REACT: Regional Economic Analysis and Change Tool

Technical documentation, Version 1.0

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Introduction

REACT is Cambridge Econometrics' (CE's) next-generation modeling suite for US economic impact analysis. Designed as a scalable and flexible tool, REACT provides single-region models that can be tailored to the area of interest, whether county, metro area, state or national.

Applying established techniques in input-output analysis, REACT is customized and configured to a local economy, blending local industry employment and wage data with regionalized versions of national and state input-output tables and gross domestic product (GDP). This produces as complete an economic picture as possible, with a set of accounts suitable to carry out assessments of total economic impact.

Economic impacts refer to the total effect on the economy resulting from a change in demand for goods or services within a specific industry, typically resulting from a change in policy or investment, or estimating the economic contributions of key industries or facilities. This impact is analyzed by examining how an initial change in demand ripples through the economy. Economic impact is typically broken down into direct, indirect, and induced effects leading to total economic impacts and multiplier effects, as shown in the figure below.

Direct Effects represent the immediate (direct) change in output and activity in an industry as a direct result of increased spending, employment or investment in that industry.

Indirect Effects occur as a result of the inter-industry transactions required to support an increase in production. Indirect effects stem from the increased demand for supply chain components and inputs as a result of increased spending or investment in an industry.

Induced Effects are the changes in economic activity resulting from the increased household income generated by the direct and indirect effects. These impacts arise as workers spend their additional earnings on goods and services in the economy.

Impact analysis requires an understanding of local[1] economic structure, especially with respect to the nature of local supply chains and import linkages. In this regard, the REACT database contains regionalized input-

[1] This technical documentation uses the terms 'local', 'regional', and 'area' interchangeably to reflect the geography of interest for the REACT model (typically one or more counties).

output tables. These tables are modified versions of the US national input-output table, with adjustments to better reflect local economic circumstances such as industry mix and productivity. This concerns, in particular, the use of regional data to identify an area's relative concentrations of economic activity (specializations) and the recognized tendency for smaller areas to source more productive inputs from outside the area (Imports).

Table 1: Standard REACT output variables by industry

Output	**Value added**	**Employment**
Output refers to the total value of goods and services produced by an industry or sector within an economy. Output is the sum of intermediate input and value added and can be thought of as the total sales or total expenditures.	Value added refers to the net output of a sector after subtracting the value of intermediate inputs. It is a similar concept to GDP, capturing the contribution of labor and capital to the production process, and is the sum of employee compensation, taxes on production and imports, and gross operating surplus (i.e., profits).	Employment is the count of filled jobs, including both full- and part-time and temporary and permanent employees, based on the location of businesses and organizations.

REACT is well-suited to quantifying the economic scale of different policy and investment interventions, with a high level of sectoral detail (166 sectors, by default) to understand how expenditures lead to impacts across a local economy.

Typical applications of REACT include:

- Industrial, commercial and mixed-use development projects
- Industry expansion or retraction studies – capital and operating
- Infrastructure investments (e.g., transportation, water/sewer, energy)
- Economic studies of visitor and tourist attractions (e.g., museums, recreation and sports facilities)
- Economic contributions of existing business parks, key industry clusters, etc.

The rest of this document provides more detail on:

- The purpose and structure of REACT
- REACT's approach to economic impact analysis
- Data sources and methods with which to develop a database for regional impact analysis
- A detailed list of industries included in REACT
- A glossary of terms

REACT – Overview

Purpose

REACT is a flexible tool for economic impact analysis, applicable at county, state and national levels. In application, each REACT model is customized to the area of interest, combining local and national data to provide a tailored representation of the relevant economy.

REACT offers the full features of an economic impact model (see Box 1 and below), capturing region-specific economic structure to shed light on the potential effects of investments and other interventions.

