The Inforum LIFT U.S. Economic Model

The current edition of LIFT is the fourth generation of the primary Inforum U.S. model, though earlier Inforum models of the U.S. economy were operating since the 1960s. The latest edition is similar to the previous generation (LIFT 3) that was in use from Fall 2016 through Spring 2021, but a variety of improvements have been made. Some changes were prompted by the continual evolution of NAICS codes and corresponding industry data, structural changes to NIPA accounts, and other data developments. In addition, the model was revised to better suit the needs of Inforum research sponsors; for example, recent generations of LIFT offer expanded detail for health care supply, government activity, and corporate profits.

The BEA began to publish new and revised economic data in Fall 2023, and publication was completed in the spring of 2024. The new NIPA and industry accounts incorporate newer economic census data and represent a new benchmark, with volumes presented in 2017 dollars. New benchmark input-output tables are available for 2017, improving and enhancing the information provided in annual input-output tables. These data support development of LIFT 5, which currently is under way and will support future Inforum forecasting and analytical efforts.

Table 8 presents a brief summary of differences between the fourth (current) and fifth (forthcoming) generations of the LIFT models. Additional details will be made available upon request and presented in forthcoming documentation.

Table 8: The LIFT Model
The Fourth and Fifth Generations

	LIFT 4	LIFT 5*
Commodity Sectors	121	121
Input-Output Transaction Matrix	121 x 121	121 x 121
Industries	71	71
Consumption Types	83	83
Construction Types	26	26
Equipment Purchasing Sectors	71	71
Intellectual Property Investment	✓	✓
NAICS/IO Account Standards	2012	2017
NIPA Benchmark	2012	2017

*Tentative Details

The Inforum approach to modeling attempts to provide both the dynamics and high-level accounting of macroeconomic models and the industry structure featured in the general equilibrium approach to modeling. The Long-term Interindustry Forecasting Tool (LIFT) is a dynamic general equilibrium representation of the U.S. national economy. It combines an inter-industry input-output (I-O) formulation with extensive use of regression analysis to employ a “bottom-up” approach to macroeconomic modeling. In this way, the model works like the actual economy, building the macroeconomic totals from details of industry

activity, rather than by distributing predetermined macroeconomic quantities among industries. For example, aggregate investment, total exports, and employment are not determined directly, but instead they are computed as the sum of their parts: investment by industry, exports by commodity, and employment by industry. LIFT contains full demand and supply accounting for 121 productive sectors.

This bottom-up technique provides several desirable properties for analyzing the economy. First, the model describes how changes in one industry, such as increasing productivity or changing international trade patterns, affect related sectors and the aggregate quantities. Second, parameters in the behavioral equations differ among products, reflecting differences in, for instance, consumer preferences, price elasticities in foreign trade, and industrial structure. Third, the detailed level of disaggregation permits the modeling of prices by industry, allowing one to explore the causes and effects of relative price changes.

Another important feature of the model is the dynamic determination of endogenous variables. LIFT is an annual model, solving year by year, and it incorporates key dynamics that include investment and capital stock formation. For example, investment depends on a distributed lag in the growth of investing industries and international trade depends on a distributed lag of foreign price changes. Moreover, parameter estimates for structural equations largely are based on time-series regressions, thereby reflecting the dynamic behavior of the economic data underlying the model. Therefore, model solutions are not static, but instead they project a time path for the endogenous quantities. The LIFT model thus simulates the economy year-by-year, allowing analysts to examine both the ultimate economic impacts of projected energy or environmental policies and the dynamics of the economy's adjustment process over time.

Despite its industry basis, LIFT is a general equilibrium model, using bottom-up accounting to determine macroeconomic quantities that are consistent with the underlying industry detail. It includes macroeconomic variables that are consistent with the National Income and Product Accounts (NIPA) and other published data. This macroeconomic "superstructure" contains key functions for household savings behavior, interest rates, unemployment rates, taxes, government spending, and current account balances. Like many aggregate macroeconomic models, this structure is configured to make LIFT exhibit "Keynesian" demand-driven behavior over the short run but neoclassical growth characteristics over the longer term. For example, while monetary and fiscal policies and changes in exchange rates can affect the level of output in the short-to-intermediate term, supply forces – available labor, capital, and technology – will determine the level of output in the long term.

The LIFT model thus is particularly suited to examination and assessment of the macroeconomic and industry impacts of the changing composition of consumption, production, foreign trade, and employment as the economy grows through time.

