191.143	715.076	906.219	75.518
17	576.009	28.128	604.137	50.345
18	225.080	552.670	777.750	64.813
19	1,223.022	439.954	1,662.976	138.581
20	507.899	2,070.120	2,578.019	214.835
21	492.649	76.759	569.408	47.451
22	657.456	480.116	1,137.572	94.798
23	5,078.266	179.124	5,257.390	438.116
24	3,160.808	793.861	3,954.669	329.556
25	1,433.580	1,047.714	2,481.294	206.774
26	791.256	540.044	1,331.300	110.942
27	821.266	1,499.755	2,321.020	193.418
28	306.662	419.763	726.425	60.535
29	1,714.392	1,416.397	3,130.789	260.899
total	33,222.132	16,153.843	49,375.975	4,114.665
IMPORT	LA+LB/F/IMP	LA+LB/D/IMP	LA+LB/IMP	LA+LB/IMP
1	3,461.700	3.349	3,465.049	288.754
2	797.923	44.083	842.006	70.167
3	306.265	4.829	311.094	25.924
4	215.726	2.134	217.859	18.155
5	1,025.569	106.627	1,132.195	94.350
6	586.348	1.606	587.954	48.996
7	64.640	1.301	65.941	5.495
8	37.023	3.927	40.950	3.413
9	8.631	0.000	8.631	0.719
10	3,107.925	3,103.754	6,211.679	517.640
11	2,259.888	468.453	2,728.340	227.362
12	153.331	3.390	156.722	13.060
13	3.821	0.000	3.821	0.318
14	1,432.809	1,077.606	2,510.414	209.201
15	6,638.519	8.112	6,646.632	553.886
16	1,597.950	212.786	1,810.736	150.895
17	889.126	3.774	892.900	74.408
18	1,017.440	25.850	1,043.291	86.941
19	34,785.637	62.956	34,848.593	2,904.049
20	2,568.135	28.908	2,597.043	216.420
21	1,741.001	2.663	1,743.664	145.305
22	6,420.596	42.622	6,463.218	538.601
23	12,596.629	58.189	12,654.817	1,054.568
24	41,181.253	76.173	41,257.426	3,438.119
25	17,588.402	465.260	18,053.662	1,504.472
26	539.416	55.674	595.089	49.591
27	4,018.357	143.758	4,162.115	346.843
28	7,909.832	18.231	7,928.063	660.672
29	11,623.447	55.840	11,679.287	973.274
total	164,577.337	6,081.854	170,659.191	14,221.599
Use only 29 USC ommodity sectors	Convert SITC to USC sectors and then use WISERT data directly	First, Convert WCUS to SITC in Short Tons. Second, Convert Tons to Dollars from WISERTrade Foreign data. Finally, convert SITC to USC sectors.	WISERT+WCUS	Distribution: SUM/12

Table 4. Port of Houston Final Demand Calculations ($millions)

USC Sectors	2001_ WISERT*	2001_WCUS**	SUM	FD LOSS
EXPORT	Houston/F/EXP	Houston/D/EXP	Houston/EXP	Houston/EXP
1	252.359	0.000	252.359	21.030
2	1,259.799	25.172	1,284.971	107.081
3	125.367	2.845	128.211	10.684
4	67.230	5.480	72.710	6.059
5	595.984	303.981	899.965	74.997
6	14.227	0.000	14.227	1.186
7	0.242	0.000	0.242	0.020
8	50.084	7.980	58.063	4.839
9	26.776	0.973	27.750	2.312
10	1,958.020	3,220.501	5,178.521	431.543
11	3,928.797	3,043.526	6,972.323	581.027
12	203.252	9.407	212.659	17.722
13	37.650	0.000	37.650	3.137
14	1,077.757	3,527.219	4,604.975	383.748
15	2,255.633	0.573	2,256.206	188.017
16	28.262	150.667	178.929	14.911
17	159.625	0.000	159.625	13.302
18	14.695	124.868	139.563	11.630
19	216.270	129.363	345.633	28.803
20	160.725	623.144	783.869	65.322
21	93.229	243.983	337.212	28.101
22	606.359	389.998	996.357	83.030
23	5,442.698	61.097	5,503.794	458.650
24	1,207.895	159.790	1,367.686	113.974
25	675.096	178.842	853.938	71.162
26	104.006	161.534	265.540	22.128
27	281.642	479.601	761.243	63.437
28	73.336	190.140	263.476	21.956
29	323.961	3,408.169	3,732.130	311.011
total	21,240.976	16,448.852	37,689.828	3,140.819
IMPORT	Houston/F/IMP	Houston/D/IMP	Houston/IMP	Houston/IMP
1	157.180	0.000	157.180	13.098
2	205.951	37.289	243.240	20.270
3	35.440	24.598	60.038	5.003
4	28.398	0.000	28.398	2.366
5	680.613	115.412	796.025	66.335
6	388.916	0.000	388.916	32.410
7	0.622	0.000	0.622	0.052
8	51.759	22.285	74.044	6.170
9	18.178	7.791	25.969	2.164
10	9,655.338	3,922.865	13,578.203	1,131.517
11	1,097.063	4,289.804	5,386.868	448.906
12	57.282	88.710	145.992	12.166
13	35.547	17.217	52.764	4.397
14	355.423	1,492.028	1,847.451	153.954
15	537.011	0.303	537.315	44.776
16	259.908	102.172	362.080	30.173
17	120.140	0.096	120.236	10.020
18	18.431	101.143	119.575	9.965
19	373.058	154.403	527.462	43.955
20	432.051	33.923	465.974	38.831
21	1,238.311	610.139	1,848.450	154.038
22	1,456.622	326.929	1,783.551	148.629
23	2,386.970	43.231	2,430.201	202.517
24	1,504.205	541.416	2,045.621	170.468
25	1,564.554	61.088	1,625.641	135.470
26	103.515	92.585	196.100	16.342
27	106.855	467.985	574.841	47.903
28	254.807	78.275	333.082	27.757
29	415.182	2,461.027	2,876.209	239.684
total	23,539.328	15,092.717	38,632.045	3,219.337
Use only 29 USC ommodity sectors	*Convert SITC to USC sectors and then use WISERT data directly	**First, Convert WCUS to SITC in Short Tons. Second, Convert Tons to Dollars from WISERTrade Foreign data. Finally, convert SITC to USC sectors.	WISERT+WCUS	Distribution: SUM/12

Table 5. Port of New York/Newark Final Demand Calculations ($Millions)

USC Sectors	2001_ WISERT	2001_WCUS	SUM	FD LOSS
EXPORT	NY+NW/F/EXP	NY+NW/D/EXP	NY+NW/EXP	NY+NW/EXP
1	136.568	0.000	136.568	11.381
2	260.525	0.000	260.525	21.710
3	361.546	0.000	361.546	30.129
4	63.569	0.000	63.569	5.297
5	354.069	20.081	374.150	31.179
6	19.007	0.000	19.007	1.584
7	16.464	0.000	16.464	1.372
8	53.534	260.008	313.542	26.128
9	30.037	0.000	30.037	2.503
10	194.870	16,470.381	16,665.251	1,388.771
11	1,544.702	120.816	1,665.519	138.793
12	367.103	23.391	390.494	32.541
13	10.632	0.000	10.632	0.886
14	2,029.851	2,369.860	4,399.711	366.643
15	1,586.458	0.000	1,586.458	132.205
16	252.680	1,246.154	1,498.834	124.903
17	458.590	0.000	458.590	38.216
18	441.117	906.441	1,347.558	112.296
19	600.793	723.233	1,324.026	110.335
20	317.367	1,826.867	2,144.234	178.686
21	649.603	0.000	649.603	54.134
22	596.959	815.456	1,412.414	117.701
23	3,864.052	0.000	3,864.052	322.004
24	1,749.605	2,389.825	4,139.429	344.952
25	1,512.163	687.957	2,200.121	183.343
26	683.592	1,521.547	2,205.139	183.762
27	888.097	3,423.864	4,311.961	359.330
28	307.721	1,032.414	1,340.135	111.678
29	2,026.675	1,114.624	3,141.298	261.775
total	21,377.947	34,952.919	56,330.866	4,694.239
IMPORT	NY+NW/F/IMP	NY+NW/D/IMP	NY+NW/IMP	NY+NW/IMP
1	1,334.586	0.000	1,334.586	111.216
2	1,145.213	224.144	1,369.357	114.113
3	275.383	163.583	438.966	36.580
4	404.199	0.000	404.199	33.683
5	2,975.727	423.736	3,399.463	283.289
6	1,849.803	0.000	1,849.803	154.150
7	19.388	0.000	19.388	1.616
8	81.761	108.475	190.236	15.853
9	38.114	0.000	38.114	3.176
10	8,102.875	4,582.102	12,684.977	1,057.081
11	2,145.521	1,051.624	3,197.145	266.429
12	1,015.345	26.146	1,041.492	86.791
13	5.892	0.000	5.892	0.491
14	1,454.366	2,685.660	4,140.026	345.002
15	2,248.398	5.088	2,253.486	187.790
16	501.635	282.407	784.042	65.337
17	690.425	0.000	690.425	57.535
18	434.609	448.111	882.720	73.560
19	10,286.442	731.844	11,018.285	918.190
20	1,498.490	187.919	1,686.409	140.534
21	1,091.796	5.327	1,097.122	91.427
22	1,592.147	177.670	1,769.817	147.485
23	5,912.691	3.924	5,916.615	493.051
24	2,842.884	1,381.295	4,224.179	352.015
25	10,314.817	223.895	10,538.712	878.226
26	582.376	838.780	1,421.156	118.430
27	915.763	1,780.571	2,696.334	224.694
28	2,060.205	279.884	2,340.089	195.007
29	2,337.428	628.281	2,965.710	247.142
total	64,158.280	16,240.466	80,398.745	6,699.895
Use only 29 USC ommodity sectors	Convert SITC to USC sectors and then use WISERT data directly	First, Convert WCUS to SITC in Short Tons. Second, Convert Tons to Dollars from WISERTrade Foreign data. Finally, convert SITC to USC sectors.	WISERT+WCUS	Distribution: SUM/12

Because the New York-Newark ports straddle two states, we also tested an alternate 49-State NIEMO model that combines New York and New Jersey. We conducted simulations that compared the results generated by the two versions of NIEMO, with and without the two states combined. The outputs, shown in Appendix 7, demonstrate that the results are approximately the same. This suggests that NIEMO accurately accounts for state-to-state commodity flows, even in circumstances in which flows are as difficult to separate as in the case of NY/NJ.

VI. Terrorist Attack Simulation Results

Based on the export final demand losses shown in Tables 3-5, the state-by-state indirect impacts from attacks on the three ports were estimated and are summarized in Tables 6a-6f. Aggregate effects vary in direct proportion to port activity (Table 6a). The indirect effects are shown or each state. Direct as well as indirect effects are shown for the states directly impacted. We also include the direct effects of import losses for the states where the attack takes place. Examined from this perspective, multipliers summed across all states range from 1.24 (Los Angeles/Long Beach) to 1.98 (Houston). The differences are accounted for by the fact that LA/LB has the largest value of imports.

A one-month loss of the services of the Los Angeles/Long Beach port costs the U.S. economy approximately $22.8 billion. Corresponding impacts for the ports of New York-New Jersey and Houston are $16.2 billion and $9.7 billion, respectively. If ports are unusable for longer periods, these losses would grow, although strict proportionality would

Table 6a. Sum of Intra- and Interstate Effects: Three Ports, Shutdowns One-Month ($Millions)

State	LA/LB	NY/NJ	Houston
AL	26.96	19.97	28.25
AK	3.08	13.65	1.05
AZ	53.69	7.86	19.53
AR	25.52	11.39	24.38
CA	2,641.24	115.76	146.24
Direct_Impact_EXPORT	4,114.66	--	--
Direct_Impact_IMPORT	14,221.60	--	--
CO	31.40	12.35	21.87
CT	16.04	47.97	8.79
DE	5.08	6.85	2.58
DC	0.63	1.64	0.28
FL	31.23	36.37	24.32
GA	25.92	35.00	23.61
HI	5.40	7.99	0.94
ID	12.31	12.16	3.51
IL	70.84	48.25	53.94
IN	53.17	36.55	44.96
IA	36.06	28.55	12.81
KS	31.99	9.26	17.80
KY	29.16	55.69	25.42
LA	77.95	105.94	96.59
ME	5.39	26.76	2.33
MD	11.43	42.75	6.87
MA	21.80	54.06	11.93
MI	54.99	95.82	40.50
MN	33.80	22.97	16.69
MS	14.68	12.14	28.79
MO	35.92	47.13	24.45
MT	16.27	5.72	3.34
NE	25.32	5.88	5.63
NV	13.08	2.33	1.68
NH	7.22	9.76	3.36
NJ	42.33	--	21.52
NM	6.62	4.68	21.85
NY	54.85	--	43.53
NY+NJ	--	2,753.40	--
Direct_Impact_EXPORT	--	4,694.24	--
Direct_Impact_IMPORT	--	6,699.90	--
NC	33.14	45.19	22.98
ND	4.87	20.34	1.71
OH	76.85	165.07	58.15
OK	26.99	24.61	70.97
OR	50.39	24.07	11.05
PA	61.80	247.67	44.13
RI	4.85	4.88	3.35
SC	16.76	33.23	14.49
SD	6.72	8.36	3.44
TN	33.69	28.18	25.43
TX	391.97	345.30	2,233.28
Direct_Impact_EXPORT	--	--	3,140.82
Direct_Impact_IMPORT	--	--	3,219.34
UT	31.76	5.74	11.08
VM	2.41	11.75	1.64
VA	16.98	33.36	15.72
WA	79.50	16.21	17.98
WV	10.58	60.16	13.12
WI	52.77	65.68	28.46
WY	6.52	3.77	7.46
US Total	22,766.18	16,234.29	9,733.92
Rest of World	492.02	589.97	316.02
World Total	23,258.21	16,824.25	10,049.93