Box 1: Standard REACT outputs

Direct, indirect and induced impacts for:

- Output
- Value added
- Employment

Supplementary:

- Income tax receipts
- Sales tax receipts

Model Logic

As an economic impact model, REACT is, at its core, a tool for input-output analysis, elaborated at the level of 166 industry sectors.[2]

Given an investment, industry or policy change (the *direct* impacts), REACT generates estimates of the *wider* impacts, based on a sectoral depiction of a region's economy, as represented by input-output tables. These wider impacts capture:

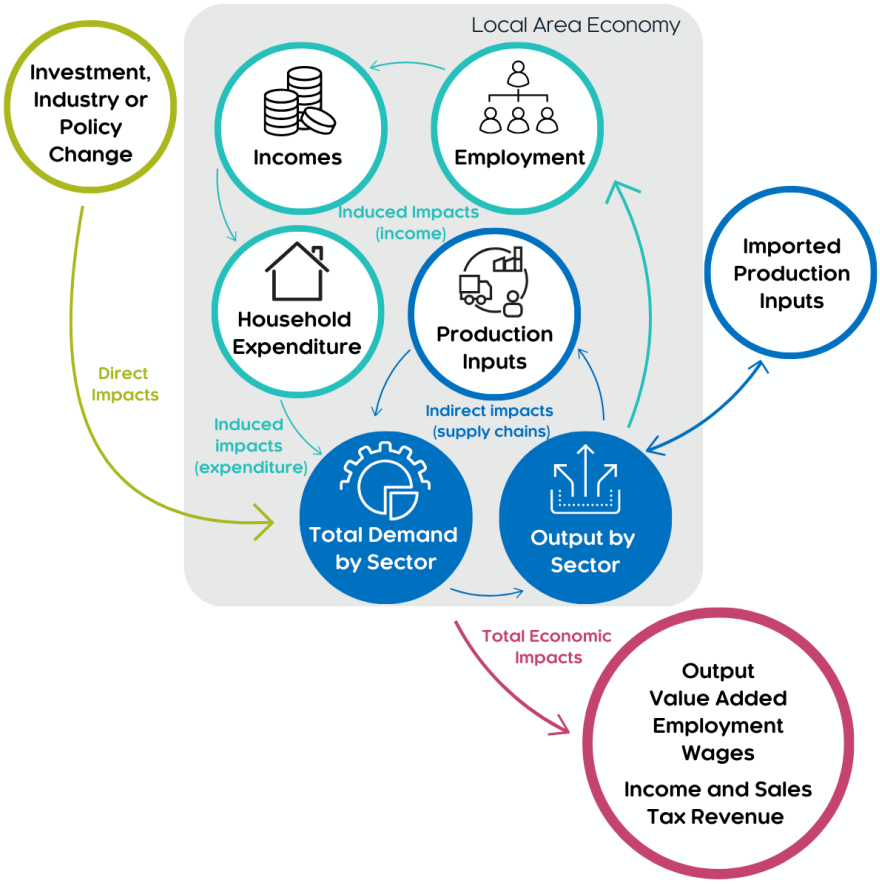
- Local supply chains and import linkages, recognizing that areas are rarely self-sufficient in productive capabilities, leading to region-specific *indirect* economic impacts, through those supply chains
- Employment and income, leading to *induced* economic impacts as a result of income-expenditure effects

Impacts are presented consistently in terms of output (whether total or value added) and employment, with the option to estimate potential income and sales tax receipts.

Figure 1 shows the core economic logic in REACT. As discussed later, the framework is flexible and implemented in software that permits easy extension if required.

[2] The number of industries is based on the US Bureau of Labor Statistics (BLS) input-output industry structure (derived from the Bureau of economic Analysis (BEA)'s I-O table), and can vary year-to-year as BLS adjusts its industry composition.

Figure 1: REACT Economic Logic



Structure

In implementation, a REACT model is generated for a designated area, which can be one or more counties.

1. Embedding a default area-specific dataset constructed from:

   – available and credible local data
   – broader state and US data to inform and constrain any regionalized estimates (for cases in which the local equivalent is not available)

   The development of the database applies established techniques in regional input-output analysis to create a scalable solution for standard US geographies.

   Depending on other available information for the specific area (i.e., beyond standardized sources), it is possible to further customize the dataset according to local conditions.