The inter-industry framework underlying the model is composed of five blocks: final demand, supply, factor income, prices, and the accountant. The first block of LIFT uses econometric equations to predict the behavior of real final demand (consumption, investment, imports, exports, and government expenditures). The components are modeled at various levels of detail. For example, aggregate consumption is the sum of 83 consumption products, and aggregate construction investment is the sum of expenditures for 26 types of private structures. Demand by product, with product sectors consistent with the input-output table (A matrix), is determined using bridge matrices to convert final demand to the commodity level. This equation is specified as:

$$f_{121} = B^{C}_{121\times 83} c_{83} + B^{E}_{121\times 71} e_{71} + B^{S}_{121\times 26} s_{26} + g_{121} + v_{121} + x_{121} - m_{121}$$

where *B* represents a bridge matrix for the various components (consumption, equipment investment by purchasing industry, and construction by type[1]) and where remaining variables represent consumption by product, equipment investment by purchasing industry, structures by type, inventory change, exports and imports, and government spending.

These detailed demand predictions then are used in an input-output production identity to calculate real gross output:

$$q = A \times q + f$$

where *q* and *f* are vectors of output and final demand by commodity, respectively, each having 121 elements, and where *A* is a 121x121 matrix of input-output coefficients. Input-output coefficients and the bridge matrix coefficients vary over time according to historical trends evident in available data and, in some cases, using assumptions about how technology and tastes might develop in the future. This equation establishes and reconciles supply (domestic production and imports) and demand (domestic demand and exports).

Commodity prices are determined in a similar fashion. In the factor income portion of the model, econometric behavioral and other equations predict each value-added component (including labor compensation, profits, interest, rent, and taxes on production and imports) by industry. Labor compensation depends on industry-specific wages that are determined by industry-specific factors as well as overall labor market conditions. Profit margins are dependent on measures of industry slack (excess supply or demand) and, for tradable sectors, on international prices. Depreciation depends on capital stock levels. Taxes and subsidies are imposed, in most cases, through exogenous ad-valorum rates on overall nominal output.

The industry value added levels are allocated to production commodities using a make matrix. The fundamental input-output price identity then combines value added per unit of output with unit costs of intermediate goods and services to form an indicator of commodity prices:

$$p' = p' \times A + v'$$

where *p* and *v* have 121 elements to represent production prices, unit costs, and unit value added, respectively. This identity ensures that income, prices, and output by sector are directly related and are consistent. In turn, relative prices and income flows are included as independent variables in the regression equations for final demand, establishing simultaneity between final demand and value added.[2]

As noted above, LIFT also calculates the major nominal economic balances for an economy: personal income and expenditure, the government fiscal balance (at both the federal and state and local government levels), and the current account balance. It also contains a full accounting for population, the labor force, and employment. This content is important for forecasting and for building alternative simulations because it ensures consistency between economic growth determined on the product side and the inflation and income components. The model allows us to examine how alternative microeconomic conditions

[1] Note that some details presented here are simplified accounts of the actual model, such as the presentation of the government demand vector. Government spending by commodity type within the model is the constructed as sum of several bridged demand vectors that provide detail for federal defense, federal nondefense, and state and local spending. Also, private nonresidential investment includes Intellectual Property, such as spending for software and R&D.

[2] This simplified representation of domestic price calculations omits details concerning import prices.

or policies will affect other aspects of the economy. Because the input-output structure allows a bottom-up approach to modeling the macro economy, macroeconomic results fully are consistent with simulated industry disruptions.

Applications of the LIFT model include analyses of the effects of the sequester (following the Great Recession) and other changes to fiscal policy. A series of studies consider the harm done by continued deterioration of public infrastructure and potential benefits of policies to improve public infrastructure. LIFT was used to analyze potential policies to encourage development and adoption of specific technologies related to energy production and consumption; these included wind, solar, and advanced nuclear technologies for electricity production, together with other power production and efficiency-enhancing technologies. In addition to projecting investment, production, consumption, and other economic factors, LIFT was employed to calculate implications for greenhouse gas emissions based on activity levels for all sectors. Other examples of impact analysis conducted with the Lift model include studies of the economic effects of port closures (e.g. due to terrorism or labor strikes) and the economic impacts of the September 2001 attacks. Additional studies include economic effects of immigration policy; tax policy; environmental regulation; health care spending, production, and policy; defense spending; and a wide variety of other topics. More information about these and other studies is available upon request.