Table 6b. USC24 Sectoral Effects (Electronic and Other Electrical Equipment): Three Ports, Shutdowns One-Month ($Millions)

USC24	LA/LB	NY/NJ	Houston
AL	0.69	0.80	0.74
AK	0.07	0.05	0.03
AZ	2.57	1.44	0.82
AR	0.46	0.37	0.40
CA	142.07	24.52	14.34
Direct_Impact_EXPORT	329.56	--	--
Direct_Impact_IMPORT	3,438.12	--	--
CO	5.14	1.43	1.47
CT	0.99	5.40	0.45
DE	0.28	0.29	0.12
DC	0.04	0.05	0.01
FL	2.62	4.16	2.06
GA	2.13	2.17	1.31
HI	0.10	0.24	0.02
ID	0.40	0.40	0.16
IL	3.04	3.23	2.65
IN	1.28	1.20	1.49
IA	0.67	0.82	0.51
KS	0.72	0.41	0.42
KY	1.19	0.98	0.49
LA	0.33	0.55	0.58
ME	0.12	0.51	0.07
MD	1.91	1.65	0.44
MA	5.05	6.58	1.86
MI	1.83	1.69	1.86
MN	2.29	2.69	0.94
MS	0.38	0.46	0.70
MO	1.29	1.36	0.75
MT	0.13	0.11	0.02
NE	0.50	0.30	0.15
NV	0.41	0.12	0.08
NH	1.50	1.29	0.31
NJ	2.04	--	0.73
NM	0.35	0.23	0.20
NY	6.75	--	3.20
NY+NJ	--	135.10	--
Direct_Impact_EXPORT	--	344.95	--
Direct_Impact_IMPORT	--	352.01	--
NC	2.71	5.66	1.39
ND	0.07	0.17	0.04
OH	2.67	3.95	2.82
OK	1.16	0.29	0.77
OR	1.86	1.23	0.46
PA	2.56	7.56	2.60
RI	0.35	0.37	0.16
SC	0.94	0.78	0.63
SD	0.41	0.27	0.21
TN	1.34	1.25	0.90
TX	10.33	5.41	73.55
Direct_Impact_EXPORT	--	--	113.97
Direct_Impact_IMPORT	--	--	170.47
UT	1.34	0.35	0.60
VM	0.31	0.91	0.14
VA	1.65	2.23	1.01
WA	10.49	2.91	3.73
WV	0.09	0.38	0.08
WI	1.81	1.48	0.86
WY	0.09	0.04	0.04
US Total	3,997.24	932.83	413.84
Rest of World	54.91	79.94	34.73
World Total	4,052.14	1,012.77	448.57

Table 6c. USC25 Sectoral Effects (Motorized Vehicles, Including Parts): Three Ports, Shutdowns One-Month ($Millions)

USC25	LA/LB	NY/NJ	Houston
AL	0.69	0.30	0.23
AK	0.01	0.02	0.00
AZ	0.24	0.15	0.12
AR	0.16	0.13	0.14
CA	25.10	1.03	1.17
Direct_Impact_EXPORT	206.77	--	--
Direct_Impact_IMPORT	1,504.47	--	--
CO	0.24	0.13	0.12
CT	0.20	0.37	0.03
DE	0.70	0.39	0.04
DC	0.08	0.00	0.00
FL	0.44	0.36	0.15
GA	0.80	0.89	0.36
HI	0.07	0.01	0.03
ID	0.20	0.04	0.02
IL	1.95	0.81	0.54
IN	1.99	2.33	1.67
IA	0.32	0.22	0.17
KS	0.69	0.19	0.24
KY	2.54	1.39	0.69
LA	0.46	0.34	0.26
ME	0.05	0.06	0.02
MD	0.14	0.20	0.08
MA	0.10	0.29	0.09
MI	12.55	9.55	8.46
MN	0.90	0.46	0.55
MS	0.20	0.14	0.15
MO	4.21	1.03	1.00
MT	0.05	0.02	0.02
NE	0.22	0.19	0.13
NV	0.24	0.03	0.01
NH	0.03	0.03	0.01
NJ	0.23	--	0.19
NM	0.04	0.06	0.06
NY	0.47	--	0.34
NY+NJ	--	22.31	--
Direct_Impact_EXPORT	--	183.34	--
Direct_Impact_IMPORT	--	878.23	--
NC	0.50	0.68	0.30
ND	0.07	0.09	0.03
OH	2.89	5.23	1.60
OK	0.76	0.43	0.68
OR	0.55	0.18	0.18
PA	0.46	1.64	0.26
RI	0.04	0.01	0.02
SC	0.74	0.63	0.34
SD	0.04	0.06	0.03
TN	1.12	1.01	0.97
TX	1.96	1.06	12.34
Direct_Impact_EXPORT	--	--	71.16
Direct_Impact_IMPORT	--	--	135.47
UT	0.49	0.08	0.04
VM	0.02	0.03	0.01
VA	0.50	0.57	0.16
WA	0.44	0.18	0.18
WV	0.05	0.19	0.04
WI	0.89	0.72	0.38
WY	0.01	0.01	0.01
US Total	1,779.09	1,117.82	241.29
Rest of World	27.17	22.93	13.15
World Total	1,806.26	1,140.75	254.44

Table 6d. USC10 Sectoral Effects (Coal and Petrolium Products): Three Ports, Shutdowns One-Month ($Millions)

USC10	LA/LB	NY/NJ	Houston
AL	0.40	1.53	0.52
AK	0.27	8.69	0.20
AZ	1.99	0.36	1.18
AR	0.38	0.25	0.50
CA	272.93	21.87	23.27
Direct_Impact_EXPORT	444.81	--	--
Direct_Impact_IMPORT	517.64	--	--
CO	1.13	1.34	4.34
CT	0.07	2.54	0.05
DE	0.13	0.40	0.14
DC	0.02	0.59	0.02
FL	0.30	1.74	0.31
GA	0.24	0.76	0.29
HI	0.19	5.31	0.11
ID	0.05	2.53	0.02
IL	2.29	4.92	3.68
IN	1.41	1.51	1.12
IA	0.17	8.83	0.11
KS	2.88	1.08	1.18
KY	0.69	24.96	0.73
LA	36.38	66.11	35.88
ME	0.02	4.88	0.01
MD	0.06	12.58	0.05
MA	0.11	3.30	0.09
MI	0.37	27.67	0.29
MN	0.41	1.03	0.27
MS	1.95	2.55	10.45
MO	0.22	15.60	0.24
MT	3.18	2.80	0.33
NE	0.30	0.09	0.11
NV	0.42	0.41	0.03
NH	0.02	0.32	0.02
NJ	1.09	--	2.84
NM	0.96	1.55	4.97
NY	0.31	--	0.24
NY+NJ	--	387.85	--
Direct_Impact_EXPORT	--	1,388.77	--
Direct_Impact_IMPORT	--	1,057.08	--
NC	0.16	0.48	0.15
ND	0.16	12.63	0.08
OH	1.05	46.29	1.17
OK	5.17	11.84	25.44
OR	0.17	7.73	0.05
PA	1.42	75.70	1.21
RI	0.02	0.05	0.02
SC	0.07	7.04	0.07
SD	0.02	2.25	0.02
TN	0.25	0.48	0.22
TX	171.80	203.62	300.27
Direct_Impact_EXPORT	--	--	431.54
Direct_Impact_IMPORT	--	--	1,131.52
UT	3.99	1.01	3.19
VM	0.01	1.74	0.00
VA	0.25	1.72	0.26
WA	1.72	1.42	0.33
WV	0.71	28.68	0.87
WI	0.24	17.42	0.13
WY	1.05	1.72	3.64
US Total	1,482.07	3,483.59	1,993.76
Rest of World	156.04	259.47	80.11
World Total	1,638.11	3,743.06	2,073.87

Table 6e. USC29 Sectoral Effects (Miscellaneous Manufactured Products,): Three Ports, Shutdowns One-Month ($Millions)

USC29	LA/LB	NY/NJ	Houston
AL	0.30	0.45	0.40
AK	0.06	0.03	0.04
AZ	3.70	0.12	0.90
AR	0.16	0.34	0.46
CA	34.43	2.36	3.34
Direct_Impact_EXPORT	260.90	--	--
Direct_Impact_IMPORT	973.27	--	--
CO	4.09	0.15	0.58
CT	0.18	1.01	0.13
DE	0.02	0.27	0.02
DC	0.08	0.04	0.05
FL	0.65	0.94	0.62
GA	0.32	1.66	0.42
HI	0.06	0.04	0.04
ID	0.05	0.32	0.03
IL	1.72	2.27	1.13
IN	1.62	0.49	1.02
IA	1.79	0.14	0.16
KS	0.56	0.16	0.16
KY	0.30	0.31	0.35
LA	1.45	0.17	0.76
ME	0.03	0.89	0.03
MD	0.14	0.72	0.15
MA	0.22	4.29	0.17
MI	0.56	0.68	0.41
MN	0.26	0.23	0.26
MS	0.13	0.10	0.27
MO	1.51	0.21	0.30
MT	0.47	0.02	0.02
NE	0.20	0.04	0.04
NV	0.32	0.03	0.09
NH	0.06	0.17	0.03
NJ	5.10	--	0.25
NM	0.14	0.08	1.92
NY	1.19	--	5.37
NY+NJ	--	19.75	--
Direct_Impact_EXPORT	--	261.77	--
Direct_Impact_IMPORT	--	247.14	--
NC	2.06	0.34	0.24
ND	0.22	0.06	0.10
OH	1.65	1.24	1.08
OK	1.33	0.10	1.22
OR	0.47	0.27	2.24
PA	0.92	3.79	0.60
RI	0.05	0.12	0.03
SC	0.20	0.37	0.14
SD	0.03	0.04	0.08
TN	0.64	1.42	0.59
TX	3.56	2.40	23.43
Direct_Impact_EXPORT	--	--	311.01
Direct_Impact_IMPORT	--	--	239.68
UT	1.29	0.07	0.53
VM	0.02	0.62	0.02
VA	0.26	0.75	3.12
WA	2.65	0.14	1.19
WV	0.08	0.21	0.10
WI	0.42	1.01	0.40
WY	0.04	0.01	0.02
US Total	1,311.92	560.33	605.73
Rest of World	30.48	22.01	22.10
World Total	1,342.40	582.35	627.83

Table 6f. USC23 Sectoral Effects (Machinary): Three Ports, Shutdowns One-Month ($Millions)

USC23	LA/LB	NY/NJ	Houston
AL	0.72	0.61	0.87
AK	0.01	0.02	0.13
AZ	2.00	0.67	1.00
AR	1.58	0.65	1.07
CA	54.44	2.97	6.96
Direct_Impact_EXPORT	438.12	--	--
Direct_Impact_IMPORT	1,054.57	--	--
CO	1.19	0.21	0.50
CT	1.68	3.55	1.32
DE	0.32	0.18	0.01
DC	0.01	0.03	0.01
FL	3.08	1.99	1.29
GA	1.66	1.10	1.01
HI	0.16	0.01	0.01
ID	0.19	0.18	0.04
IL	5.16	3.10	3.78
IN	3.10	2.46	5.21
IA	1.80	1.51	1.33
KS	0.72	0.46	0.83
KY	1.04	1.34	0.79
LA	0.33	0.56	0.77
ME	0.12	0.19	0.13
MD	0.34	0.89	0.18
MA	1.91	2.34	0.80
MI	2.49	3.28	2.49
MN	2.00	1.26	1.95
MS	0.58	0.39	0.74
MO	1.29	0.99	0.87
MT	0.16	0.10	0.10
NE	0.35	0.29	0.30
NV	0.42	0.11	0.12
NH	0.46	0.51	0.16
NJ	1.28	--	0.58
NM	0.21	0.14	0.21
NY	1.92	--	2.22
NY+NJ	--	38.84	--
Direct_Impact_EXPORT	--	322.00	--
Direct_Impact_IMPORT	--	493.05	--
NC	1.51	2.69	1.42
ND	0.10	0.22	0.04
OH	7.36	6.36	3.65
OK	1.09	0.81	4.67
OR	1.83	0.47	0.26
PA	2.47	7.91	2.29
RI	0.27	0.16	0.17
SC	1.65	1.16	0.94
SD	0.25	0.23	0.10
TN	1.68	1.52	1.67
TX	4.76	3.36	30.55
Direct_Impact_EXPORT	--	--	458.65
Direct_Impact_IMPORT	--	--	202.52
UT	1.18	0.33	0.28
VM	0.15	0.18	0.04
VA	0.99	1.30	1.10
WA	2.53	0.50	0.64
WV	0.20	0.59	0.11
WI	3.55	2.83	2.97
WY	0.07	0.02	0.09
US Total	1,617.07	916.60	749.99
Rest of World	31.99	28.71	26.27
World Total	1,649.05	945.31	776.26

be an overstatement of the impact because substitution options become more feasible and important as time passes. As expected, the overall state-by-state impacts are, in general, a function of state size and distance from the terrorist attack.