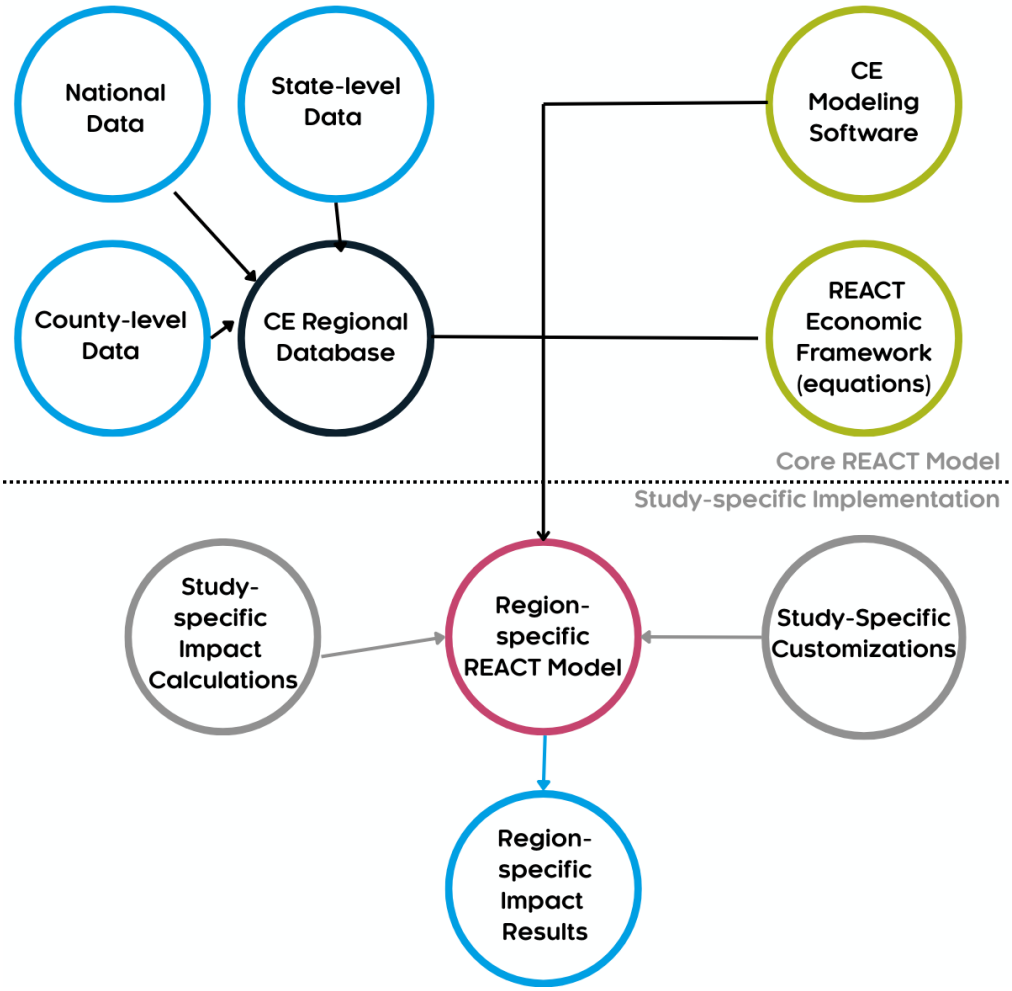
2. Building on CE's own proven modeling software libraries, offering:[3]

   – efficient and tested techniques for managing data and inputs, and generating a range of output results
   – substantial flexibility and extensibility, to be able to quickly modify the standard REACT setup as needed (e.g., to generate supplementary indicators or implement other features for the problem at hand)

In these respects, the purpose of REACT is to provide rapid and pragmatic access to a benchmark local economic impact model, with the ability to further customize as needs and data dictate.

[3] REACT shares underlying software and economic foundations with CE's FRAMES suite of models. FRAMES can be deployed on an as-needed basis to countries for which there are not already established macroeconomic models.

Figure 2: Typical REACT setup



Modeling Approach

This section lays out the technical foundations of REACT, detailing the main inputs and equations that make up the core impact model. The sub-sections below detail, in turn, the construction of the national input-output table from US Bureau of Labor Statistics data; the approach to regionalization to the local area; and the derivation of the Type I and Type II multipliers, following standard approaches.

National Input-Output Table

The starting point for a REACT model is a national input-output table. This table is then regionalized to reflect the economic structure of the area of interest (see next section).