Inforum LIFT Model Commodities	
1 Crop production	62 Other retail
2 Animal production	63 Air transportation
3 Forestry, fishing and agriculture support activities	64 Rail transportation
4 Crude oil extraction	65 Water transportation
5 Natural gas extraction	66 Truck transportation
6 Coal mining	67 Transit and ground passenger transportation
7 Metal ore mining	68 Pipeline transportation
8 Nonmetallic mineral mining	69 Transportation support, sightseeing, couriers
9 Support activities for mining	70 Warehousing and storage
10 Electric utilities	71 Publishing, except internet and software
11 Natural gas distribution	72 Software
12 Water, sewage and other systems	73 Motion picture and sound recording
13 New construction	74 Broadcasting: Cable, TV and radio
14 Maintenance and repair construction	75 Telecommunications
15 Dairy products, meat and seafood	76 Information and data processing
16 Other foods	77 Banks, credit cards and finance
17 Beverages	78 Securities and commodities brokers
18 Tobacco	79 Other financial investment activities
19 Textiles and textile products	80 Insurance
20 Apparel and leather	81 Funds, trusts and other financial vehicles
21 Wood products	82 Real estate
22 Paper	83 Owner-occupied dwellings
23 Printing	84 Rental and leasing of goods
24 Petroleum and coal products	85 Royalties
25 Resin, synthetic rubber and fibers	86 Legal services
26 Pharmaceuticals	87 Architectural, engineering and related services
27 Other chemicals	88 Computer systems design and related services
28 Plastic products	89 Scientific research and development services
29 Rubber products	90 Advertising
30 Nonmetallic mineral products	91 Other professional, scientific and technical services
31 Iron and steel	92 Management of companies and enterprices
32 Nonferrous metals	93 Administrative and support services
33 Fabricated metal products	94 Waste management and remediation
34 Agriculture, construction and mining machinery	95 Educational services
35 Industrial machinery	96 Offices of physicians
36 Commercial and service industry machinery	97 Offices of dentists
37 Ventilation, heating, air-conditioning and ventilation equ.	98 Offices of other health practitioners
38 Metalworking machinery	99 Outpatient care centers
39 Engine, turbine and power transmission equipment	100 Medical and diagnostic laboratories
40 Other general purpose machinery	101 Home health care services
41 Computers and peripheral equipment	102 Other ambulatory health care services
42 Communications and audio-video equipment	103 Hospitals
43 Semiconductors and other electronic components	104 Nursing and residential care facilities
44 Electromedical and electrotherapeutic apparatus	105 Child care and social assistance
45 Search, detection and navigation equipment	106 Performing arts, spectator sports and museums
46 Measuring and control instruments, and media	107 Amusements, gambling and recreation
47 Household appliances	108 Accomodation
48 Electrical equipment	109 Food services and drinking places
49 Other electrical equipment and components	110 Automotive repair and maintenance
50 Motor vehicles	111 Other repair and maintenance, personal services
51 Motor vehicle parts	112 Religious, grantmaking and other organizations
52 Aerospace products and parts	113 Private households
53 Ship and boat building	114 Postal service and federal government enterprises
54 Other transportation equipment	115 State and local government enterprises
55 Furniture	116 Federal general government defense
56 Medical equ. and supplies, dental labs, ophthalmic goods	117 Federal general government nondefense
57 Miscellaneous manufacturing	118 State and local general government
58 Wholesale trade	119 Scrap, used and secondhand
59 Motor vehicle and parts dealers	120 Noncomparable imports
60 Food and beverage stores	121 Rest of the world adjustment to final uses
61 General merchandise stores	