Similar results are available from NIEMO simulations for all 29 USC commodity sectors. For the sake of brevity, specific results of sectoral effects for only the five largest sectors in terms of total U.S. output (See Appendix 1f.) are shown in Tables 6b-f.

VII. Conclusions

A variety of caveats must be attached to our results. We have several reasons to expect that our tallies include both overestimates and underestimates. First, as already mentioned, linear, demand-driven models are more relevant to short-term-impact analyses. In the longer run, markets drive a variety of substitutions and price adjustments that the version of the model adopted here cannot account for. Second, it is questionable that a cessation ofimports would have demand-driven effects as large as would a cessation of exports. In Section VI., we focused on the full effects of export losses. Only the direct impacts of import losses were included. Third, our analysis omits induced effects transmitted via the household sector. In the short run, households do not adjust their labor force participation across state lines. Nevertheless, we believe that we have advanced the state of the art by identifying the approximate orders of magnitude of losses from various events.

Also, it is widely accepted that in a federal system, much of politics is local, and we expect that decision makers would benefit from information that includes the spatial incidence of losses from various terrorist attacks. Our model has made it possible to estimate these on a state-by-state basis, but for disaggregated intraregional impacts there are advantages for applying a much more spatially disaggregated model like the one we have developed for Southern California, SCPM (Southern California Planning Model). Few similar models have been developed for other metropolitan regions.

Still, NIEMO results do have important political implications because the simulations show that the terrorist attacks in one state have significant economic impacts in other states. In the Congress, especially in the Senate where political power is evenly distributed among states, this conclusion could help to garner nationwide support for prevention measures in specific locations, often distant from the states where the measures are taken.

References

Bureau of Transportation Statistics and U.S. Census Bureau, 1999, *1997 Commodity Flow Survey: United States*, Washington, DC

Bureau of Transportation Statistics and U.S. Census Bureau, 2000, *Commodity Flow Survey 1997: CD-EC97-CFS*, Washington, DC

Bureau of Transportation Statistics and U.S. Census Bureau, 2003, *2002 Commodity Flow Survey: United States (Preliminary)*, Washington, DC

Chenery, H.B., 1953, Regional Analysis, in *The Structure and Growth of the Italian Economy*, edited by H.B. Chenery, P.G. Clark and V.C. Pinna, U.S. Mutual Security Agency, Rome: 98-139

Howe, D., 2004, *Planning Scenarios* (http://132.160.230.113:8080/revize/repository/CSSPrototype/simplelist/Planning_Scenarios__Exec_Summary_.pdf)

Isard, W., 1951, Interregional and Regional Input-Output Analysis: A Model of a Space Economy, *Review of Economics and Statistics*, 33: 318-328

Jack Faucett Associates, INC, 1983, *The Multiregional Input-Output Accounts, 1977: Introduction and Summary, Vol. I (Final Report)*, prepared for the U.S. Department of Health and Human Services, Washington

Lahr, M.L., 1993, A Review of the Literature Supporting the Hybrid Approach to Constructing Regional Input-Output Models, *Economic Systems Research*, 5: 277-293

Miller, R.E. and P. D. Blair, 1985, *Input-Output Analysis: Foundations and Extensions*, New Jersey: Prentice-Hall

Moses, L.N., 1955, The Stability of Interregional Trading Patterns and Input-Output Analysis, *American Economic Review*, 45: 803-832

Polenske, K.R., 1980, *The U.S. Multiregional Input-Output Accounts and Model*, DC Health, Lexington, MA

U.S. Bureau of the Census, Current Business Reports, Series BW/96-RV, 1997, *Annual Benchmark Report for Wholesale Trade: January 1987 Through February 1997*, Washington, DC

Robison, W.S., 1950, Ecological Correlations and the Behavior of Individuals, *American Sociological Review* 15: 351-357.

Miller, R.E. and G. Shao, 1990, Spatial and Sectoral Aggregation in the Commodity-Industry Multiregional Input-Output Model, *Environment and Planning A* 22: 1637-1656.

Jackson, R.W., W.R. Schwarm, Y. Okuyama, and S. Islam, 2004, A Method for Constructing Commodity by Industry Flow Matrices, *Paper presented at the 2004 Southern Regional Science Association Conference*, New Orleans, LA

Park, J., P. Gordon, J.E. Moore II, and H.W. Richardson, 2004, Construction of a U.S. Multiregional Input-Output Model Using IMPLAN, *Paper presented at 2004 National IMPLAN User's Conference*, Eastern Management Development Center, Shepherdstown, West Virginia

Statistical Abstract of the United States, No. 1277. U.S. International Trade Goods and Services (http://www.census.gov/prod/2003pubs/02statab/foreign.pdf)

Appendices

Appendix 1. Data Reconciliation and Definition of USC Sectors

The aggregation of 2001 IMPLAN sectors was in light of the fundamental characteristics of sectors: commodity sectors vs. non-commodity (service) sectors. IMPLAN's commodity sectors are based on NAICS and BEA sectors and were aggregated into 43 SCTG sectors used in the 1997 CFS as shown in Figure 3. Although the 43 (1997) CFS SCTG commodity sectors were based on SIC industry codes, and not the NAICS industry codes, SCTG commodity classification names in 1997 CFS and 2002 CFS remain the same. Because at this writing, the 2002 CFS full data sets are not available, we worked with the 1997 CFS data. To test our converted results, we compared aggregates to the currently available 2002 CFS values (Appendix 1f). After noting the reasonability of our sector aggregations at the national level, the final USC sectors and various conversion bridges were used in NIEMO construction which required the same data conversion processes at the state level.

Starting in 2001, IMPLAN adopted the NAICS industry codes, while also maintaining matches to the BEA commodity codes. Owing to its basis in the NAICS codes, the remaining IMPLAN sectors are relatively easily aggregated into 19 NAICS two-digit service sectors added to the commodity aggregations and redefined as aggregation codes in Appendix 1a, which were combined with the 19 USC service sectors.

Appendix 1a. Selected IMPLAN Sector Aggregation to Two-Digit NAICS Codes

IMPLAN 2001 (509)	Aggregation Codes	Aggregation Descriptions	NAICS 2 digit codes
19	**16**	Oil Extraction	-
33-45	**53**	Construction	Construction
390	**54**	Wholesale Trade	Wholesale Trade
401-412	**57**	Retail Trade	Retail Trade
30-32	**52**	Utility	Utility
391-397	**55**	Transportation	Transportation
398-400	**56**	Warehousing	Warehousing
416,420-424	**58**	Broadcasting and information services	Part Information (Publishing, Motion pictures, and Recording (IMPLAN 413-415, 417-419) are excluded in this sector and included in Commodity Flows)
425-430	**59**	Finance and Insurance	Finance and Insurance
431-436, 509	**60**	Real estate and rental and leasing	Real estate and rental and leasing
437-450	**61**	Professional, Scientific, and Technical services	Professional, Scientific, and Technical services
451	**62**	Management of companies and enterprises	Management of companies and enterprises
452-460	**63**	Administrative support and waste management	Administrative support and waste management
461-462	**64**	Education Services	Education Services
463-470	**65**	Health Care and Social Assistances	Health Care and Social Assistances
471-478	**66**	Arts, Entertainment, and Recreation	Arts, Entertainment, and Recreation
479-481	**67**	Accommodation and Food services	Accommodation and Food services
495-499, 503-506	**68**	Public administration	Public administration
482-494	**69**	Other services (except public administration)	Other services (except public administration)
18, 27-29, 243	**69**	Support activities (18=Agriculture and forestry, 27-29=Mining) and Etc. (243=Machine shops)	-
500, 507-508	**99**	Unknown commodity	Unknown
All other IMPLAN sectors[1]	**1-15, 17-41, 43**	SCTG 1-15, 17-41, 43	-

Notes: 1. Detail sector bridge between IMPLAN and SCTG in this Aggregation Codes is shown in Appendix 2

In addition to the service sector IMPLAN aggregation, the reconciliation to the final 29 commodity USC sectors was accomplished by further manual adjustments, producer/purchaser dollar value adjustments, and minor sector (SCTG 16 and 43) corrections at the national level. Minor manual adjustments were based on judgments and using sector names. A detailed sector bridge table for IMPLAN->BEA->SCTG->USC for all commodity and service sectors is shown in Appendix 2.

Dollar-value comparisons by aggregated sectors make it easier for data reconciliations to be confirmed. Producer/purchaser dollar value adjustments were conducted because the IMPLAN data uses producer values, while the CFS data are based on purchaser values which include transportation costs, wholesale markups, and retail markups besides the producer values. Appendix 1b shows dollar value adjustments of all the CFS data using price ratios (= producer prices/purchaser prices) at the sector-level. These were adjusted by calibrating producer/purchaser ratios aggregated to the two-digit SCTG sectors following the conversion steps shown in Figure 3, utilizing producer and purchaser values at the BEA five-digit level from BEA NDN-0307 data at the BEA website. This step allows the estimated commodity flows in terms of producer values to be converted to flows in terms of purchaser values consistent with the CFS reports. Any estimated flows can be compared with CFS flows using these conversion ratios (the P-ratios; for SCTG 43 is assumed as equal to one due to its unavailability).

Appendix 1b: Aggregated 1997 BEA Benchmark: Producer/Purchaser Values and Ratios

SCTG	V_PRO	P_PRO	V_PUR	P_PUR	P-Ratios (=V_PRO/V_PUR)
1	15,217	0.35%	15,346	0.27%	0.99
2	44,068	1.01%	57,901	1.01%	0.76
3	93,060	2.13%	135,909	2.37%	0.68
4	33,075	0.76%	44,105	0.77%	0.75
5	157,516	3.60%	195,765	3.41%	0.80
6	72,776	1.67%	101,044	1.76%	0.72
7	174,908	4.00%	240,070	4.18%	0.73
8	77,799	1.78%	117,648	2.05%	0.66
9	40,018	0.92%	62,357	1.09%	0.64
10	2,686	0.06%	3,914	0.07%	0.69
11	1,967	0.05%	3,181	0.06%	0.62
12	260	0.01%	395	0.01%	0.66
13	4,290	0.10%	8,313	0.14%	0.52
14	9,375	0.21%	10,019	0.17%	0.94
15	23,597	0.54%	35,128	0.61%	0.67
17	83,541	1.91%	146,500	2.55%	0.57
18	338	0.01%	593	0.01%	0.57
19	26,510	0.61%	33,865	0.59%	0.78
20	56,732	1.30%	71,607	1.25%	0.79
21	121,089	2.77%	171,889	2.99%	0.70
22	369	0.01%	427	0.01%	0.86
23	130,938	3.00%	177,939	3.10%	0.74
24	185,554	4.25%	256,787	4.47%	0.72
25	20,189	0.46%	22,050	0.38%	0.92
26	100,980	2.31%	128,085	2.23%	0.79
27	57,525	1.32%	70,262	1.22%	0.82
28	20,104	0.46%	27,944	0.49%	0.72
29	116,818	2.67%	150,008	2.61%	0.78
30	264,847	6.06%	424,046	7.39%	0.62
31	94,800	2.17%	118,661	2.07%	0.80
32	188,172	4.31%	223,302	3.89%	0.84
33	173,656	3.97%	208,604	3.63%	0.83
34	361,183	8.26%	433,471	7.55%	0.83
35	691,944	15.83%	820,069	14.28%	0.84
36	558,530	12.78%	661,763	11.53%	0.84
37	107,897	2.47%	111,758	1.95%	0.97
38	80,347	1.84%	107,100	1.87%	0.75
39	60,851	1.39%	99,511	1.73%	0.61
40	100,010	2.29%	213,248	3.71%	0.47
41	7,432	0.17%	21,146	0.37%	0.35
43	--	--	--	--	--
99	9,251	0.21%	9,251	0.16%	1.00
ALL	4,370,221	100%	5,740,983	100%	0.76

Data source: BEA NDN-0307 data (http://www.bea.gov/bea/dn2/iedguide.htm#IO)
Note: V_Pro=Producer's Value, P_Pro=Proportions of V_Pro,

V_Pur=Purchaser's Value, P_Pro=Proportions of V_Pur

Special adjustments were required for two of the SCTG sectors, CFS 'Mixed Freight' (SCTG 43), and 'Oil and Gas Extraction' (SCTG 16). The CFS Mixed Freight sector has no corresponding BEA or IMPLAN commodity sectors. Using the labels and definitions that accompany CFS Mixed Freight sector, we assumed that the national value for SCTG 43 from the 2002 CFS preliminary version to be the same as similarly named subsectors' values of Wholesale Trade in 2002 Economic Census. Appendix 1c shows the subsectors of Economic Census whose names roughly correspond to SCTG Sector 43.

Appendix 1c. Sales Values Matched to SCTG 43 from 2002 Wholesale Economic Census

2002 NAICS code and Description	CFS Mixed Freight Code and Description	Sales Value($1,000)
4244. Grocery and related products merchant wholesalers	43991. Items(including food) for Grocery and Convenience stores 43992. Supplies and food for restaurant and fast food chains	616,389,515
4237. Hardware, and plumbing and heating equipment and supplies merchant wholesalers	43992. Hardware or plumbing supplies	82,578,288
42412. Stationery and office supplies merchant wholesalers	43994. Office Supplies	34,218,647
--	43999. Miscellaneous	--
Total		733,186,450

*Source: 2002 Economic Census, Industry Series Reports, Wholesale Trade from "http://www.census.gov/econ/census02/guide/INDRPT42.HTM"

Based on this definition, our adjusted subsector value of wholesale value for 2001 IMPLAN is shown in Appendix 1d. Instead of using $733 billions shown in Appendix 1c

we substituted SCTG Sector 43 for the wholesale subsector value of the 2002 Economic Census with sector value from the 2002 CFS. It was better to use 2002 CFS value as the subsector value, because the subsectors of the 2002 Economic Census wholesale still do not reflect the SCTG 43 sector entirely. Therefore, by showing that this SCTG sector 43 is made up of subsectors of wholesale, we assume that the value of 2002 SCTG 43 can be that subsector's value of wholesale trade.

