The New Regional Economic Impact Modeling Approach for the U.S. Minerals Management Service

*By Kim F. Coffman, Vicki Zatarain and Stephanie Gambino**

Introduction

The U.S. Minerals Management Service (MMS) is responsible for managing mineral resources on the Federal Outer Continental Shelf (OCS). Among the many factors decision makers must consider prior to scheduling and conducting OCS oil and gas lease sales (auctions of development rights) are the magnitude and location of economic impacts on local communities. In the late 1990s, MMS developed a new framework for estimating regional economic impacts that recognizes regional differences but provides for a consistent approach to the development of models for all coastal areas and for different levels of analysis. This paper presents a general description of that framework and the models themselves, focusing on models for Gulf of Mexico (GOM) analyses. For more details on the various activities that comprise an offshore oil and gas project,[1] the resulting expenditures, and the allocation of those expenditures to specific industrial sectors in designated onshore economies, see the papers by David Dismukes & Williams Olatubi and by Jonathan Skolnik & Chris Holleyman in the proceedings for the April 2001 IAEE International Conference.

Background

Legal Mandate

The OCS Lands Act, as amended, established a policy for the management of oil and natural gas on the OCS and for protection of the marine and coastal environments. The mandate given MMS under the OCS Lands Act and other laws, is essentially

- to expedite exploration & development of the OCS;
- to protect human, marine, & coastal environments;
- to obtain for the public a fair & equitable return on OCS resources;
- to preserve & maintain competition; and
- to balance this range of objectives under all market conditions.

Regional economic impact analyses play a part in two kinds of planning to help carry out this mandate. The first is the development of a new 5-year program (a 5-year schedule of proposed auctions of mineral rights, which are called lease sales). The OCS Lands Act requires that a 5-year program be in place and lays out a variety of considerations and requirements for developing one. After a 5-year program has been approved, and prior to each lease sale, MMS conducts more detailed analyses for decision makers, who then decide whether the sale will be held as proposed, modified, delayed, or cancelled.

The regional economic impact analyses conducted in these planning phases help satisfy two primary statutory requirements. Section 18 of the OCS Lands Act requires that, in the development of a 5-year program, the

> [t]iming and location of exploration, development, and production of oil and gas among the oil- and gas-bearing physiographic regions of the outer Continental Shelf shall be based on a consideration of … (B) an equitable sharing of developmental benefits and environmental risks among the various regions … . [43 U.S.C. 1344(a)(2)]

The equitable sharing analysis, which examines all coastal areas near lease sale areas on a proposed schedule, is included in the decision document for each of three stages in the development of a new 5-year program.

In addition, the National Environmental Policy Act (NEPA) of 1969 states that

> [t]he Congress authorizes and directs that, to the fullest extent possible: … (2) all agencies of the Federal Government shall … (C) include in every recommendation or report on a proposal for legislation and other major Federal Actions significantly affecting the quality of the human environment, a detailed statement by the responsible official on (i) the environmental impact of the proposed action, … . [42 U.S.C. 4332]

To this end, MMS prepares Environmental Impact Statements (EISs) and Environmental Assessments (EAs); acquires marine environmental data; analyzes data, literature surveys, socioeconomic studies, and special studies; and holds public conferences. The EIS for a proposed 5-year program contains a regional impact analysis for each coastal area throughout the Nation near a sale on the proposed schedule, while the EIS for an individual lease sale includes an analysis for the local coastal areas.

Application of Regional Economic Impact Analyses to MMS Mandate

However they measure regional economic effects of new investments or activity, such as OCS oil and gas development, regional economists generally classify the effects as direct, indirect, or induced. For the equitable sharing and EIS analyses, direct effects are those resulting from the first round of "new" spending by companies working directly on an OCS project(s). Indirect effects result from the additional project-related spending of contractors, vendors, and others who provide goods and services to the companies working directly on the OCS project(s). Induced effects result from the additional consumer spending by employees (and their families) of the businesses working directly on, or providing goods and services in support of, the project(s).