Inforum LIFT Model Consumption Products	
1 New cars	43 Water supply and sanitation
2 New light trucks	44 Electricity
3 Used cars and trucks	45 Gas
4 Tires, tubes, accessories and other parts	46 Physicians
5 Furniture and furnishings	47 Dentists
6 Household appliances	48 Home health care
7 Glassware, tableware and utensils	49 Medical laboratories
8 Tools and equipment for house and garden	50 Other professional medical services
9 Video and audio equipment	51 Hospitals
10 Photographic equipment	52 Nursing Homes
11 Information processing equipment	53 Motor vehicle maintenance and repair
12 Sporting equipment, supplies, guns, ammunition	54 Motor vehicle renting and leasing, other services
13 Sports and recreational vehicles	55 Ground transportation
14 Books	56 Air and water transportation
15 Jewelry and watches	57 Clubs, sports centers, parks, theatres and museums
16 Therapeutic appliances, eyeglasses, contacts	58 Cable and satellite TV, video rental
17 Luggage and similar personal items	59 Photographic services, photo and computer repair
18 Telephone and fax equipment	60 Gambling
19 Cereals and bakery products	61 Other recreation services
20 Meat, poultry, eggs, dairy and seafood (off premise)	62 Eating and drinking places
21 Fruits and vegetables (off premise)	63 Alcohol in purchased meals
22 Nonalcoholic beverages (off premise)	64 School lunches and food for employees
23 Other food products (off-premise)	65 Accomodations
24 Alcohol purchased for off-premise consumption	66 Financial services
25 Clothing, women's and children's	67 Life insurance
26 Clothing, men's and boy's	68 Net household insurance
27 Other clothing	69 Net health insurance
28 Footwear	70 Net motor vehicle and other tranportation insurance
29 Motor vehicle fuels, lubricants, fluids	71 Telecommunications services
30 Fuel oil and other fuels	72 Postal and delivery services
31 Pharmaceutical products	73 Internet access
32 Other medical products	74 Higher education
33 Games, toys, hobbies, photo supplies	75 Nursery, elementary and secondary schools
34 Pets, flowers seeds, and plants	76 Commercial and vocational schools
35 Household supplies	77 Professional and other services
36 Personal care products	78 Personal care and clothing services
37 Tobacco	79 Social services and religious activities
38 Magazines, newspapers and stationery	80 Household maintenance
39 Net expenditures abroad by U.S. residents	81 Americans Travel Abroad
40 Rental of tenant-occupied nonfarm housing, group housing	82 Foreigners spending in the US
41 Owner-occupied housing	83 Final consumption expenditures of nonprofit institutions
42 Rental value of farm dwellings	

Since its founding in 1967, Inforum has been dedicated to improving business planning, government policy analysis, and the general understanding of the economic environment. We work closely with government and private sector organizations to investigate a wide variety of economic issues. Inforum services include analytical research and projections of macroeconomic and industrial economic data. We have particular expertise in input-output techniques, global macro and regional economic data, and international market comparisons.

The work of Inforum typically involves the development and use of detailed models of the U.S. economy that combine a "bottom-up" (input-output) structure with a dynamic macroeconomic framework. Because of this approach, Inforum has amassed special expertise in economic analysis at the industrial level, including capital spending and employment. Our flagship model of the U.S. economy is called LIFT (Long-term Interindustry Forecast Tool). It contains consistent historical data and projections of demand, revenue, production, and international trade for 121 commodities. It includes value added and employment for 71 industries. A second U.S. model, Iliad, produces forecasts of final demand and output at a 350-commodity level that are consistent with the Lift projections. Finally, the STEMS model produces forecasts of employment, output, GDP, and personal income for the states at a 71-sector level, where these again are consistent with Lift forecasts.

Inforum has contributed U.S. macroeconomic forecasts to the Blue Chip Economic Indicators consensus forecasts for more than 30 years, and it also contributes forecasts to Consensus Economics, the National Association for Business Economics, and Focus Economics. Inforum economists often leverage the Lift model data to develop and maintain economic and industrial forecasts, and this work is extended with "satellite" modeling that connects industry-specific data to developments in consuming or supplying industries and to the macroeconomic environment.

Finally, Inforum regularly completes projects to answer "what if" questions concerning the impact on industries of fluctuation in the macroeconomic environment, such as changes in the exchange rate, or for changes in policies, such as spending on infrastructure. For example, in recent years we have worked with the National Association of Manufacturers (NAM) to examine the impacts of various fiscal policies on manufacturing output and employment, and we worked with the Environmental Protection Agency (EPA) to identify economic impacts of air quality regulations.[3]

Inforum offers extensive experience in data compilation, analysis, and forecasting for specific industries and the macroeconomy. Additional information is available upon request.

[3] A sample of recent reports can be found at https://inforumecon.com/inforum-research/. Examples of recent projects include "Delivering for America," joint with Keybridge Research (2019 and 2021); "Failure to Act: The Economic Impact Of Status Quo Investment Across Infrastructure Systems," sponsored by the American Society of Civil Engineers and completed in support of the EBP US.; and The Economic Footprints of the Agricultural and Construction Equipment Industries (April-September 2014).