Appendix 1d. Calculation of SCTG 43 Value From 2001 IMPLAN Using Economic Census

		2002 Economic Census	2002 CFS	2001 IMPLAN
Purchaser Values	Wholesale (Sales) Value	4,376,337,051		
	Subsectors of Wholesale Trade or SCTG 43	858,320,000	858,320,000	
Adjustment Ratio**		0.2074		
Derived Producer Values	Adjusted Wholesale Value	907,457,995		875,318,813
	Adjusted Subsectors' Value of Wholesale value	177,977,459		171,674,082
Subsectors' Proportion		0.196		0.196

* Unit: $1,000
**Source: 1987-1995 average (Gross Margin/Sales price) Ratio from "Annual Benchmark Report for Wholesale Trade: January 1987 through February 1997"

In Appendix 1d, the relevant subsectors' value in the 2002 Economic Census is estimated at 19.6 percent. This was used to adjust 2001 IMPLAN Wholesale total value ($875.3 million) for the following results.

Here follows a summary of the steps followed to derive the adjusted producer value of subsector of wholesale trade matched to SCTG 43: (i) adjust dollar value to producer value by the average of the 1987-1995 ratio of (gross margin)/(sales price) = 20.7% from the "Annual Benchmark Report For Wholesale Trade" (U.S. Bureau of the Census, 1997), (ii) calculate subsectors ratio (Adjusted Wholesale Value/ Adjusted Subsectors of wholesale value=19.6%) from the derived producer values cell, and (iii) multiply the calculated ratio by the wholesale sector output value from 2001 IMPLAN (875.3 million dollars). From all these steps, we get $178 million as our estimate of CFS Sector 43 and $172 million correspondently estimated to be our estimate IMPLAN's mixed freight component of the wholesale sector.

Two Appendices 3a and 3b show the results of aggregating the 2001 IMPLAN sectors to the 43 SCTG sectors for 1997 and 2002. Although we reconciled sectors by following above steps, there are still differences between the two. In order to improve the correspondence of IMPLAN sectors to SCTG sectors, we aggregated to 29 USC sectors from the 43 SCTG sectors. During aggregating, the SCTG 'Oil and Gas Extraction' sector (#16) which was removed from CFS due to the problem of overwhelming number of shipments is included in USC sector 10. Therefore, the final USC Sectors are shown in Appendix 1e. According to the two Appendices and the USC sectors of Appendix 1e, Appendix 1f shows the final 2001 IMPLAN reconciliation with 1997 and 2002 CFS, all in producer prices by USC sector, where 2001 IMPLAN value ratios with 2002 CFS (=V1/V4) in USC sectors are mostly near one

Appendix 1e. Definitions of USC Two-Digit Sectors

Classification	USC	Description	SCTG	NAICS
Commodity Sectors	USC01	Live animals and live fish & Meat, fish, seafood, and their preparations	(1+5)	11,31
	USC02	Cereal grains & Other agricultural products except for Animal Feed	(2+3)	11,31
	USC03	Animal feed and products of animal origin, n.e.c.	4	11,31
	USC04	Milled grain products and preparations, and bakery products	6	31
	USC05	Other prepared foodstuffs and fats and oils	7	11,31
	USC06	Alcoholic beverages	8	31,32
	USC07	Tobacco products	9	11,31
	USC08	Nonmetallic minerals (Monumental or building stone, Natural sands, Gravel and crushed stone, n.e.c.)	(10~13)	21,32
	USC09	Metallic ores and concentrates	14	21,32
	USC10	Coal and petroleum products (Coal and Fuel oils, n.e.c.)	(15~19)	21,32
	USC11	Basic chemicals	20	32
	USC12	Pharmaceutical products	21	32,33
	USC13	Fertilizers	22	32
	USC14	Chemical products and preparations, n.e.c.	23	31,32
	USC15	Plastics and rubber	24	31,32,33
	USC16	Logs and other wood in the rough & Wood products	(25+26)	11,32
	USC17	Pulp, newsprint, paper, and paperboard & Paper or paperboard articles	(27+28)	32
	USC18	Printed products	29	32,51
	USC19	Textiles, leather, and articles of textiles or leather	30	11,31,32,33
	USC20	Nonmetallic mineral products	31	32,33
	USC21	Base metal in primary or semi-finished forms and in finished basic shapes	32	33
	USC22	Articles of base metal	33	33
	USC23	Machinery	34	32,33
	USC24	Electronic and other electrical equipment and components, and office equipment	35	32,33,51
	USC25	Motorized and other vehicles (including parts)	36	32,33
	USC26	Transportation equipment, n.e.c.	37	33
	USC27	Precision instruments and apparatus	38	33
	USC28	Furniture, mattresses and mattress supports, lamps, lighting fittings, and illuminated signs	39	33
	USC29	Miscellaneous manufactured products, Scrap, Mixed freight, and Commodity unknown	(40~99)	11,31,32,33
Non-Commodity (Service) Sectors	USC30	Utility		22
	USC31	Construction		23
	USC32	Wholesale Trade		42
	USC33	Transportation		48
	USC34	Postal and Warehousing		49
	USC35	Retail Trade		(44+45)
	USC36	Broadcasting and information services*		(515~519)
	USC37	Finance and Insurance		52
	USC38	Real estate and rental and leasing		53
	USC39	Professional, Scientific, and Technical services		54
	USC40	Management of companies and enterprises		55
	USC41	Administrative support and waste management		56
	USC42	Education Services		61
	USC43	Health Care and Social Assistances		62
	USC44	Arts, Entertainment, and Recreation		71
	USC45	Accommodation and Food services		72
	USC46	Public administration		92
	USC47	Other services except public administration**		81

*Publishing, Motion pictures, and Recording (IMPLAN 413-415, 417-419, or NAICS 511~512) are excluded in this sector and included in Commodity Sectors

**USC47 includes NAICS 81plus Support activities (18=Agriculture and forestry, 27-29=Mining) and Etc. (243=Machine shops) in IMPLAN

Appendix 1f. IMPLAN Reconciliation With 1997/2002 CFS Producer Prices by USC Sector

Sectors	2001 IMPLAN		2002 CFS_Revised		1997 CFS_Revised		2002 Ratio		1997 Ratio	
USC	V1*	P1**	V4	P4	V5	P5	V1/ V4	P1/ P4	V1/ V5	P1/ P5
USC01	192,478	3.18%	171,981	2.92%	153,997	3.03%	1.12	1.09	1.25	1.05
USC02	130,536	2.16%	131,504	2.24%	115,470	2.27%	0.99	0.97	1.13	0.95
USC03	45,911	0.76%	41,433	0.70%	50,130	0.99%	1.11	1.08	0.92	0.77
USC04	86,329	1.43%	86,226	1.47%	79,122	1.56%	1.00	0.97	1.09	0.92
USC05	302,706	5.01%	263,970	4.49%	252,361	4.96%	1.15	1.11	1.20	1.01
USC06	80,602	1.33%	76,558	1.30%	58,148	1.14%	1.05	1.02	1.39	1.17
USC07	54,172	0.90%	49,519	0.84%	36,191	0.71%	1.09	1.06	1.50	1.26
USC08	20,141	0.33%	19,396	0.33%	17,936	0.35%	1.04	1.01	1.12	0.94
USC09	11,054	0.18%	14,729	0.25%	11,794	0.23%	0.75	0.73	0.94	0.79
USC10	480,173	7.94%	270,347	4.60%	253,304	4.98%	1.78	1.73	1.90	1.59
USC11	104,099	1.72%	120,479	2.05%	126,464	2.49%	0.86	0.84	0.82	0.69
USC12	174,086	2.88%	300,630	5.11%	158,114	3.11%	0.58	0.56	1.10	0.93
USC13	22,231	0.37%	29,431	0.50%	23,606	0.46%	0.76	0.73	0.94	0.79
USC14	159,819	2.64%	172,452	2.93%	154,153	3.03%	0.93	0.90	1.04	0.87
USC15	231,896	3.83%	248,130	4.22%	201,484	3.96%	0.93	0.91	1.15	0.97
USC16	122,282	2.02%	115,614	1.97%	113,525	2.23%	1.06	1.03	1.08	0.91
USC17	154,827	2.56%	160,021	2.72%	158,010	3.11%	0.97	0.94	0.98	0.82
USC18	133,501	2.21%	106,600	1.81%	202,729	3.99%	1.25	1.22	0.66	0.55
USC19	292,878	4.84%	316,653	5.39%	236,813	4.66%	0.92	0.90	1.24	1.04
USC20	113,064	1.87%	114,330	1.94%	87,240	1.72%	0.99	0.96	1.30	1.09
USC21	169,411	2.80%	213,769	3.64%	240,745	4.73%	0.79	0.77	0.70	0.59
USC22	200,391	3.31%	199,880	3.40%	193,294	3.80%	1.00	0.97	1.04	0.87
USC23	433,014	7.16%	424,514	7.22%	347,545	6.83%	1.02	0.99	1.25	1.05
USC24	844,544	13.96%	799,929	13.60%	733,800	14.43%	1.06	1.03	1.15	0.97
USC25	654,570	10.82%	620,959	10.56%	481,910	9.48%	1.05	1.02	1.36	1.14
USC26	143,113	2.37%	157,354	2.68%	124,723	2.45%	0.91	0.88	1.15	0.96
USC27	160,050	2.65%	166,576	2.83%	118,491	2.33%	0.96	0.93	1.35	1.14
USC28	92,277	1.53%	82,582	1.40%	59,471	1.17%	1.12	1.09	1.55	1.30
USC29	436,417	7.22%	404,687	6.88%	295,358	5.81%	1.08	1.05	1.48	1.24
ALL	6,047,838	100%	5,880,253	100%	5,085,927	100%	1.03	1.00	1.19	1.00

* Unit: (million$)
** {(Each SCTG sector value)x100}/ (ALL value).

Despite the national-level reconciliation, state-level reconciliations between IMPLAN and CFS required more specific work because various concepts in these two data sources are not same at the state level. For example, based on CFS definitions, foreign imports which are transported from port of entry to the destination state are included in CFS interstate commodity flows. However, in IMPLAN, foreign imports refer to the imports which are consumed in the local area. This can be verified from the difference between the sum of foreign imports in each state and national foreign imports. In other words, the foreign imports which are not consumed in the local area and transported to other state(s) are excluded from the state or county-level IMPLAN data.

In order to make the concept of "interstate commodity flow" consistent between these two data sources, IMPLAN Foreign Imports (=*IFI*) data are added to Total Commodity Output in the IMPLAN data at the state level, being adjusted by dividing new 29 ratios (=NRATIO). NRATIO means the vector proportions of foreign imports of sum of every state to U.S. foreign imports by 29 USC commodity sector. Adjusted Foreign Imports (=*AFI*) will then include the foreign imports consumed in certain local areas which are used as a port of entry, as well as those consumed in other states. In this way, CFS and IMPLAN data were made more comparable at the state level. Based on the above discussion and for each NRATIO, we denote Remaining IMPLAN Foreign Imports in each state as *RIFI* (= NRATIO **AFI*), and denote Other IMPLAN Foreign Imports as *OIFI* (= (1- NRATIO)* *AFI*)). These concepts denoted will be used to estimate trade flows shown in Appendix 4.