The MMS bases all its analyses of proposed lease sales, not just those of regional economic impacts, on Exploration and Development (E&D) Scenarios. The appropriate MMS regional office's Resource Evaluation unit prepares an E&D scenario for each sale or schedule of sales. The E&D scenario consists of estimates of the amount of infrastructure

---

* Kim F. Coffman, Vicki Zatarain, and Stephanie Gambino, are with the U.S. Minerals Management Service.This is an edited version of a paper presented at the 24th Annual International Conference of the IAEE in Houston, TX.

Any views expressed herein are those of the authors and may not reflect the official views and policies of the U.S. Minerals Management Service.

[1] See footnotes at end of text

required for the exploration, development, and production anticipated from the proposal in question. Each scenario is based on an analysis of existing geologic data and assumptions about the extent to which unleased resources will be discovered and produced at specified price paths. For some analyses, the scenario includes a forecast of the annual distribution of these activities over time, e.g., the number of exploration wells in year 1, the number of exploration wells and of development wells in year 2, etc. For the GOM, these estimates are provided for several water depths, from shallow to ultra deep water.

The E&D scenario for a proposed 5-year program encompasses all anticipated projects in each OCS planning area. For a single proposed lease sale, it encompasses all anticipated projects in the OCS planning area for which the sale is scheduled. Post-lease analyses would tend to focus on a specific project, for which the direct effects may be known.

For the GOM planning areas,[2] the E&D scenario provides estimates of

- number of new exploration & delineation wells
- number of new platforms
- number of new development wells
- miles of new pipeline installed
- number of workovers
- quantity of oil produced
- quantity of gas produced
- number of new gas processing facilities
- number of platforms removed.

Any model that MMS uses to estimate regional economic impacts of proposed OCS oil and gas activities must do several things. First, for each OCS activity related to a specific OCS planning area, the model must estimate the typical industry expenditure, then allocate that expenditure among the onshore geographic areas to be considered in the analysis. Such models must be developed specifically for OCS oil and gas analyses to reflect the unique expenditure patterns of OCS-related companies. For example, OCS activities require much larger purchases of steel pipe and air and water transportation than do onshore activities, where a higher proportion of expenditures necessarily goes to the other factors, including ground transportation. Industry expenditures also vary by the water depth at the location of the exploration or production facilities. For example, an exploratory well in 50 meters of water is expected to be drilled using a jack-up rig and to cost about $4 million, whereas an exploratory well in 950 meters of water may be drilled using a drill ship and cost more than $10 million to complete.

The model also must estimate indirect and induced effects. For an EIS, MMS needs impact data for specific onshore areas composed of single boroughs/municipalities (in Alaska) or groups of contiguous counties/parishes that exhibit shared economic activity (in GOM States). Because the secondary and tertiary spending patterns resulting from direct expenditures vary by onshore area, a separate set of multipliers[3] must be used for each.

In addition, an accurate model must reflect typical commuting patterns for workers in OCS-related industries. For example, OCS platform workers tend to spend a week or more offshore, followed by the same period at home. This allows them to commute longer distances and results in such workers spending most of their income outside the areas of analysis. Therefore, to accurately model the onshore effects of OCS activities, an analyst must know what percentage of workers spend what portion of their income where, then must use a customized model or must "recalibrate" a more general model to properly characterize local labor payments in certain industries.

Regional Economic Modeling: Previous MMS Methodology

Prior to the Autumn of 2000, the Alaska OCS Regional Office and the GOM OCS Regional Office used independently developed processes to estimate regional employment impacts for EISs. The equitable sharing analysis was done with existing data, with little use of output from impact models.