By default, the national table comes from the US Bureau of Labor Statistics (BLS) rather than directly from the US Bureau of Economic Analysis (BEA). The advantage of the BLS version (which is derived from the original BEA data) is that the BLS version has already been processed to conform to the latest (2022) version of the NAICS classification, and for the latest available year of data (currently 2023; as published in September 2024). While the sectoral disaggregation in the BLS data is less detailed than the original BEA data, we consider the BLS breakdown sufficient for most typical applications, distinguishing 166 individual sectors.

We use the BLS data to construct a symmetric industry-by-industry input-output table by the 166-sector classification.

Regionalization

Regional economies rely on domestic products from other parts of their state and country, resulting in a higher proportion of imported goods compared to the national average. Furthermore, these regional economies tend to be less diversified than the national economy due to factors such as local specialization, workforce skills, natural resources, and other regional characteristics. Consequently, smaller regions are less likely to meet their own demand through local production. For instance, a rural county in Vermont is likely to import most of its plastic products and pharmaceuticals, while an urban county in the San Francisco area may import nearly all its dairy and timber products. Therefore, national multipliers, which represent the overall economy, need to be adjusted to accurately reflect regional economic activity.

These adjustments to the national input-output tables are called Regional Purchase Coefficients (RPCs). RPCs estimate the proportion of a region's demand for a specific good or service that is met by local production. To appropriately reflect the economic and industry capabilities of a region, RPCs estimate the industry-by-industry self-sufficiency to measure how reliant a region is on imports to fulfill its consumption needs.

To estimate RPCs, two critical factors are:

- The region’s specialization in each industry relative to the nation (i.e., the portion of the economy dedicated to each sector)
- The relative size of the overall regional economy (the smaller the economy, the higher the share of imports).

Regional Specialization

To account for the region’s relative industry specialization, we calculate RPCs based on the Location Quotient (LQ). LQ is a measure used to compare the concentration of a particular industry in a region to the concentration of that same industry in the nation. LQs are calculated by dividing the region’s proportion of total employment in a specific industry by the proportion of total national employment in the same industry. An LQ above 1.0 indicates the industry is more concentrated in the region than the US average, while an LQ below 1.0 suggests it is less concentrated. Mathematically, the LQ is defined as:

$$LQ_i = \frac{\frac{E_i^R}{E^R}}{\frac{E_i^N}{E^N}}$$

Where E_i^R is the employment in industry *i* in region *R* and E^R is the total employment in the region. Similarly, E_i^N is the employment in industry *i* in the nation *N* and E^N is the total national employment.

If a region is more specialized in an industry than the nation, its LQ will be greater than one. However, because the regional economy is smaller than the national, we never adjust the national coefficient up (i.e., we never multiply them by a number greater than one). To ensure that the RPC always lies between zero and one, we adjust the LQ using stepwise linear transformations. For LQs below 0.5, the LQ is adopted as-is for the RPC. For larger LQs, values are adjusted so that the RPC value reaches its maximum value of one for LQs greater than five and falls somewhere between 0.5 and one for LQs greater than 0.5 but less than five.

The process described above is applied to all industries that are considered traded (i.e., their goods or services are primarily imported/exported from/to other regions). Alternatively, non-traded industries produce goods and services primarily intended for local consumption or to meet local needs. For example, a machine parts manufacturer that exports its products to other states is a traded sector while hospitals and daycare services are largely local serving and therefore non-traded. Some portion of the population might travel to another region for these non-traded services, but the majority of these services will be both provided and purchased within the region. Therefore, RPCs for non-traded sectors have a minimum value of 0.75, rather than zero, to reflect the higher share of demand satisfied within the region.

Size of the Regional Economy

RPCs based solely on LQs do not consider the relative size of an economy because LQ only measures the relative *share* of total employment in an industry. For example, a rural county in Massachusetts may have the same LQ in crop production as the state of Massachusetts overall. However, the scale of the state's economy is substantially larger than the county's, so it stands to reason that the state overall will be able to supply more (and thus import less) agricultural output than the county, despite the similar LQ. Imagine, for example, that the rural county specializes in asparagus farming. While there may be a large asparagus farm employing a high share of the local labor force, residents of the county will still have to import most of their vegetables. For larger economies such as the state, crop production is likely more diversified and can satisfy more demand even if the relative share of the employment in the industry is the same in the county as in the state.