Appendix 2. Conversion Table: IMPLAN-BEA-SCTG-USC Sectors

IMPLAN	BEA	Description	SCTG	USC
1	1111A0	Oilseed farming	3	2
2	1111B0	Grain farming	2	2
3	111200	Vegetable and melon farming	3	2
4	111335	Tree nut farming	3	2
5	1113A0	Fruit farming	3	2
5	1113A0	Fruit farming	7	5
6	111400	Greenhouse and nursery production	3	2
6	111400	Greenhouse and nursery production	40	29
7	111910	Tobacco farming	3	2
7	111910	Tobacco farming	9	7
8	111920	Cotton farming	3	2
9	1119A0	Sugarcane and sugar beet farming	3	2
10	1119B0	All other crop farming	2	2
10	1119B0	All other crop farming	3	2
10	1119B0	All other crop farming	7	5
10	1119B0	All other crop farming	30	19
11	112100	Cattle ranching and farming	7	5
11	112100	Cattle ranching and farming	7	5
11	112100	Cattle ranching and farming	4	3
11	112100	Cattle ranching and farming	1	1
12	112300	Poultry and egg production	5	1
13	112A00	Animal production, except cattle and poultry and eggs	5	1
14	113300	Logging	25	16
15	113A00	Forest nurseries, forest products, and timber tracts	26	16
16	114100	Fishing	5	1
17	114200	Hunting and trapping	5	1
18	115000	Agriculture and forestry support activities	69	47
19	211000	Oil and gas extraction	16	10
20	212100	Coal mining	15	10
21	212210	Iron ore mining	14	9
22	212230	Copper, nickel, lead, and zinc mining	14	9
23	2122A0	Gold, silver, and other metal ore mining	14	9
24	212310	Stone mining and quarrying	10	8
24	212310	Stone mining and quarrying	12	8
24	212310	Stone mining and quarrying	13	8
25	212320	Sand, gravel, clay, and refractory mining	13	8
25	212320	Sand, gravel, clay, and refractory mining	11	8
25	212320	Sand, gravel, clay, and refractory mining	12	8
26	212390	Other nonmetallic mineral mining	13	8
27	213111	Drilling oil and gas wells	69	47
28	213112	Support activities for oil and gas operations	69	47
29	21311A	Support activities for other mining	69	47
30	221100	Power generation and supply	52	30
31	221200	Natural gas distribution	52	30
32	221300	Water, sewage and other systems	52	30
33	230110	New residential 1-unit structures, nonfarm	53	31
34	230120	New multifamily housing structures, nonfarm	53	31
35	230130	New residential additions and alterations, nonfarm	53	31
36	230140	New farm housing units and additions and alterations	53	31
37	230210	Manufacturing and industrial buildings	53	31
38	230220	Commercial and institutional buildings	53	31
39	230230	Highway, street, bridge, and tunnel construction	53	31
40	230240	Water, sewer, and pipeline construction	53	31

41	230250	Other new construction	53	31
42	230310	Maintenance and repair of farm and nonfarm residential structures	53	31
43	230320	Maintenance and repair of nonresidential buildings	53	31
44	230330	Maintenance and repair of highways, streets, bridges, and tunnels	53	31
45	230340	Other maintenance and repair construction	53	31
46	311111	Dog and cat food manufacturing	4	3
47	311119	Other animal food manufacturing	4	3
48	311211	Flour milling	3	2
48	311211	Flour milling	6	4
49	311212	Rice milling	6	4
50	311213	Malt manufacturing	6	4
51	311221	Wet corn milling	7	5
51	311221	Wet corn milling	6	4
52	311222	Soybean processing	7	5
53	311223	Other oilseed processing	7	5
54	311225	Fats and oils refining and blending	5	1
54	311225	Fats and oils refining and blending	7	5
55	311230	Breakfast cereal manufacturing	7	5
56	311310	Sugar manufacturing	7	5
57	311320	Confectionery manufacturing from cacao beans	7	5
58	311330	Confectionery manufacturing from purchased chocolate	7	5
59	311340	Nonchocolate confectionery manufacturing	7	5
60	311410	Frozen food manufacturing	7	5
61	311420	Fruit and vegetable canning and drying	7	5
61	311420	Fruit and vegetable canning and drying	3	2
62	311511	Fluid milk manufacturing	6	4
62	311511	Fluid milk manufacturing	7	5
63	311512	Creamery butter manufacturing	7	5
64	311513	Cheese manufacturing	7	5
65	311514	Dry, condensed, and evaporated dairy products	23	14
65	311514	Dry, condensed, and evaporated dairy products	6	4
65	311514	Dry, condensed, and evaporated dairy products	7	5
66	311520	Ice cream and frozen dessert manufacturing	7	5
67	311611	Animal, except poultry, slaughtering	7	5
67	311611	Animal, except poultry, slaughtering	5	1
68	311612	Meat processed from carcasses	5	1
69	311613	Rendering and meat byproduct processing	7	5
70	311615	Poultry processing	5	1
71	311700	Seafood product preparation and packaging	5	1
72	311813	Frozen cakes and other pastries manufacturing	6	4
73	31181A	Bread and bakery product, except frozen, manufacturing	6	4
74	311821	Cookie and cracker manufacturing	6	4
75	311822	Mixes and dough made from purchased flour	6	4
76	311823	Dry pasta manufacturing	6	4
77	311830	Tortilla manufacturing	6	4
78	311911	Roasted nuts and peanut butter manufacturing	3	2
78	311911	Roasted nuts and peanut butter manufacturing	7	5
79	311919	Other snack food manufacturing	6	4
79	311919	Other snack food manufacturing	7	5
80	311920	Coffee and tea manufacturing	7	5
80	311920	Coffee and tea manufacturing	3	2
81	311930	Flavoring syrup and concentrate manufacturing	7	5
81	311930	Flavoring syrup and concentrate manufacturing	8	6
82	311941	Mayonnaise, dressing, and sauce manufacturing	7	5
83	311942	Spice and extract manufacturing	7	5
84	311990	All other food manufacturing	7	5

85	312110	Soft drink and ice manufacturing	7	5
86	312120	Breweries	8	6
87	312130	Wineries	8	6
88	312140	Distilleries	8	6
89	312210	Tobacco stemming and redrying	3	2
89	312210	Tobacco stemming and redrying	9	7
90	312221	Cigarette manufacturing	9	7
91	312229	Other tobacco product manufacturing	9	7
92	313100	Fiber, yarn, and thread mills	30	19
93	313210	Broadwoven fabric mills	30	19
94	313220	Narrow fabric mills and schiffli embroidery	30	19
95	313230	Nonwoven fabric mills	30	19
96	313240	Knit fabric mills	30	19
97	313310	Textile and fabric finishing mills	30	19
98	313320	Fabric coating mills	30	19
99	314110	Carpet and rug mills	30	19
100	314120	Curtain and linen mills	30	19
101	314910	Textile bag and canvas mills	30	19
102	314992	Tire cord and tire fabric mills	30	19
103	31499A	Other miscellaneous textile product mills	30	19
103	31499A	Other miscellaneous textile product mills	40	29
104	315111	Sheer hosiery mills	30	19
105	315119	Other hosiery and sock mills	30	19
106	315190	Other apparel knitting mills	30	19
107	315200	Cut and sew apparel manufacturing	30	19
108	315900	Accessories and other apparel manufacturing	24	15
108	315900	Accessories and other apparel manufacturing	30	19
109	316100	Leather and hide tanning and finishing	30	19
110	316200	Footwear manufacturing	30	19
111	316900	Other leather product manufacturing	30	19
112	321113	Sawmills	26	16
113	321114	Wood preservation	26	16
114	321219	Reconstituted wood product manufacturing	26	16
115	32121A	Veneer and plywood manufacturing	26	16
116	32121B	Engineered wood member and truss manufacturing	26	16
117	321911	Wood windows and door manufacturing	26	16
118	321912	Cut stock, resawing lumber, and planing	26	16
119	321918	Other millwork, including flooring	26	16
120	321920	Wood container and pallet manufacturing	26	16
121	321991	Manufactured home, mobile home, manufacturing	36	25
122	321992	Prefabricated wood building manufacturing	26	16
123	321999	Miscellaneous wood product manufacturing	26	16
124	322110	Pulp mills	23	14
124	322110	Pulp mills	27	17
125	3221A0	Paper and paperboard mills	27	17
125	3221A0	Paper and paperboard mills	28	17
126	322210	Paperboard container manufacturing	27	17
126	322210	Paperboard container manufacturing	28	17
127	322225	Flexible packaging foil manufacturing	28	17
128	322226	Surface-coated paperboard manufactuing	28	17
129	32222A	Coated and laminated paper and packaging materials	27	17
129	32222A	Coated and laminated paper and packaging materials	24	15
130	32222B	Coated and uncoated paper bag manufacturing	24	15
130	32222B	Coated and uncoated paper bag manufacturing	27	17
131	322231	Die-cut paper office supplies manufacturing	28	17
132	322232	Envelope manufacturing	28	17

133	322233	Stationery and related product manufacturing	28	17
134	322291	Sanitary paper product manufacturing	28	17
135	322299	All other converted paper product manufacturing	28	17
135	322299	All other converted paper product manufacturing	30	19
135	322299	All other converted paper product manufacturing	40	29
136	323116	Manifold business forms printing	29	18
137	323117	Books printing	29	18
138	323118	Blankbook and looseleaf binder manufacturing	29	18
139	32311A	Commercial printing	29	18
140	323121	Tradebinding and related work	34	23
141	323122	Prepress services	34	23
142	324110	Petroleum refineries	17	10
142	324110	Petroleum refineries	18	10
143	324121	Asphalt paving mixture and block manufacturing	19	10
144	324122	Asphalt shingle and coating materials manufacturing	31	20
145	324191	Petroleum lubricating oil and grease manufacturing	19	10
146	324199	All other petroleum and coal products manufacturing	19	10
147	325110	Petrochemical manufacturing	19	10
147	325110	Petrochemical manufacturing	20	11
148	325120	Industrial gas manufacturing	20	11
149	325130	Synthetic dye and pigment manufacturing	20	11
150	325180	Other basic inorganic chemical manufacturing	20	11
150	325180	Other basic inorganic chemical manufacturing	22	13
151	325190	Other basic organic chemical manufacturing	20	11
151	325190	Other basic organic chemical manufacturing	8	6
152	325211	Plastics material and resin manufacturing	24	15
152	325211	Plastics material and resin manufacturing	23	14
153	325212	Synthetic rubber manufacturing	24	15
154	325221	Cellulosic organic fiber manufacturing	24	15
154	325221	Cellulosic organic fiber manufacturing	30	19
155	325222	Noncellulosic organic fiber manufacturing	30	19
156	325311	Nitrogenous fertilizer manufacturing	20	11
156	325311	Nitrogenous fertilizer manufacturing	22	13
157	325312	Phosphatic fertilizer manufacturing	20	11
157	325312	Phosphatic fertilizer manufacturing	22	13
158	325314	Fertilizer, mixing only, manufacturing	22	13
159	325320	Pesticide and other agricultural chemical manufacturing	20	11
159	325320	Pesticide and other agricultural chemical manufacturing	23	14
160	325400	Pharmaceutical and medicine manufacturing	21	12
161	325510	Paint and coating manufacturing	23	14
162	325520	Adhesive manufacturing	23	14
163	325611	Soap and other detergent manufacturing	20	11
163	325611	Soap and other detergent manufacturing	23	14
164	325612	Polish and other sanitation good manufacturing	23	14
165	325613	Surface active agent manufacturing	23	14
165	325613	Surface active agent manufacturing	20	11
166	325620	Toilet preparation manufacturing	23	14
167	325910	Printing ink manufacturing	23	14
168	325920	Explosives manufacturing	23	14
168	325920	Explosives manufacturing	24	15
169	325991	Custom compounding of purchased resins	23	14
170	325992	Photographic film and chemical manufacturing	23	14
171	325998	Other miscellaneous chemical product manufacturing	23	14
172	326110	Plastics packaging materials, film and sheet	24	15
173	326120	Plastics pipe, fittings, and profile shapes	24	15
174	326130	Laminated plastics plate, sheet, and shapes	24	15

175	326160	Plastics bottle manufacturing	24	15
176	326192	Resilient floor covering manufacturing	24	15
177	32619A	Plastics plumbing fixtures and all other plastics products	24	15
178	3261A0	Foam product manufacturing	24	15
179	326210	Tire manufacturing	24	15
180	326220	Rubber and plastics hose and belting manufacturing	24	15
181	326290	Other rubber product manufacturing	24	15
181	326290	Other rubber product manufacturing	30	19
182	327111	Vitreous china plumbing fixture manufacturing	31	20
183	327112	Vitreous china and earthenware articles manufacturing	31	20
184	327113	Porcelain electrical supply manufacturing	31	20
184	327113	Porcelain electrical supply manufacturing	35	24
185	327121	Brick and structural clay tile manufacturing	31	20
186	327122	Ceramic wall and floor tile manufacturing	31	20
187	327125	Nonclay refractory manufacturing	31	20
188	32712A	Clay refractory and other structural clay products	31	20
189	327213	Glass container manufacturing	31	20
190	32721A	Glass and glass products, except glass containers	31	20
191	327310	Cement manufacturing	31	20
192	327320	Ready-mix concrete manufacturing	31	20
193	327331	Concrete block and brick manufacturing	31	20
194	327332	Concrete pipe manufacturing	31	20
195	327390	Other concrete product manufacturing	31	20
196	327410	Lime manufacturing	31	20
197	327420	Gypsum product manufacturing	31	20
198	327910	Abrasive product manufacturing	20	11
198	327910	Abrasive product manufacturing	40	29
198	327910	Abrasive product manufacturing	31	20
199	327991	Cut stone and stone product manufacturing	31	20
200	327992	Ground or treated minerals and earths manufacturing	13	8
200	327992	Ground or treated minerals and earths manufacturing	14	9
200	327992	Ground or treated minerals and earths manufacturing	31	20
201	327993	Mineral wool manufacturing	31	20
202	327999	Miscellaneous nonmetallic mineral products	31	20
203	331111	Iron and steel mills	32	21
204	331112	Ferroalloy and related product manufacturing	32	21
205	331210	Iron, steel pipe and tube from purchased steel	32	21
206	331221	Rolled steel shape manufacturing	32	21
207	331222	Steel wire drawing	32	21
208	331311	Alumina refining	32	21
209	331312	Primary aluminum production	32	21
210	331314	Secondary smelting and alloying of aluminum	32	21
211	331315	Aluminum sheet, plate, and foil manufacturing	32	21
212	331316	Aluminum extruded product manufacturing	32	21
213	331319	Other aluminum rolling and drawing	32	21
214	331411	Primary smelting and refining of copper	32	21
215	331419	Primary nonferrous metal, except copper and aluminum	32	21
216	331421	Copper rolling, drawing, and extruding	32	21
217	331422	Copper wire, except mechanical, drawing	32	21
218	331423	Secondary processing of copper	32	21
219	331491	Nonferrous metal, except copper and aluminum, shaping	32	21
220	331492	Secondary processing of other nonferrous	32	21
221	331510	Ferrous metal foundaries	34	23
221	331510	Ferrous metal foundaries	33	22
222	33152A	Aluminum foundries	33	22
223	33152B	Nonferrous foundries, except aluminum	33	22

