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Introducing Inforum

Inforum is the popular name for a not-for-profit economic education and research corporation, the Interindustry Economic Research Foundation (IERF). Since its founding over thirty five years ago, Inforum¹ has been dedicated to improving business planning, government policy analysis, and the general understanding of the economic environment. It accomplishes this mission through:

- Building and using structural economic models of U.S. and other economies. Inforum pioneered the construction of dynamic, interindustry, macroeconomic models which portray the economy in a unique “bottom-up” fashion.
- Working with government and private sector organizations to investigate a variety of issues. Economic projections and analysis using Inforum econometric models are distinguished by detail at the industrial and product level.
- Serving as a training crucible for University of Maryland graduate students. Students receive valuable training in empirical economics and find fertile ground for dissertation research.
- Maintaining active ties with a world-wide network of research associates, each of which uses Inforum modeling methods and software. The Inforum partners have held annual conferences since 1993. The 2007 conference will be held in Trujillo, Spain in September.

Inforum’s operations are housed at the University of Maryland in the Economics Department. It was founded there by Dr. Clopper Almon in 1967, now Professor Emeritus of the University. Clopper supervised over 40 Ph.D. dissertations, many of which have contributed to the infrastructure of Inforum.

Most of our analyses involve the development and use of Interindustry-Macroeconomic (IM) models that combine input-output structure with econometric equations in a dynamic and detailed framework. Because of their ability to portray the detailed structure of economies over actual time periods, we find that these models fill an important gap in the inventory of existing models of the U.S. and foreign economies. For example, we often use these models to answer "what if" questions on the impact across industries of fluctuation in the macroeconomic environment, such as changes in exchange rate or tax policy. The effects on demands, revenue, production and trade can be described at a level of 97 sectors, or for many scenarios, at the 360 sector-level.

Inforum services include macroeconomic and industrial forecasting and “satellite” modeling to connect data for more detailed sectors to a more aggregated environment. Indeed, many subscribers use our software and models on their computers for routine analysis or issue-specific research. We also perform analytical research and computations of economic or other data, with particular expertise in input-output techniques, global economic data, and international market comparisons.

Inforum researchers learn the details concerning the meaning and compilation of economic data so that this data can be deployed in the most relevant and meaningful fashion. We are dedicated to timely, thorough and reliable assistance to our research sponsors. Finally, Inforum explores economic phenomena and principles in a nonpartisan fashion, according to generally accepted economic theory and econometric methods, regardless of the implications for public policy or private strategy.

¹ Inforum stands for the INterindustry FORecasting at the University of Maryland and is a registered trademark of IERF. IERF handles contracts and subscriptions; a substantial portion of its receipts are donated to the University of Maryland where the research is accomplished. Please visit our website at: www.inforum.umd.edu.

Inforum Models

Most of Inforum's analyses are based on Interindustry-Macroeconomic (IM) models that combine input-output structure with econometric equations in a dynamic and detailed framework. Inforum's flagship model, **Lift (Long-term Interindustry Forecasting Tool)**, is a 97-sector general equilibrium representation of the U.S. economy that employs a "bottom-up" approach to macroeconomic modeling.

In an IM model, quantities such as total capital investment, total imports and total profit income are not projected directly but are computed from the sum of their parts: investment by production branch, imports by commodity, and profits by industry. This bottom-up technique possesses several desirable properties for analyzing the economy. For example, industry-specific changes in government policies or market setting can be individually specified, and the impact of these industry-level changes on related sectors and on the aggregate economy can be identified. At the same time, the impact of macroeconomic events such as exchange rate changes or fiscal policy can be traced to and illustrated at the sectoral level.

Lift's structure contains information and simulation results for macroeconomic sectors and variables such as the GDP and its components, inflation, employment, financial markets, government accounts, and international balances. At the sectoral level, the model provides data and results for revenue and production, consumption and government demand, capital investment and profits, employment and wages, and exports and imports.

Inforum builds and maintains other models of the U.S. economy including:

- Iliad, a 360 sector model that uses the results of Lift to develop forecasts and simulations at a more detailed level.
- Demographic Projection Model (DPM), a population forecasting system that produces forecasts by gender and age.
- State Employment Modeling System (STEMS), a model which allocates national Lift results for industrial production, employment and income by each state.