In the Alaska office, MMS used the "Manpower" model to convert E&D scenarios into estimates of direct employment expected to result from a proposed OCS lease sale. Manpower, which was developed by MMS employees with contractor assistance, consists of a set of simple multipliers on spreadsheet pages in a Corel Quattro Pro notebook. MMS used the Rural Alaska Model (RAM), developed by the University of Alaska, and the output from Manpower to estimate indirect and induced employment. The RAM consists of a set of worksheets in a Microsoft Excel workbook. Like Manpower, it uses simple multipliers to estimate results. The RAM is actually a collection of 10 models, 1 for each of 10 local onshore areas.

In the GOM office, MMS used an unnamed, staff-developed, MS Excel spreadsheet to estimate direct, indirect, and induced employment effects. The GOM office based its direct employment and population projections on average employment requirements for OCS activities (by type of activity and water depth), determined through an informal survey of industry employment types and locations. The GOM region allocated onshore direct effects using historical data from an offshore rig locator service. The same model used exogenous multipliers developed and modified over time from County Business Pattern data to estimate indirect and induced employment.

Given the lack of proposed lease sales in either region for more than 15 years, no PC-based models were maintained to estimate regional employment impacts for the Atlantic OCS region or the Pacific OCS region. The Pacific OCS Regional Office had planned to use analyses of internal environmental studies to help estimate direct employment effects and to use proprietary IMPLAN data and software to estimate indirect and induced employment effects.

The New MMS Consistent Approach to Regional Economic Impact Modeling

In the mid-1990s, MMS formed the Developmental Benefits Model Assessment Team (DBMAT) to develop proposals to improve its regional economic impact models. The DBMAT was composed of members from each MMS OCS regional office and relevant units at MMS headquarters.

While the DBMAT researched a broad range of models used for regional economic impact analyses, it is important to note that there was, and is still, no secondary source from which MMS could obtain data showing how a given expen-

(continued on page 20)

diture on OCS oil and gas activities reverberates through onshore economies. No standard statistical series, such as those compiled by the Departments of Commerce and Labor, gathers data on the offshore oil and gas industry. In every case, offshore is combined with onshore oil and gas or with all mining. These distinctions are important because of the different spending patterns cited above and because the sector in which money is spent and workers are employed can strongly influence the level of indirect and induced effects.

The DBMAT proposed a two-step modeling process that would allow the development of region-specific models to be developed under a consistent methodology, whether for large, Statewide or multi-State areas in equitable sharing analyses or for sub-State areas in specific pre-sale analyses. Given the Team's belief that there was no single readily available model adequate for all MMS analyses, this proposal called for region-specific "first-step" model components to estimate direct effects and "second-step" model components comprised of, or including multipliers from, a single static input-output model[4] with region-specific databases to estimate indirect and induced effects. Accordingly, the first-step component would include a cost function[5] that not only estimated the total required expenditures for each E&D expenditure but also allocated expenditures among industrial sectors in each onshore area.

After the proposal was approved, the DBMAT selected the IMPLAN (IMpact Analysis for PLANning) model for the universal second-step component, because it had the simplicity and flexibility to meet current and unforeseen MMS needs, and it was the most widely used input-output model available with regularly updated data for all coastal areas. Furthermore, IMPLAN had been used to analyze impacts from oil, gas, and non-oil related economic shocks in all MMS regions.

The necessary first-step data for the two OCS regions available for leasing consideration was obtained through outside contracts. The Center for Energy Studies (CES) at Louisiana State University developed the data for the cost functions and onshore allocations for the GOM under a Coastal Marine Institute contract. Jack Faucett Associates (JFA) was hired to develop first-step models for the Arctic and Sub-Arctic Alaska OCS.