224	332111	Iron and steel forging	33	22
225	332112	Nonferrous forging	33	22
226	332114	Custom roll forming	33	22
227	33211A	All other forging and stamping	33	22
227	33211A	All other forging and stamping	34	23
228	332211	Cutlery and flatware, except precious, manufacturing	33	22
229	332212	Hand and edge tool manufacturing	34	23
229	332212	Hand and edge tool manufacturing	38	27
229	332212	Hand and edge tool manufacturing	40	29
229	332212	Hand and edge tool manufacturing	33	22
230	332213	Saw blade and handsaw manufacturing	33	22
231	332214	Kitchen utensil, pot, and pan manufacturing	33	22
232	332311	Prefabricated metal buildings and components	33	22
232	332311	Prefabricated metal buildings and components	40	29
233	332312	Fabricated structural metal manufacturing	33	22
234	332313	Plate work manufacturing	33	22
235	332321	Metal window and door manufacturing	33	22
236	332322	Sheet metal work manufacturing	33	22
237	332323	Ornamental and architectural metal work manufacturing	33	22
238	332410	Power boiler and heat exchanger manufacturing	34	23
239	332420	Metal tank, heavy gauge, manufacturing	33	22
239	332420	Metal tank, heavy gauge, manufacturing	34	23
240	332430	Metal can, box, and other container manufacturing	33	22
241	332500	Hardware manufacturing	34	23
242	332600	Spring and wire product manufacturing	33	22
243	332710	Machine shops	69	47
244	332720	Turned product and screw, nut, and bolt manufacturing	33	22
245	332811	Metal heat treating	33	22
246	332812	Metal coating and nonprecious engraving	33	22
247	332813	Electroplating, anodizing, and coloring metal	33	22
248	332910	Metal valve manufacturing	34	23
249	332991	Ball and roller bearing manufacturing	34	23
250	332994	Small arms manufacturing	40	29
251	332995	Other ordnance and accessories manufacturing	40	29
252	332996	Fabricated pipe and pipe fitting manufacturing	32	21
253	332997	Industrial pattern manufacturing	34	23
254	332998	Enameled iron and metal sanitary ware manufacturing	33	22
255	332999	Miscellaneous fabricated metal product manufacturing	40	29
255	332999	Miscellaneous fabricated metal product manufacturing	32	21
256	33299A	Ammunition manufacturing	40	29
257	333111	Farm machinery and equipment manufacturing	34	23
258	333112	Lawn and garden equipment manufacturing	34	23
259	333120	Construction machinery manufacturing	34	23
260	333131	Mining machinery and equipment manufacturing	34	23
261	333132	Oil and gas field machinery and equipment	34	23
262	333210	Sawmill and woodworking machinery	34	23
263	333220	Plastics and rubber industry machinery	34	23
264	333291	Paper industry machinery manufacturing	34	23
265	333292	Textile machinery manufacturing	34	23
265	333292	Textile machinery manufacturing	40	29
266	333293	Printing machinery and equipment manufacturing	34	23
267	333294	Food product machinery manufacturing	34	23
268	333295	Semiconductor machinery manufacturing	34	23
269	333298	All other industrial machinery manufacturing	34	23
270	333313	Office machinery manufacturing	35	24
271	333314	Optical instrument and lens manufacturing	38	27

272	333315	Photographic and photocopying equipment manufacturing	38	27
273	333319	Other commercial and service industry machinery manufacturing	34	23
273	333319	Other commercial and service industry machinery manufacturing	35	24
273	333319	Other commercial and service industry machinery manufacturing	38	27
273	333319	Other commercial and service industry machinery manufacturing	40	29
274	33331A	Automatic vending, commercial laundry and drycleaning machinery	34	23
275	333411	Air purification equipment manufacturing	31	20
275	333411	Air purification equipment manufacturing	34	23
276	333412	Industrial and commercial fan and blower manufacturing	34	23
277	333414	Heating equipment, except warm air furnaces	35	24
277	333414	Heating equipment, except warm air furnaces	34	23
278	333415	AC, refrigeration, and forced air heating	34	23
279	333511	Industrial mold manufacturing	34	23
280	333512	Metal cutting machine tool manufacturing	34	23
281	333513	Metal forming machine tool manufacturing	34	23
282	333514	Special tool, die, jig, and fixture manufacturing	33	22
282	333514	Special tool, die, jig, and fixture manufacturing	34	23
283	333515	Cutting tool and machine tool accessory manufacturing	33	22
283	333515	Cutting tool and machine tool accessory manufacturing	34	23
284	33351A	Rolling mill and other metalworking machinery	34	23
285	333611	Turbine and turbine generator set units manufacturing	34	23
285	333611	Turbine and turbine generator set units manufacturing	35	24
286	333618	Other engine equipment manufacturing	34	23
287	33361A	Speed changers and mechanical power transmission equipment	34	23
287	33361A	Speed changers and mechanical power transmission equipment	35	24
287	33361A	Speed changers and mechanical power transmission equipment	36	25
288	333911	Pump and pumping equipment manufacturing	34	23
289	333912	Air and gas compressor manufacturing	34	23
290	333913	Measuring and dispensing pump manufacturing	34	23
291	333921	Elevator and moving stairway manufacturing	34	23
292	333922	Conveyor and conveying equipment manufacturing	34	23
293	333923	Overhead cranes, hoists, and monorail systems	34	23
294	333924	Industrial truck, trailer, and stacker manufacturing	34	23
294	333924	Industrial truck, trailer, and stacker manufacturing	36	25
295	333991	Power-driven handtool manufacturing	33	22
295	333991	Power-driven handtool manufacturing	34	23
296	333992	Welding and soldering equipment manufacturing	34	23
297	333993	Packaging machinery manufacturing	34	23
298	333994	Industrial process furnace and oven manufacturing	34	23
299	333995	Fluid power cylinder and actuator manufacturing	34	23
300	333996	Fluid power pump and motor manufacturing	34	23
301	33399A	Scales, balances, and miscellaneous general purpose machinery	34	23
301	33399A	Scales, balances, and miscellaneous general purpose machinery	38	27
302	334111	Electronic computer manufacturing	35	24
303	334112	Computer storage device manufacturing	35	24
304	334113	Computer terminal manufacturing	35	24
305	334119	Other computer peripheral equipment manufacturing	35	24
305	334119	Other computer peripheral equipment manufacturing	38	27
306	334210	Telephone apparatus manufacturing	35	24
307	334220	Broadcast and wireless communications equipment	35	24
308	334290	Other communications equipment manufacturing	35	24
308	334290	Other communications equipment manufacturing	38	27
309	334300	Audio and video equipment manufacturing	35	24
310	334411	Electron tube manufacturing	35	24
311	334413	Semiconductors and related device manufacturing	35	24
312	33441A	All other electronic component manufacturing	35	24

313	334510	Electromedical apparatus manufacturing	35	24
313	334510	Electromedical apparatus manufacturing	38	27
314	334511	Search, detection, and navigation instruments	35	24
314	334511	Search, detection, and navigation instruments	38	27
315	334512	Automatic environmental control manufacturing	38	27
315	334512	Automatic environmental control manufacturing	40	29
316	334513	Industrial process variable instruments	38	27
317	334514	Totalizing fluid meters and counting devices	38	27
318	334515	Electricity and signal testing instruments	38	27
318	334515	Electricity and signal testing instruments	35	24
319	334516	Analytical laboratory instrument manufacturing	38	27
320	334517	Irradiation apparatus manufacturing	38	27
321	33451A	Watch, clock, and other measuring and controlling device manufacturing	38	27
321	33451A	Watch, clock, and other measuring and controlling device manufacturing	40	29
322	334611	Software reproducing	35	24
323	334612	Audio and video media reproduction	35	24
324	334613	Magnetic and optical recording media manufacturing	35	24
325	335110	Electric lamp bulb and part manufacturing	35	24
326	335120	Lighting fixture manufacturing	33	22
326	335120	Lighting fixture manufacturing	35	24
327	335211	Electric housewares and household fan manufacturing	35	24
327	335211	Electric housewares and household fan manufacturing	34	23
328	335212	Household vacuum cleaner manufacturing	34	23
328	335212	Household vacuum cleaner manufacturing	35	24
329	335221	Household cooking appliance manufacturing	33	22
329	335221	Household cooking appliance manufacturing	35	24
330	335222	Household refrigerator and home freezer manufacturing	34	23
331	335224	Household laundry equipment manufacturing	34	23
332	335228	Other major household appliance manufacturing	34	23
332	335228	Other major household appliance manufacturing	35	24
333	335311	Electric power and specialty transformer manufacturing	35	24
334	335312	Motor and generator manufacturing	34	23
334	335312	Motor and generator manufacturing	35	24
335	335313	Switchgear and switchboard apparatus manufacturing	35	24
336	335314	Relay and industrial control manufacturing	35	24
337	335911	Storage battery manufacturing	35	24
338	335912	Primary battery manufacturing	35	24
339	335921	Fiber optic cable manufacturing	31	20
339	335921	Fiber optic cable manufacturing	35	24
340	335929	Other communication and energy wire manufacturing	35	24
341	335930	Wiring device manufacturing	35	24
342	335991	Carbon and graphite product manufacturing	35	24
343	335999	Miscellaneous electrical equipment manufacturing	35	24
343	335999	Miscellaneous electrical equipment manufacturing	40	29
344	336110	Automobile and light truck manufacturing	36	25
345	336120	Heavy duty truck manufacturing	36	25
346	336211	Motor vehicle body manufacturing	36	25
347	336212	Truck trailer manufacturing	36	25
348	336213	Motor home manufacturing	36	25
349	336214	Travel trailer and camper manufacturing	36	25
350	336300	Motor vehicle parts manufacturing	36	25
351	336411	Aircraft manufacturing	37	26
352	336412	Aircraft engine and engine parts manufacturing	34	23
353	336413	Other aircraft parts and equipment	37	26
354	336414	Guided missile and space vehicle manufacturing	40	29
355	33641A	Propulsion units and parts for space vehicles and guided missiles	40	29

355	33641A	Propulsion units and parts for space vehicles and guided missiles	34	23
356	336500	Railroad rolling stock manufacturing	37	26
357	336611	Ship building and repairing	37	26
358	336612	Boat building	37	26
359	336991	Motorcycle, bicycle, and parts manufacturing	36	25
359	336991	Motorcycle, bicycle, and parts manufacturing	40	29
360	336992	Military armored vehicles and tank parts manufacturing	36	25
360	336992	Military armored vehicles and tank parts manufacturing	40	29
361	336999	All other transportation equipment manufacturing	36	25
362	337110	Wood kitchen cabinet and countertop manufacturing	39	28
363	337121	Upholstered household furniture manufacturing	39	28
364	337122	Nonupholstered wood household furniture manufacturing	39	28
365	337124	Metal household furniture manufacturing	39	28
366	337127	Institutional furniture manufacturing	39	28
367	33712A	Other household and institutional furniture	34	23
367	33712A	Other household and institutional furniture	39	28
368	337211	Wood office furniture manufacturing	39	28
369	337212	Custom architectural woodwork and millwork	39	28
370	337214	Office furniture, except wood, manufacturing	39	28
370	337214	Office furniture, except wood, manufacturing	33	22
371	337215	Showcases, partitions, shelving, and lockers	33	22
371	337215	Showcases, partitions, shelving, and lockers	39	28
372	337910	Mattress manufacturing	39	28
373	337920	Blind and shade manufacturing	24	15
374	339111	Laboratory apparatus and furniture manufacturing	39	28
375	339112	Surgical and medical instrument manufacturing	38	27
376	339113	Surgical appliance and supplies manufacturing	21	12
376	339113	Surgical appliance and supplies manufacturing	30	19
377	339114	Dental equipment and supplies manufacturing	39	28
377	339114	Dental equipment and supplies manufacturing	21	12
378	339115	Ophthalmic goods manufacturing	38	27
379	339116	Dental laboratories	40	29
380	339910	Jewelry and silverware manufacturing	40	29
381	339920	Sporting and athletic goods manufacturing	30	19
381	339920	Sporting and athletic goods manufacturing	40	29
382	339930	Doll, toy, and game manufacturing	40	29
383	339940	Office supplies, except paper, manufacturing	40	29
384	339950	Sign manufacturing	39	28
385	339991	Gasket, packing, and sealing device manufacturing	40	29
386	339992	Musical instrument manufacturing	40	29
387	339994	Broom, brush, and mop manufacturing	40	29
388	339995	Burial casket manufacturing	40	29
389	33999A	Buttons, pins, and all other miscellaneous manufacturing	40	29
390	420000	Wholesale trade	54	32
391	481000	Air transportation	55	33
392	482000	Rail transportation	55	33
393	483000	Water transportation	55	33
394	484000	Truck transportation	55	33
395	485000	Transit and ground passenger transportation	55	33
396	486000	Pipeline transportation	55	33
397	48A000	Scenic and sightseeing transportation and support activities for transportation	55	33
398	491000	Postal service	56	34
399	492000	Couriers and messengers	56	34
400	493000	Warehousing and storage	56	34
401	4A0000	Motor vehicle and parts dealers	57	35
402	4A0000	Furniture and home furnishings stores	57	35