In addition, Inforum's International System of Models links the U.S. economy with its 12 major trading partners. Specifically, in cooperation with research partners throughout the world, Inforum maintains and uses Interindustry Macro Models (i.e., similar to Lift) for several countries including:

Austria	Italy
Belgium	Japan
Canada	Mexico
China	Spain
France	South Korea
Germany	United Kingdom

These models are tied together at the detailed commodity level through a Bilateral Trade Model (BTM). This model has the capability to perform unique studies on global developments such as changing exchange rates or new trade liberalization.

Inforum Client and Project Examples

Federal Agencies:

- Center for Medicare and Medicaid Services(CMS)
Illustrate the long-term implications of increases in social and private medical expenditures.
Develop Demographic Projections Model (DPM).
- Department of Defense
Develop and maintain DEPPS, the Defense Employment and Purchases Projection System, which calculates the macroeconomic, industrial, and regional effects of defense spending.
- Department of Commerce
Describe the economic impacts of energy price and exchange rate fluctuations.
- Institute for Defense Analysis
Analyze effects of defense force mobilization.
- Congressional Budget Office
Analyze budgetary impacts of defense expenditures.
- Other U.S. Government
Build and maintain interindustry-macroeconomic models for several foreign countries and an international bilateral trade model. Analyze global bilateral trade flows and issues.

Private Sector:

- Energy Security Leadership Council /Securing America's Future Energy
Evaluate economic impacts of Senate energy bills.
- Axiom Valuation
Provide very detailed industry forecasts for online business web site.
- National Rural Electric Co-op Association
Develop county/utility area model to analyze electricity policy and regulation changes.
- Integra Information, Inc.
Develop and maintain detailed sales forecasts for U.S industries.
- Manufacturer's Alliance (MAPI)
Conduct special studies on the Asian Crisis and foreign trade liberalization.
- American Council of Life Insurance
Provide U.S. Demographic Projections Model (DPM) forecasts and analysis.
- PWC Consulting
Analyze effects of changing U.S. tax policies.

Foreign Clients:

- Canadian Government
- Fundación Tomillo (Spain)
- Institute for International Trade and Investment (Japan)
- Ministry for International Trade and Industry (Japan)
- Korean Environmental Institute

Inforum Staff

Clopper Almon, Jr.

Clopper founded the INFORUM project in 1967 and now is Professor Emeritus in the Economics Department at the University of Maryland. He remains the Chairman of the IERF Board. He wrote *The Craft of Economic Modeling* which he used to teach model building through hands-on experience with his econometric software package *G* (available free at the Inforum web site). He created *Interdyme*, the software environment used for developing Inforum's multisectoral policy and forecasting models.

Margaret McCarthy

Margaret works on the development and use of US databases and models. Margaret consults on U.S. model-related projects, recently supplying, for example, an updated IO table economic time series data for the U.S. economy to MITI. She leads Inforum's assistance to the Chief Actuary of the Centers for Medicare and Medicaid. Margaret has 30 years of experience at Inforum, concentrating on the U.S. input-output accounts and related U.S. industry statistics, as well as developing the family of Inforum models.

Douglas Meade

Doug returned to Inforum in May, 2006, after serving 3 years as Deputy Chief of the Industry Division at the Bureau of Economic Analysis (BEA). Before working for BEA, Doug contributed significantly to the development of the Lift and Iliad models of the U.S., and the Jidea model for Japan. He has served as principal investigator on a wide variety of projects for private sector and government clients. He has nearly 20 years of experience with economic modeling and data development, and has also held positions at Data Resources Inc., and the Bureau of Census. Doug received his Ph.D. from the University of Maryland.

Douglas Nyhus

Doug develops and maintains the international interindustry models and the bilateral trade system linking countries into a world forecasting system. He performs many analyses with the international/bilateral trade system. He has supported impact analyses by U.S. government agencies for studies of the Chinese, Korean, Japanese, and Indian economies. He has nearly 30 years of experience working with international models and data, and has been instrumental in developing the Inforum international network of researchers. Doug has a PhD from the University of Maryland.

Jeffrey Werling

Returning to Inforum in 2003, Jeff has served as manager and principle investigator for several recent projects, including a recent currency study for the Department of Commerce using the Inforum Bilateral Trade Model. He maintains and operates the DEPPS model for the Department of Defense. Previously, Jeff held positions as an international and industry economist with the National Electrical Manufacturers Association (NEMA), the Manufacturers Alliance (MAPI), and the WEFA Group (now Global Insight). Jeff received his PhD from the University of Maryland.