To account for the size of the region's total economy, we adjust the RPC for each sector based on the relative size of the industry in the state of interest compared to all other states. For each sector, we rank each state from largest to smallest based on gross state product in the industry. The median state is assigned an RPC adjuster value of 1.0, while the largest is adjusted by 1.25 and the smallest by 0.75. For the state of interest, these adjustors for each industry are then applied to the state's RPC for that industry. To further adjust for any sub-state (e.g., county-level) regions, we ensure that a sub-state region's RPC does not exceed the state's, as shown below:

$$RPC_i^c = \begin{cases} RPC_i^c & if\ RPC_i^c \leq RPC_i^s \\ \\ RPC_i^s & if\ RPC_i^c > RPC_i^s \end{cases}$$

Where RPC_i^C is the regional purchase coefficient for industry *i* in county (or other sub-state region) *c* and RPC_i^S is the regional purchase coefficient for industry *i* in state *s*.

The result of these steps is a highly-customized final set of RPCs for each industry. This vector is applied row wise to the national IO matrix (i.e., each column in the matrix is multiplied by the corresponding RPC for that industry) to generate a regionalized input-output table.

Multipliers

Having constructed the regionalized input-output table, standard Type I and Type II multipliers can be calculated. Following standard notation, we define:[4]

- Z, an (m x m) matrix of inter-industry purchases (intermediate consumption)
- f, an (m x 1) vector of final demand
- q, an (m x 1) vector of (total) output

where m gives the number of industries (sectors) in the table.

As a matter of accounting, output by industry is the sum of intermediate consumption and final demand:

$$q = Z.i + f$$

where i is an (m x 1) summation vector of ones.

We then define the input-output matrix, A, as an (m x m) matrix with elements:

$$a_{ij} = \frac{z_{ij}}{q_j}$$

where a_{ij} and z_{ij} denote elements of A and Z (row i, column j), respectively; and q_j if the j-th row of q.

A is thus a symmetric industry-by-industry table of coefficients in which each column represents an industry and the elements of that column represent the amount purchased, per dollar of output, from supplying industries (the rows).

This gives an alternative formulation of output, q, as:

$$q = A.q + f$$

Type I

Solving for q:

$$q = L.f$$

where L is the Type I Leontief inverse matrix:

$$L = (I - A)^{-1}$$

and I is the identity matrix.

The Leontief inverse is the key output from this calculation, providing an indication of the scale and sectoral pattern of output required to support changes in final demand:

$$q^* = L.f^*$$

This gives wider (direct plus indirect) economic impacts arising from industries' need to purchase inputs from their supply chains to support production.

Type II

Type II multipliers follow a similar logic to Type I, but for an extension to the original A matrix to endogenize households. This involves adding a new row of coefficients to the matrix, to represent compensation of employees per dollar of output. This amounts to treating households (labor) as a further source of productive

[4] The notation is broadly consistent with, for example:
Miller, R.E., Blair, P.D. (2009) *Input-Output Analysis: Foundations and Extensions*, Cambridge University Press.

inputs. The new A matrix is then made square by appending a new column to represent household purchases. This is a vector of household consumption by industry divided by household income.

With the augmented input-output matrix so constructed, the calculation of the Type II multipliers is as above.

Data Sources

Industry Employment

Industry employment is a critical input for the regionalization process. The main publicly available source of employment data in the US is the Bureau of Labor Statistics (BLS) Quarterly Census of Employment and Wages (QCEW). These data are available for download at the county and state levels and for all levels of NAICS industry detail (two- through six-digit). However, the more disaggregated these data are, the more likely they are to be suppressed due to privacy concerns. As a result, county-level data or data for detailed industries are often incomplete, especially for smaller and more rural counties.

To account for this limitation, REACT integrates detailed, un-suppressed employment data from MassEconomics' data-Fab. These data are provided at the county-level and non-disclosed values are estimated using a well-vetted methodology that has been validated in terms of accuracy tests. Data-Fab data are used for both state and county analysis to ensure employment information is comprehensive and consistent.