403	4A0000	Electronics and appliance stores	57	35
404	4A0000	Building material and garden supply stores	57	35
405	4A0000	Food and beverage stores	57	35
406	4A0000	Health and personal care stores	57	35
407	4A0000	Gasoline stations	57	35
408	4A0000	Clothing and clothing accessories stores	57	35
409	4A0000	Sporting goods, hobby, book and music stores	57	35
410	4A0000	General merchandise stores	57	35
411	4A0000	Miscellaneous store retailers	57	35
412	4A0000	Nonstore retailers	57	35
413	511110	Newpaper publishers	29	18
414	511120	Periodical publishers	29	18
415	511130	Book publishers	29	18
416	5111A0	Database, directory, and other publishers	58	36
417	511200	Software publishers	35	24
418	512100	Motion picture and video industries	35	24
419	512200	Sound recording industries	35	24
420	513100	Radio and television broadcasting	58	36
421	513200	Cable networks and program distribution	58	36
422	513300	Telecommunications	58	36
423	514100	Information services	58	36
424	514200	Data processing services	58	36
425	522A00	Nondepository credit intermediation and related activities	59	37
426	523000	Securities, commodity contracts, investments	59	37
427	524100	Insurance carriers	59	37
428	524200	Insurance agencies, brokerages, and related	59	37
429	525000	Funds, trusts, and other financial vehicles	59	37
430	52A000	Monetary authorities and depository credit intermediation	59	37
431	531000	Real estate	60	38
432	532100	Automotive equipment rental and leasing	60	38
433	532230	Video tape and disc rental	60	38
434	532400	Machinery and equipment rental and leasing	60	38
435	532A00	General and consumer goods rental except video tapes and discs	60	38
436	533000	Lessors of nonfinancial intangible assets	60	38
437	541100	Legal services	61	39
438	541200	Accounting and bookkeeping services	61	39
439	541300	Architectural and engineering services	61	39
440	541400	Specialized design services	61	39
441	541511	Custom computer programming services	61	39
442	541512	Computer systems design services	61	39
443	54151A	Other computer related services, including facilities management	61	39
444	541610	Management consulting services	61	39
445	5416A0	Environmental and other technical consulting services	61	39
446	541700	Scientific research and development services	61	39
447	541800	Advertising and related services	61	39
448	541920	Photographic services	61	39
449	541940	Veterinary services	61	39
450	5419A0	All other miscellaneous professional and technical services	61	39
451	550000	Management of companies and enterprises	62	40
452	561100	Office administrative services	63	41
453	561200	Facilities support services	63	41
454	561300	Employment services	63	41
455	561400	Business support services	63	41
456	561500	Travel arrangement and reservation services	63	41
457	561600	Investigation and security services	63	41
458	561700	Services to buildings and dwellings	63	41

459	561900	Other support services	63	41
460	562000	Waste management and remediation services	63	41
461	611100	Elementary and secondary schools	64	42
462	611A00	Colleges, universities, and junior colleges	64	42
463	611B00	Other educational services	65	43
464	621600	Home health care services	65	43
465	621A00	Offices of physicians, dentists, and other health practioners	65	43
466	621B00	Other ambulatory health care services	65	43
467	622000	Hospitals	65	43
468	623000	Nursing and residential care facilities	65	43
469	624400	Child day care services	65	43
470	624A00	Social assistance, except child day care services	65	43
471	711100	Performing arts companies	66	44
472	711200	Spectator sports	66	44
473	711500	Independent artists, writers, and performers	66	44
474	711A00	Promoters of performing arts and sports and agents for public figures	66	44
475	712000	Museums, historical sites, zoos, and parks	66	44
476	713940	Fitness and recreational sports centers	66	44
477	713950	Bowling centers	66	44
478	713A00	Other amusement, gambling, and recreation industries	66	44
479	7211A0	Hotels and motels, including casino hotels	67	45
480	721A00	Other accommodations	67	45
481	722000	Food services and drinking places	67	45
482	811192	Car washes	69	47
483	8111A0	Automotive repair and maintenance, except car washes	69	47
484	811200	Electronic equipment repair and maintenance	69	47
485	811300	Commercial machinery repair and maintenance	69	47
486	811400	Household goods repair and maintenance	69	47
487	812100	Personal care services	69	47
488	812200	Death care services	69	47
489	812300	Drycleaning and laundry services	69	47
490	812900	Other personal services	69	47
491	813100	Religious organizations	69	47
492	813A00	Grantmaking and giving and social advocacy organizations	69	47
493	813B00	Civic, social, professional and similar organizations	69	47
494	814000	Private households	69	47
495	S00101	Federal electric utilities	68	46
496	S00102	Other Federal Government enterprises	68	46
497	S00201	State and local government passenger transit	68	46
498	S00202	State and local government electric utilities	68	46
499	S00203	Other State and local government enterprises	68	46
500	S00300	Noncomparable imports	69	47
501	S00401	Scrap	41	29
502	S00402	Used and secondhand goods	40	29
503	S00500	State & Local Education	68	46
504	S00500	State & Local Non-Education	68	46
505	S00500	Federal Military	68	46
506	S00500	Federal Non-Military	68	46
507	S00600	Rest of the world adjustment to final uses	99	29
508	S00700	Inventory valuation adjustment	99	29
509	S00800	Owner-occupied dwellings	60	38

Note: SCTG43(USC29) sector should be calculated from IMPLAN sector 380 by multiplying 0.196 as described in section II.

Appendix 3a. Comparison of Aggregated 2001 IMPLAN with 1997_CFS: U.S. Total, Including SCTG16

2001_IMPLAN_SCTG			1997_CFS		BEA	Revised_1997_CFS		Ratio	
SCTG	V1*	P1**	V2	P2	P_Ratio	V5(=V2xP_Ratio)	P5	V1/V5	P1/P5
1	16,884	0.279%	6,173	0.089%	0.99	6,121	0.120%	2.758	2.398
2	39,472	0.653%	59,642	0.859%	0.76	45,393	0.893%	0.870	0.756
3	91,064	1.506%	102,344	1.474%	0.68	70,078	1.378%	1.299	1.130
4	45,911	0.759%	66,848	0.963%	0.75	50,130	0.986%	0.916	0.796
5	175,594	2.903%	183,784	2.647%	0.80	147,876	2.908%	1.187	1.032
6	86,329	1.427%	109,854	1.582%	0.72	79,122	1.556%	1.091	0.949
7	302,706	5.005%	346,379	4.988%	0.73	252,361	4.962%	1.199	1.043
8	80,602	1.333%	87,932	1.266%	0.66	58,148	1.143%	1.386	1.205
9	54,172	0.896%	56,394	0.812%	0.64	36,191	0.712%	1.497	1.301
10	2,818	0.047%	2,726	0.039%	0.69	1,871	0.037%	1.506	1.309
11	2,374	0.039%	4,279	0.062%	0.62	2,646	0.052%	0.897	0.780
12	5,191	0.086%	11,508	0.166%	0.66	7,572	0.149%	0.686	0.596
13	9,758	0.161%	11,329	0.163%	0.52	5,847	0.115%	1.669	1.451
14	11,054	0.183%	12,605	0.182%	0.94	11,794	0.232%	0.937	0.815
15	24,862	0.411%	25,486	0.367%	0.67	17,120	0.337%	1.452	1.263
16	197,809	3.271%	--	--	--	--	--	--	--
17	114,753	1.897%	217,051	3.126%	0.57	123,772	2.434%	0.927	0.806
18	114,753	1.897%	94,309	1.358%	0.57	53,779	1.057%	2.134	1.855
19	27,996	0.463%	74,900	1.079%	0.78	58,633	1.153%	0.477	0.415
20	104,099	1.721%	159,623	2.299%	0.79	126,464	2.487%	0.823	0.716
21	174,086	2.878%	224,448	3.232%	0.70	158,114	3.109%	1.101	0.957
22	22,231	0.368%	27,334	0.394%	0.86	23,606	0.464%	0.942	0.819
23	159,819	2.643%	209,487	3.017%	0.74	154,153	3.031%	1.037	0.901
24	231,896	3.834%	278,832	4.015%	0.72	201,484	3.962%	1.151	1.001
25	15,593	0.258%	15,129	0.218%	0.92	13,852	0.272%	1.126	0.979
26	106,688	1.764%	126,426	1.821%	0.79	99,672	1.960%	1.070	0.931
27	74,409	1.230%	106,578	1.535%	0.82	87,257	1.716%	0.853	0.741
28	81,685	1.351%	98,347	1.416%	0.72	70,753	1.391%	1.155	1.004
29	133,501	2.207%	260,327	3.749%	0.78	202,729	3.986%	0.659	0.573
30	292,878	4.843%	379,161	5.460%	0.62	236,813	4.656%	1.237	1.075
31	113,064	1.869%	109,197	1.573%	0.80	87,240	1.715%	1.296	1.127
32	169,411	2.801%	285,690	4.114%	0.84	240,745	4.734%	0.704	0.612
33	200,391	3.313%	227,182	3.272%	0.85	193,294	3.801%	1.037	0.901
34	433,014	7.160%	417,103	6.007%	0.83	347,545	6.833%	1.246	1.083
35	844,544	13.964%	869,675	12.524%	0.84	733,800	14.428%	1.151	1.001
36	654,570	10.823%	570,981	8.223%	0.84	481,910	9.475%	1.358	1.181
37	143,113	2.366%	129,185	1.860%	0.97	124,723	2.452%	1.147	0.998
38	160,050	2.646%	157,946	2.275%	0.75	118,491	2.330%	1.351	1.174
39	92,277	1.526%	97,255	1.401%	0.61	59,471	1.169%	1.552	1.349
40	225,430	3.727%	420,883	6.061%	0.47	197,389	3.881%	1.142	0.993
41	18,578	0.307%	32,714	0.471%	0.35	11,498	0.226%	1.616	1.405
43	171,674	2.839%	230,415	3.318%	0.20	49,947	0.982%	3.437	2.988
99	20,735	0.343%	36,524	0.526%	1.00	36,524	0.718%	0.568	0.494
ALL	6,047,838	100%	6,943,985	100%	0.77	5,085,927	100%	1.150	1

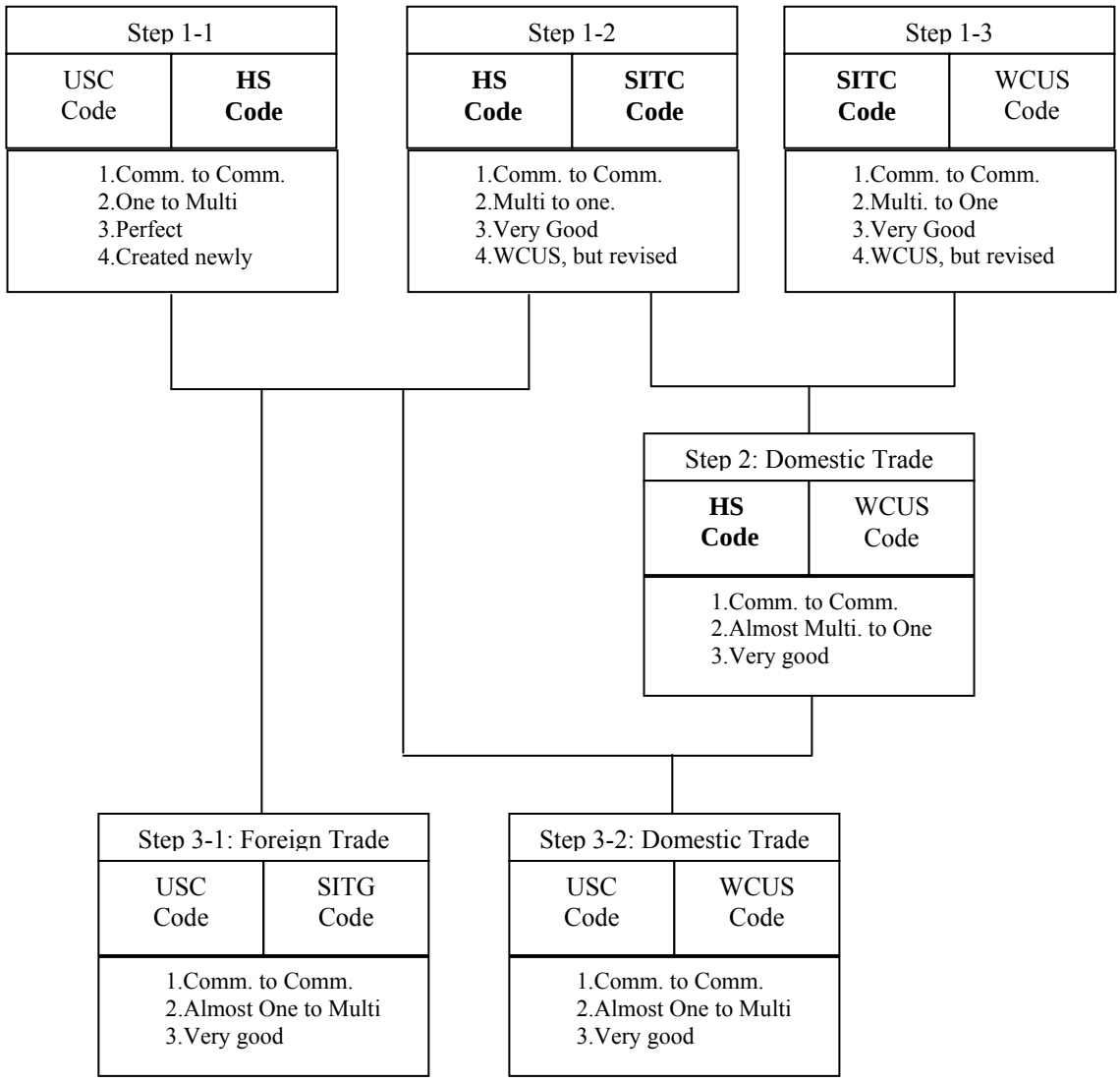
*Unit: (million$), **(Each SCTG sector value)x100/ (ALL value).