Ron Horst

Ron's work has included the estimation of investment, consumption and labor productivity equations for the Lift model and maintaining Inforum software. He constructed a regional model of Andalusia, Spain. He is completing his dissertation concerning at the economics of the nuclear power industry.

The Inforum International System of Models

In order to analyze the global economic impact of various shocks (economic and non-economic), one must use a consistent and empirical economic framework rooted in sound economic theory and reliable economic data. Inforum pioneered such an infrastructure through its International System (IS) of IM models of key national economies.

This collection of models has been built over the past three decades by a network of international researchers applying a framework and philosophy first pioneered by Professor Clopper Almon at the University of Maryland's Inforum project. The system currently includes models of Austria, Belgium, Canada, China, France, Germany, Italy, Japan, Mexico, South Korea, Spain, the United Kingdom, and the United States. The models are tied together through a Bilateral Trade Model (BTM) that describes bilateral merchandise trade flows among countries for 120 commodities.

The Inforum system incorporates several important features that make it an ideal tool to provide quantitative analyses on how the changing global environment is impacting not only individual economies, but specific industries as well. These features include:

- **National economies are modeled from the bottom-up.**

While each model has an explicit accounting for macroeconomic quantities such as GDP, inflation and unemployment, the approach to determining these quantities is unique. Combining a classical input-output formulation with extensive use of regression analysis, the models employ a "bottom-up" approach to macroeconomic modeling. For example, aggregate consumption, total exports, and employment are not determined directly, but are computed as the sum of their parts: consumption of specific goods and services, exports by commodity, and employment by industry.

- **The national models reflect specific country structures and institutions.**

Though the Inforum models share a common structure, they are not simple applications of a general model form. At the most fundamental level, each model is based on the economic data of its subject country, including the interindustry structure indicated by country-specific input-output tables. Moreover, the models incorporate economic characteristics and econometrically-estimated behavior specific to each country. The model of China reflects the institutions that are in place today and projects how those institutions might change over time. Likewise, the US model assumes US institutions and economic structures. Thus, each model will react to global economic shocks in different ways.

- **Scenario modeling capability is extensive and flexible.**

The Inforum models possess a flexible structure for performing alternative scenarios. Exogenous assumptions can be easily modified, and endogenous variables or equation structure can be altered at the industry-level. For example, the system was successfully used to conduct an ambitious analysis of European Integration that required more than a dozen sector-specific studies. Issues analyzed included the removal of customs stations, changes in the structure of retail banking, the decline of costs in trucking, and the reduction of management "x-inefficiencies" due to the increase of competition in key sectors.

- **The national models are linked via a bilateral trade model.**

The Inforum models are connected by the detailed Bilateral Trade Model (BTM). As the name implies, BTM models the bilateral flows of merchandise trade from one country to another for 120 categories of tradable goods. For each country and commodity, the model predicts the share of

imports sourced in each of the other 13 countries plus two regions (Rest of Europe and Rest of World). These shares are projected as a function of the relative prices among competing exporters and each exporter's capacity to export. Thus, for example, an increase in the capital stock of the automobile industry in South Korea will lead, over time, to an increase Korea's share in the imports of other countries' auto imports. A detailed description of the BTM can be found at: www.inforum.umd.edu/WorkPaper/INFORUM/Dissertations/Wang.pdf