GDP, Output, and Components of Value Added

GDP, output, components of value added, and national industry employment data from the US Bureau of Economic Analysis (BEA) are used to:

- Account for the size of the overall economy in the regionalization process. For this step, BEA Gross State Product (GSP) by industry for all states is ranked and each state is given an RPC adjustment score for each industry, as described in the Approach section above.
- Determine the share of value added (GDP) made up of each of the different components of value added, including compensation of employees, taxes on production and imports less subsidies, and gross operating surplus. This is used to estimate the total compensation of employees (including wages as well as other benefits).
- Estimate state and county output by industry, which is not available in public sources. For this estimation, we use BEA data to estimate GDP per employee at the state and national level by industry. We then calculate the state's share of the national GDP per employee and apply that share to national output per job data to estimate state output per job. Multiplying this value by the state's industry employment provides an estimation of output by state. To estimate output for a sub-state area such as a county, the state output values are adjusted based on a similar process but based on relative wages per employee.

National IO Tables

Both the BLS and BEA produce publicly available IO matrices. The BEA releases annual IO tables that include 71 sectors and detailed tables every five years that include 402 sectors. However, there is a substantial delay in the release of the detailed tables – in Spring of 2025 the 2022 detailed tables have yet to be released, making the 2017 tables the most recent available. Alternatively, BLS matrices, which are derived from the BEA tables, provide IO accounts every year while maintaining substantial sector disaggregation (166 sectors for the 2023 data). Because these data are more frequently updated, they use the latest NAICS codes to define their sectors, making the data easier to match with other sources for employment, wages, and other data. Given the frequency of release and consistency in NAICS years across other sources, REACT uses the BLS national IO tables as a basis for the model rather than the BEA tables. The 166 sectors used by BLS and adopted for REACT are shown in the table below.

Sector	Description	Sector	Description
1	Crop production	84	Transit and ground passenger transportation
2	Animal production and aquaculture	85	Pipeline transportation
3	Forestry	86	Scenic and sightseeing transportation and support activities for transportation
4	Logging	87	Couriers and messengers
5	Fishing, hunting and trapping	88	Warehousing and storage
6	Support activities for agriculture and forestry	89	Software publishers
7	Oil and gas extraction	90	Motion picture and sound recording industries
8	Coal mining	91	Telecommunications
9	Metal ore mining	92	Computing infrastructure providers, data processing, web hosting, and related services
10	Nonmetallic mineral mining and quarrying	93	Miscellaneous information services
11	Support activities for mining	94	Monetary authorities - central bank, and credit intermediation and related activities
12	Electric power generation, transmission and distribution	95	Securities, commodity contracts, and other financial investments and related activities
13	Natural gas distribution	96	Funds, trusts, and other financial vehicles
14	Water, sewage and other systems	97	Insurance carriers
15	Construction	98	Agencies, brokerages, and other insurance related activities
16	Animal food manufacturing	99	Real estate
17	Grain and oilseed milling	100	Automotive equipment rental and leasing
18	Sugar and confectionery product manufacturing	101	Rental and leasing services
19	Fruit and vegetable preserving and specialty food manufacturing	102	Lessors of nonfinancial intangible assets (except copyrighted works)
20	Dairy product manufacturing	103	Legal services
21	Animal slaughtering and processing	104	Accounting, tax preparation, bookkeeping, and payroll services
22	Seafood product preparation and packaging	105	Architectural, engineering, and related services
23	Bakeries and tortilla manufacturing	106	Specialized design services
24	Other food manufacturing	107	Computer systems design and related services
25	Beverage and tobacco product manufacturing	108	Management, scientific, and technical consulting services
26	Textile mills and textile product mills	109	Scientific research and development services
27	Apparel, leather and allied product manufacturing	110	Advertising, public relations, and related services
28	Sawmills and wood preservation	111	Other professional, scientific, and technical services
29	Veneer, plywood, and engineered wood product manufacturing	112	Management of companies and enterprises
30	Other wood product manufacturing	113	Office administrative services
31	Pulp, paper, and paperboard mills	114	Facilities support services
32	Converted paper product manufacturing	115	Employment services
33	Printing and related support activities	116	Business support services
34	Petroleum and coal products manufacturing	117	Travel arrangement and reservation services