Appendix 3b. Comparison of Aggregated 2001 IMPLAN with 2002_CFS: U.S. Total, Including SCTG16

2001_IMPLAN_SCTG			2002_CFS		BEA	Revised_2002_CFS		Ratio	
SCTG	V1*	P1**	V3	P3	P_Ratio	V4(=V3xP_Ratio)	P4	V1/V4	P1/P4
1	16,884	0.279%	7,200	0.085%	0.99	7,139	0.121%	2.365	2.299
2	39,472	0.653%	55,927	0.659%	0.76	42,565	0.724%	0.927	0.902
3	91,064	1.506%	129,890	1.531%	0.68	88,939	1.513%	1.024	0.996
4	45,911	0.759%	55,251	0.651%	0.75	41,433	0.705%	1.108	1.077
5	175,594	2.903%	204,869	2.415%	0.80	164,841	2.803%	1.065	1.036
6	86,329	1.427%	119,718	1.411%	0.72	86,226	1.466%	1.001	0.973
7	302,706	5.005%	362,312	4.271%	0.73	263,970	4.489%	1.147	1.115
8	80,602	1.333%	115,772	1.365%	0.66	76,558	1.302%	1.053	1.024
9	54,172	0.896%	77,163	0.910%	0.64	49,519	0.842%	1.094	1.064
10	2,818	0.047%	2,451	0.029%	0.69	1,682	0.029%	1.675	1.629
11	2,374	0.039%	4,611	0.054%	0.62	2,851	0.048%	0.832	0.809
12	5,191	0.086%	12,643	0.149%	0.66	8,319	0.141%	0.624	0.607
13	9,758	0.161%	12,680	0.149%	0.52	6,544	0.111%	1.491	1.450
14	11,054	0.183%	15,741	0.186%	0.94	14,729	0.250%	0.751	0.730
15	24,862	0.411%	24,085	0.284%	0.67	16,179	0.275%	1.537	1.494
16	197,809	3.271%	--	--	--	--	--	--	--
17	114,753	1.897%	233,563	2.753%	0.57	133,188	2.265%	0.862	0.838
18	114,753	1.897%	109,618	1.292%	0.57	62,509	1.063%	1.836	1.785
19	27,996	0.463%	74,693	0.880%	0.78	58,471	0.994%	0.479	0.466
20	104,099	1.721%	152,069	1.792%	0.79	120,479	2.049%	0.864	0.840
21	174,086	2.878%	426,753	5.030%	0.70	300,630	5.113%	0.579	0.563
22	22,231	0.368%	34,079	0.402%	0.86	29,431	0.501%	0.755	0.734
23	159,819	2.643%	234,355	2.762%	0.74	172,452	2.933%	0.927	0.901
24	231,896	3.834%	343,386	4.048%	0.72	248,130	4.220%	0.935	0.909
25	15,593	0.258%	5,718	0.067%	0.92	5,235	0.089%	2.978	2.896
26	106,688	1.764%	140,006	1.650%	0.79	110,379	1.877%	0.967	0.940
27	74,409	1.230%	102,406	1.207%	0.82	83,842	1.426%	0.887	0.863
28	81,685	1.351%	105,890	1.248%	0.72	76,180	1.296%	1.072	1.043
29	133,501	2.207%	136,886	1.614%	0.78	106,600	1.813%	1.252	1.218
30	292,878	4.843%	506,992	5.976%	0.62	316,653	5.385%	0.925	0.899
31	113,064	1.869%	143,106	1.687%	0.80	114,330	1.944%	0.989	0.962
32	169,411	2.801%	253,678	2.990%	0.84	213,769	3.635%	0.792	0.771
33	200,391	3.313%	234,922	2.769%	0.85	199,880	3.399%	1.003	0.975
34	433,014	7.160%	509,477	6.005%	0.83	424,514	7.219%	1.020	0.992
35	844,544	13.964%	948,049	11.175%	0.84	799,929	13.604%	1.056	1.027
36	654,570	10.823%	735,730	8.672%	0.84	620,959	10.560%	1.054	1.025
37	143,113	2.366%	162,984	1.921%	0.97	157,354	2.676%	0.909	0.884
38	160,050	2.646%	222,042	2.617%	0.75	166,576	2.833%	0.961	0.934
39	92,277	1.526%	135,049	1.592%	0.61	82,582	1.404%	1.117	1.086
40	225,430	3.727%	404,683	4.770%	0.47	189,791	3.228%	1.188	1.155
41	18,578	0.307%	49,307	0.581%	0.35	17,330	0.295%	1.072	1.042
43	171,674	2.839%	858,320	10.117%	0.20	177,977	3.027%	0.965	0.938
99	20,735	0.343%	19,588	0.231%	1.00	19,588	0.333%	1.059	1.029
ALL	6,047,838	100%	8,483,662	100%	0.77	5,880,253	100%	1.028	1

*Unit: (million$), **(Each SCTG sector value)x100/ (ALL value).

Appendix 4. Data Reconciliation Process for NIEMO Tests



< NOTE >

*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)

Appendix 5. Estimating Missing 1997 CFS Flows

The values in each unreported cell of the trade flows between states, first, total origin and total destination values had to be fixed. To calculate unreported Total Origin (Output) value of state *i* (=$\boldsymbol{TO_i^*}$), we used the ratio of 2001 IMPLAN Total Origin of state *i* (=ITO_i) to the sum and 1997 CFS Reported Total Value of each USC sector *m* (=PTV_{USC_m} ,*m*=1,…,29).

ITO_i can also be denoted as Total Supply Commodity (consisting of Net Domstic Products (=*NDP*), Domestic Export (=*IDE*), and Foreign Export (=*IFE*)) in IMPLAN plus *AFI* (Adjusted Foreign Imports), because Foreign Imports should be counted in the trade flows in U.S. domestic trade (denoting as *RIFI*) or should be consumed in each state (denoting as *OIFI*), once commodities are imported. Also, Foreign Imports more compactly related to region economy condition than Foreign Exports. ITD_j is the sum of Net Domstic Products, Domestic Imports (=*IDI*) and *AFI* (Adjusted Foreign Imports).

Total Destination (Input) values of state *j* (=$\boldsymbol{TD_j^*}$) were calibrated similarly.

$$\boldsymbol{TO_i^*} = \left(\frac{ITO_i}{\sum_i ITO_i} \right) * PTV_{USC\_m}, \qquad (1.)$$

$$\boldsymbol{TD_j^*} = \left(\frac{ITD_j}{\sum_j ITD_j} \right) * PTV_{USC\_m} \qquad (2.)$$

From the estimated total origin/destination values, unreported trade flow values between states *ij* ($\boldsymbol{V_{ij}}^{*}$) could be filled in the matrix. In this computation, the cross-effects of origin and destination values are considered to estimate unreported cell values. For instance, the cell Computed from an Unreported Destination (=$\boldsymbol{CUD_{ij}}$) can get from unreported residuals ($TD_j^{(*)} - \sum_{j'} V_{ij'}$) by multiplying the portions of total origin corresponding to unpublished cells sector $\boldsymbol{V_{ij}}^{*}$. See equation (3.) Similarly, cells Computed from Unreported Origin (=$\boldsymbol{CUO_{ij}}$) are computed as in equation (4.)

$$\boldsymbol{CUD_{ij}} = \left(TD_j^{(*)} - \sum_{j'} V_{ij'} \right) * \left(\frac{TO_k^{(*)}}{\sum_k TO_k^{(*)}} \right). \qquad (3.)$$

$$\boldsymbol{CUO_{ij}} = \left(TO_i^{(*)} - \sum_{i'} V_{i'j} \right) * \left(\frac{TD_k^{(*)}}{\sum_k TD_k^{(*)}} \right) \qquad (4.)$$

$$\boldsymbol{V_{ij}}^{*} = \left(\frac{CUD_{ij} + CUO_{ij}}{2} \right) \qquad (5.)$$

where, indices *i'* and *j'* indicate only published cells and $V_{i,j'}$ or $V_{i',j}$ mean only reported values or 0 of each cell in the given trade matrix. Index *k* indicates the corresponding cells in $\boldsymbol{TO_i}$ or $\boldsymbol{TD_j}$ to unreported cells $\boldsymbol{V_{ij}}^{*}$ in the given matrix.

However, since two matrices (***CUD$_{ij}$*** and ***CUO$_{ij}$***) are adjusted only based on total origin or total destination from the two equations of (3.) and (4.), by taking the mean value of the two in equation (5.), we can adjust one side effect to yield the estimated values of each cell.

To get optimal $\boldsymbol{V_{ij}}^{*}$, those equations (3.) to (5.) should be iterated as shown in (3-1.) to (5-1.)

$$\boldsymbol{CUD_{i\,j}}^{\boldsymbol{T}} = \left(TD_j{}^{T-1} - \sum_{j'} V_{j'}^{T-1} \right) * \left(\frac{TO_{j'}{}^{T-1}}{\sum_{j'} TO_{j'}{}^{T-1}} \right) \qquad (3\text{-}1.)$$

$$\boldsymbol{CUO_{i,j}}^{\boldsymbol{T}} = \left(TO_i{}^{T-1} - \sum_{i'} V_{i'}^{T-1} \right) * \left(\frac{TD_{i'}{}^{T-1}}{\sum_{i'} TD_{i'}{}^{T-1}} \right) \qquad (4\text{-}1.)$$

$$\boldsymbol{V_{ij}}^{\boldsymbol{T}} = \left(\frac{CUD_{ij}^{T} + CUO_{ij}^{T}}{2} \right) \qquad (5\text{-}1.)$$

Then, optimal value $\boldsymbol{V_{ij}}^{\boldsymbol{T}}$ in T^{th} iteration was chosen as the maximum value (=$\boldsymbol{MV_{ij}}^{\boldsymbol{T}}$) in equation (6.) to satisfy the following criteria:

$$\boldsymbol{MV_{ij}}^{*} = MAX \sum_j \sum_i V_{ij}^{T} \qquad (6.)$$

Subject to 1) $\sum_j \sum_i V_{ij}^{T} \left(= \sum_i \sum_j V_{ij}^{T} \right) <= PTV_{USC\_m}$,

Or 2) $\sum_j \sum_i V_{ij}^{T-1} \left(= \sum_j \sum_i V_{ij}^{T} \right) <0.99$.

Note that the optimal value $\boldsymbol{MV_{ij}}^{*}$ from this model is the closest value to PTV_{USC_m}, but only considers destination attraction and origin supply power, not distance effects.

Appendix 6. Steps for Estimating Inter-Industry Flows in Terms of USC Sectors

First, Gross Absorption files are extracted by each state from the IMPLAN program.

Second, those are changed to Data Base File (DBF) to be used for SAS program using Microsoft Access program, because 509*509 matrix format is not supported in the excel file (only about 250 columns and 65000 rows be supported).

Then, SAS 9.0 program was used to aggregate the 47 by 47 relations shown in <Figure-5> from raw 509 by 509 IMPLAN data. Since the original files are coefficients (='each industry value'/ 'total IMPLAN output'), we recalculate 47 by 47 coefficients after multiplying 'total IMPLAN output (=TIO)' according to the definition of IMPLAN and traditional IO model in the SAS program.

Following the steps, therefore, 51 matrices of inter-industry coefficients within each state and D.C. and one matrix of zero coefficients due to data limitation to foreign region are created.

Appendix 7. NIEMO tests for LA/LB Port With and Without the NY and NJ Combined

State	EXPORT	Combined_EXPORT
AL	26.96	26.93
AK	3.08	3.04
AZ	53.69	53.71
AR	25.52	25.53
CA	2,641.24	2,641.18
Direct_Impact_EXPORT	4,114.66	4,114.66
Direct_Impact_IMPORT	14,221.60	14,221.60
CO	31.40	31.35
CT	16.04	16.02
DE	5.08	5.05
DC	0.63	0.61
FL	31.23	31.21
GA	25.92	25.83
HI	5.40	5.37
ID	12.31	12.32
IL	70.84	70.72
IN	53.17	53.17
IA	36.06	36.02
KS	31.99	31.98
KY	29.16	29.19
LA	77.95	78.08
ME	5.39	5.36
MD	11.43	11.44
MA	21.80	21.78
MI	54.99	54.99
MN	33.80	33.77
MS	14.68	14.66
MO	35.92	35.87
MT	16.27	16.28
NE	25.32	25.33
NV	13.08	13.05
NH	7.22	7.23
NJ	42.33	--
NM	6.62	6.60
NY	54.85	--
NY+NJ	--	94.85
NC	33.14	33.11
ND	4.87	4.82
OH	76.85	76.90
OK	26.99	26.95
OR	50.39	50.42
PA	61.80	61.71
RI	4.85	4.86
SC	16.76	16.76
SD	6.72	6.77
TN	33.69	33.68
TX	391.97	391.68
UT	31.76	31.74
VM	2.41	2.42
VA	16.98	16.93
WA	79.50	79.51
WV	10.58	10.63
WI	52.77	52.77
WY	6.52	6.54
US_subtotal	22,766.18	22,763.00
Rest of World	492.02	491.71
Total	23,258.21	23,254.71