Bilateral Trade Model Commodity Titles

1 Unmilled cereals	41 Other wood products	81 Constr,ming,oil equip
2 Fresh fruits,vegetables	42 Furnitures and fixtures	82 Metal, wood machinery
3 Other crops	43 Pulp and waste paper	83 Sewing & knit machines
4 Livestock	44 Newsprint	84 Textile machinery
5 Silk	45 Paper products	85 Paper mill machines
6 Cotton	46 Printing,publishing	86 Printing machines
7 Wool	47 Basic chemicals	87 Food-process machines
8 Other natural fibers	48 Fertilizers	88 Other special machinery
9 Crude wood	49 Synthetic resins, fibers	89 Serv industry machinery
10 Fishery	50 Paints,varnishes,lacquers	90 Pumps
11 Iron ore	51 Drugs and medicines	91 Mech handling equip
12 Coal	52 Soap,other preparations	92 Oth non-electrical mach
13 Non-ferrous metal ore	53 Chemical products n.e.c.	93 Radio,TV,phonograph
14 Crude petroleum	54 Petroleum refineries	94 Other telecomm equip
15 Natural gas	55 Fuel oils	95 Household appliances
16 Non-metallic ore	56 Product of petroleum	96 Computers
17 Electrical energy	57 Product of coal	97 Other office machinery
18 Meat	58 Tyre and tube	98 Semiconductors
19 Dairy and eggs	59 Rubber products,n.e.c.	99 Electric motors
20 Presrvd fruits & veget	60 Plastic products,n.e.c.	100 Batteries
21 Preserved seafood	61 Glass	101 Elect bulbs,lighting eq.
22 Veget & animal oils, fats	62 Cement	102 Electrical indl appliance
23 Grain mill products	63 Ceramics	103 Shipbuilding,repairing
24 Bakery products	64 Non-metal prods n.e.c.	104 Warships
25 Sugar	65 Basic iron and steel	105 Railroad equipment
26 Cocoa, chocolate,etc	66 Copper	106 Motor vehicles
27 Food products n.e.c.	67 Aluminum	107 Motorcycles,bicycles
28 Prepared animal feeds	68 Nickel	108 Motor vehicles parts
29 Alcoholic beverage	69 Lead and zinc	109 Aircraft
30 Non-alcoholic beverage	70 Other Non-ferrous metal	110 Other transport eq
31 Tobacco products	71 Metal furn & fixtures	111 Prof measure instruments
32 Yarns and threads	72 Structural metal products	112 Photo,optical goods
33 Cotton fabric	73 Metal containers	113 Watches and clocks
34 Other textile products	74 Wire products	114 Jewelry
35 Floor coverings	75 Hardware	115 Musical instruments
36 Wearing apparel	76 Boilers and turbines	116 Sporting goods
37 Leather and hides	77 Aircraft engines	117 Ordnance
38 Leather products	78 Int combustion engines	118 Works of art
39 Footwear	79 Other power machinery	119 Manufactures n.e.c.
40 Plywood and veneer	80 Agricultural machinery	120 Scraps,used,unclassified

The LIFT Model of the U.S. Economy

The Inforum Lift (Long-term Interindustry Forecasting Tool) model is unique among large-scale models of the U.S. economy. Combining an interindustry (input-output) formulation with extensive use of regression analysis, it employs a “bottom-up” approach to macroeconomic modeling. For example, aggregate investment, total exports, and employment are not determined directly, but are computed by the sum of their parts: investment by industry, exports by commodity, and employment by industry. Indeed, Lift contains full demand and supply accounting for 97 productive sectors. (See below for Lift sector titles.)

In short, the demand/production block of Lift uses econometric equations to predict the behavior of real final demand (consumption, investment, imports, exports, government) at a detailed level. Then, the detailed predictions for demand are used in input-output production identity to generate gross output (total revenue adjusted for inflation). Lift’s approach to projecting industry prices is similar. Behavioral equations estimate each value-added component (e.g., compensation, profits, interest, rent, indirect taxes) for each industry. Value added per unit of output is then combined with the prices of intermediate goods and services with the input-output price identity to form an indicator for industry prices. Prices by industry are also dependent on measures of slack in each industry, and, in some cases, international prices. Thus, income and prices are directly related and are consistent. In turn, relative price terms and income flows are included as independent variables in the regression equations for final demand, creating a simultaneity between final demand and value-added.

This bottom-up technique possesses several desirable properties for analyzing the economy. First, the model works like the actual economy, building the macroeconomic totals from details of industry activity, rather than distributing predetermined macroeconomic quantities among industries. Second, the model describes how changes in one industry, such as increasing productivity or changing international trade patterns, affect related sectors and the aggregate quantities. Third, parameters in the behavioral equations differ among products, reflecting differences in consumer preferences, price elasticities in foreign trade, and industrial structure. Fourth, the detailed level of disaggregation permits the modeling of prices by industry, allowing one to explore the causes and effects of relative price changes.

Despite its industry basis, Lift is a full macroeconomic model, with more than 800 macroeconomic variables determined consistently with the underlying industry detail. This macroeconomic “superstructure” contains key functions for household savings behavior, interest rates, exchange rates, unemployment, taxes, government spending, and current account balances. Like in an aggregate macroeconomic model, this structure insures that Lift exhibits “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, in the long term, supply forces -- available labor, capital and technology -- will determine the level of output.

Another important feature of the Lift model is the importance given to the dynamic determination of endogenous variables. For example, investment depends on a distributed lag in the output growth of investing industries and imports and exports depend on a distributed lag of foreign price changes. Therefore, Lift model solutions are not static, but are fully capable of projecting a time path for the endogenous quantities.