Sector	Description	Sector	Description
35	Chemical manufacturing	118	Investigation and security services
36	Pharmaceutical and medicine manufacturing	119	Services to buildings and dwellings
37	Chemical manufacturing	120	Other support services
38	Plastics product manufacturing	121	Waste management and remediation services
39	Rubber product manufacturing	122	Elementary and secondary schools; private
40	Nonmetallic mineral product manufacturing	123	Junior colleges, colleges, universities, and professional schools; private
41	Iron and steel mills and ferroalloy manufacturing	124	Other educational services; private
42	Steel product manufacturing from purchased steel	125	Offices of physicians
43	Alumina and aluminum production and processing	126	Offices of dentists
44	Nonferrous metal (except aluminum) production and processing	127	Offices of other health practitioners
45	Foundries	128	Outpatient care centers
46	Fabricated metal product manufacturing	129	Medical and diagnostic laboratories
47	Fabricated metal product manufacturing	130	Home healthcare services
48	Machine shops; turned product; and screw, nut, and bolt manufacturing	131	Other ambulatory healthcare services
49	Coating, engraving, heat treating, and allied activities	132	Hospitals; private
50	Machinery manufacturing	133	Nursing and residential care facilities
51	Commercial and service industry machinery manufacturing	134	Individual and family services
52	Metalworking machinery manufacturing	135	Community food and housing, emergency and other relief services, and vocational rehabilitation services
53	Engine, turbine, and power transmission equipment manufacturing	136	Child daycare services
54	Computer and peripheral equipment manufacturing	137	Performing arts companies
55	Communications equipment manufacturing	138	Spectator sports
56	Audio and video equipment manufacturing	139	Promoters of performing arts and sports, and agents for public figures
57	Semiconductor and other electronic component manufacturing	140	Independent artists, writers, and performers
58	Navigational, measuring, electromedical, and control instruments manufacturing	141	Museums, historical sites, and similar institutions
59	Manufacturing and reproducing magnetic and optical media	142	Amusement parks and arcades
60	Electric lighting equipment manufacturing	143	Gambling industries (except casino hotels)
61	Household appliance manufacturing	144	Other amusement and recreation industries
62	Electrical equipment manufacturing	145	Accommodation
63	Other electrical equipment and component manufacturing	146	Food services and drinking places
64	Motor vehicle manufacturing	147	Automotive repair and maintenance

Sector	Description	Sector	Description
65	Motor vehicle body and trailer manufacturing	148	Electronic and precision equipment repair and maintenance
66	Motor vehicle parts manufacturing	149	Commercial and industrial machinery and equipment (except automotive and electronic) repair and maintenance
67	Aerospace product and parts manufacturing	150	Personal and household goods repair and maintenance
68	Railroad rolling stock manufacturing	151	Personal care services
69	Ship and boat building	152	Death care services
70	Other transportation equipment manufacturing	153	Drycleaning and laundry services
71	Furniture and related product manufacturing	154	Other personal services
72	Other furniture related product manufacturing	155	Religious organizations
73	Medical equipment and supplies manufacturing	156	Grantmaking and giving services and social advocacy organizations
74	Other miscellaneous manufacturing	157	Civic, social, professional, and similar organizations
75	Wholesale trade	158	Private households
76	Motor vehicle and parts dealers	159	Federal government, excluding postal service
77	Food and beverage retailers	160	Postal service
78	General merchandise retailers	161	Educational services; state and local
79	All other retail trade	162	Hospitals; state and local
80	Air transportation	163	State and local government, excluding education and hospitals
81	Rail transportation	164	Owner-occupied dwellings
82	Water transportation	165	Scrap, used and secondhand goods
83	Truck transportation	166	Noncomparable imports and rest of the world adjustment

Glossary

Economic impacts: Economic impacts refer to the total effect on the economy resulting from a change in demand for goods or services within a specific industry. This impact is analyzed by examining how an initial change in demand ripples through the economy. Economic impact is typically broken down into:

- **Direct Effects:** Direct effects represent the immediate (direct) change in output and activity in an industry as a direct result of increased spending or investment in that industry.
- **Indirect Effects:** Indirect effects occur as a result of the inter-industry transactions required to support an increase in production. Indirect effects stem from the increased demand for supply chain components and inputs as a result of increased spending or investment in an industry.
- **Induced Effects:** Induced effects are the changes in economic activity resulting from the increased household income generated by the direct and indirect effects. These impacts arise as workers spend their additional earnings on goods and services in the economy.