Finally, the Lift model is linked to other, similar models with the Inforum Bilateral Trade Model (BTM). Countries included in this system include the U.S., Japan, China, and the major European economies. Through this system, sectoral exports and imports of the U.S. economy respond to sectoral level demand

and price variables projected by models of U.S. trading partners. In summary, the Lift model is particularly suited for examining and assessing the macroeconomic and industry impacts of the changing composition of consumption, production, foreign trade, and employment as the economy grows through time.

The current model is the fourth discrete version of a modeling framework that has been in continuing existence since 1967. Since its inception, Lift has continued to develop and change. We have learned more about the properties of the model through working with clients, and in doing our own simulation tests. We have learned about the behavior of the general Inforum type of model, from work with our partners in other countries. Finally, through many experiments, we have learned that many principles of economics, while attractive theoretically, are difficult to implement practically. We will continue to experiment, and share ideas, and bring the models closer to our vision of what they should be. A detailed description of the Lift model can be found at: <http://www.inforum.umd.edu/WorkPaper/INFORUM/wp01002.pdf>

Producing Sectors of the Lift Model of the U.S. Economy

1 Agriculture, forestry, & fish

Mining

- 2 Metal mining
- 3 Coal mining
- 4 Natural gas extraction
- 5 Crude petroleum
- 6 Non-metallic mining

Construction

- 7 New construction
- 8 M & R construction

Non-Durables

- 9 Meat products
- 10 Dairy products
- 11 Canned & frozen foods
- 12 Bakery & grain mill product
- 13 Alcoholic beverages
- 14 Other food products
- 15 Tobacco products
- 16 Textiles and knitting
- 17 Apparel
- 18 Paper
- 19 Printing & publishing
- 20 Agric fertilizers & chemicals
- 21 Plastics & synthetics
- 22 Drugs
- 23 Other chemicals
- 24 Petroleum refining
- 25 Fuel oil
- 26 Rubber products
- 27 Plastic products
- 28 Shoes & leather

Durable Material & Products

- 29 Lumber
- 30 Furniture
- 31 Stone, clay & glass
- 32 Primary ferrous metals
- 33 Primary nonferrous metals
- 34 Metal products

Non-Electrical Machinery

- 35 Engines and turbines
- 36 Agr., constr., min & oil equip
- 37 Metalworking machinery
- 38 Special industry machinery
- 39 General & misc. industrial
- 40 Computers
- 41 Office equipment
- 42 Service industry machinery

Electrical Machinery

- 43 Elect. industry equipment
- 44 Household appliances

- 45 Elect. lighting & wiring eq
- 46 TV's, VCR's, radios
- 47 Communication equipment
- 48 Electronic components

Transportation Equipment

- 49 Motor vehicles
- 50 Motor vehicle parts
- 51 Aerospace
- 52 Ships & boats
- 53 Other transportation equip

Instruments & Miscellaneous

Manufacturing

- 54 Search & navigation equip
- 55 Medical instr & supplies
- 56 Ophthalmic goods
- 57 Other instruments
- 58 Miscellaneous manufacturing

Transportation

- 59 Railroads
- 60 Truck, highway pass transit
- 61 Water transport
- 62 Air transport
- 63 Pipeline
- 64 Transportation services

Utilities

- 65 Communications services
- 66 Electric utilities
- 67 Gas utilities
- 68 Water and sanitary services

Trade

- 69 Wholesale trade
- 70 Retail trade
- 71 Restaurants and bars

Finance & Real Estate

- 72 Finance & insurance
- 73 Real estate and royalties
- 74 Owner-occupied housing

Services

- 75 Hotels
- 76 Personal & repair services
- 77 Professional services
- 78 Computer & data processing
- 79 Advertising
- 80 Other business services
- 81 Automobile services
- 82 Movies & amusements
- 83 Private hospitals

- 84 Physicians
- 85 Other medical serv & dentists
- 86 Nursing homes
- 87 Education, social serv, NPO

Miscellaneous

- 88 Government enterprises
- 89 Non-competitive imports
- 90 Miscellaneous tiny flows
- 91 Scrap & used goods
- 92 Rest of the world industry
- 93 Government industry
- 94 Domestic servants
- 95 Inforum statistic discrepancy
- 96 NIPA statistical discrepancy
- 97 Chain weighting residual