Employment: Based on the BLS QCEW definition, employment is the count of filled jobs, including both full- and part-time and temporary and permanent employees.

Input Requirements: Input requirements are the value of inputs required to produce one dollar's worth of outputs. Within the IO model, input requirements are the sum of each column in the IO matrix for the corresponding industry. For example, a column sum of 0.6 shows that in order to produce one dollar's worth of output in that industry, $0.60 is required as inputs from all other industries.

Input-Output Matrix (A Matrix): An Input-Output (IO) matrix is a structured representation of the economic transactions between industries in an economy. IO matrices detail how outputs from one industry are used as inputs in other industries. The matrix provides insights into inter-industry relationships, showing the flow of goods and services needed to produce outputs across the economy. For example, a value of 0.2 in cell (*i, j*) indicates that for every dollar of output produced in industry *i*, it purchases $0.20 of inputs from industry *j*. The value represents direct inter-industry relationships.

Location Quotient: A Location Quotient (LQ) measures the concentration of a specific industry in a region compared to a larger reference area, such as the nation. LQs are calculated by dividing the region's proportion of total employment in a specific industry by the proportion of total national employment in the same industry. An LQ above 1 indicates the industry is more concentrated in the region than average, while an LQ below 1 suggests it is less concentrated. This metric helps identify regional economic strengths and specialization.

Multiplier Matrix (Leontief Inverse): Multiplier matrices are similar to IO matrices but include indirect and (in some cases) induced effects in addition to direct effects. The multiplier matrix is calculated by taking the Leontief Inverse of the IO matrix:

$$L = (I - A)^{-1}$$

where *I* is the identity matrix and *A* is the IO matrix.

Output: Output refers to the total value of goods and services produced by an industry or sector within an economy. Output is the sum of intermediate input and value added and can be thought of as the total sales or total expenditures.

Output Multiplier: Output multipliers measure the total economic impact generated in an economy for every unit of output produced by a specific industry. Multipliers capture how an initial change in output ripples through supplier networks and household spending. Output multipliers are calculated by summing the columns of a multiplier matrix.

- **Type I multipliers** measure the total economic impact of an initial change in an industry's output, including direct effects (the initial change) and indirect effects (inter-industry purchases). They do not include the effects of household spending.

- **Type II multipliers**, on the other hand, expand on Type I by also incorporating induced effects, which account for the additional economic activity generated by household spending of income earned from the direct and indirect activities. This makes Type II multipliers larger and more comprehensive than Type I.

Regional Purchase Coefficient: Regional Purchase Coefficients (RPC) estimate the proportion of a region's demand for a specific good or service that is met by local production. They help analyze the extent to which a region is self-sufficient or reliant on imports to fulfill its consumption needs. RPCs are used to adjust national IO tables to reflect the regional economy by identifying the portion of consumption supplied internally versus imported.

Traded/non-traded: Traded sectors include sectors where goods or services are primarily traded outside of the region (i.e., imported/exported from/to other regions). Alternatively, non-traded sectors include sectors selling goods and services primarily intended for local consumption or to meet local needs. For example, a machine parts manufacturer that exports its products to other states is a traded sector while hospitals and daycare services are largely local serving and therefore non-traded. This distinction is important in the context of IO models because a higher share of demand for traded sectors is likely to be met through imports into the region, whereas demand in non-traded sectors is typically met within the region.

Value Added: Value added refers to the net output of a sector after subtracting the value of intermediate inputs. It is a similar concept to GDP, capturing the contribution of labor and capital to the production process, and is the sum of employee compensation, taxes on production and imports, and gross operating surplus (i.e., profits).

Wages: Based on the BLS QCEW definition, wages are the total pre-tax compensation paid to employees, including bonuses, stock options, severance pay, profit distributions, the cash value of meals and lodging, tips and other gratuities, and, in some states, employer contributions to certain deferred compensation plans (such as 401(k) plans), during the calendar year, regardless of when the services were performed.