CES and JFA had to determine the appropriate technology for each phase of development, e.g., exploratory drilling or production operations and maintenance, then identify necessary expenditures and the industrial sectors and geographic locations of all supporting activities. For example, while a jackup rig is most likely to be used in 0-60 meters of water in the Gulf of Mexico, other drilling structures would be used in deeper water. However, JFA found that in the Beaufort Sea, where production from Federal waters will not begin until late this year at the earliest, normal rigs could not withstand the winter conditions, and production would most likely take place from artificial gravel islands until oil and gas activities eventually move out of shallow water. The cost functions for these water depths and different kinds of drilling structures can vary considerably, as can the locations of the companies providing the necessary goods and services for fabrication and installation. About 36 percent of platform fabrication and installation expenditures for a project in 0-60 meters of water go to IMPLAN sector 258 (Steel Pipe and Tubes), while that rises to 56 percent or more for a project in more than 900 meters of water. Nearby companies are likely to meet most needs for shallow-water projects in the GOM, while some important capital goods (like hulls for deep-water platforms) for deep-water projects–and the majority of goods and services for Arctic Alaska–may come from outside the region. All MMS models treat expenditures on foreign goods as leakage, while models designed for EIS's also exclude expenditures anywhere outside the local areas of interest.

These are among the many factors influencing the data used in building a first-step model. For more in-depth explanations, see the papers by Dismukes & Olatubi and Skolnik & Holleyman in the proceedings for the April 2001 International Conference in Houston. The full CES and JFA reports to MMS should be available in mid-2001.

Microsoft Access was selected as the software to link the E&D scenarios, the first-step components, and IMPLAN.[6] Given the large number of inputs for the second-step component, usually numbering many thousands, IMPLAN Pro software and data are used only to provide and regularly update sets of multipliers for the MS Access model. The IMPLAN software itself also could be used for analyses not requiring extensive data entry.

Because the magnitude of indirect and induced effects for each industry varies by geographical location, MMS develops a separate MS Access model for each onshore area in an analysis. For the Gulf of Mexico, these onshore areas are

- TX-1 (Aransas, Calhoun, Cameron, Jackson, Kenedy, Kleberg, Nueces, San Patricio, Refugio, Victoria, Willacy)
- TX-2 (Brazioria, Chambers, Fort Bend, Galveston, Hardin, Harris, Jefferson, Liberty, Matagorda, Montgomery, Orange, Waller, Wharton)
- LA-1 (Cameron, Calcasieu, Iberia, Lafayette, Vermilion)
- LA-2 (Ascension, East Baton Rouge, Lafourche, Livingston, St. Charles, St. James, St. Martin, St. Mary, St. John the Baptist, Tangipahoa, Terrebonne, West Baton Rouge)
- A-3 (Jefferson, Orleans, Plaquemines, St. Bernard, St. Tammany)
- MA-1 (Baldwin, AL; Mobile, AL; Hancock, MS; Harrison, MS; Jackson, MS; Stone, MS)
- FL-Panhandle (Escambia, Santa Rosa, Okaloosa, Walton, Bay, Franklin, Gulf)
- FL-Rest of the western coast[7]
- Rest of the U.S.

The model also produces direct spending estimates for Rest of the World, but these results are not used in either the equitable sharing analysis or the EISs.

For Gulf of Mexico analyses, the entire two-step process is accomplished within the MS Access model, as shown in Figure 1.

Figure 1 shows the design view of a sample MS Access query for the area called LA-1 that illustrates how the GOM models work. The first box in the upper left corner of the figure represents the Exploration and Development scenario, required for any model to produce data. The second requirement is the first-step component–the third box from

the left, which contains the cost functions by phase (e.g., exploratory drilling) and water depth. The MS Access query uses this data table (see footnote 5) to estimate the expenditures resulting from the activities and to allocate those expenditures to industrial sectors in the relevant onshore area addressed by this model. So for each exploratory well in 0-60 meters of water, for example, about 70 percent of the estimated $4.25 million spent to drill each well will be allocated to sector 38 in the group of parishes called LA-1.

The other boxes to the right comprise the second step of the model. These are the multipliers for employment, employee wages, personal income, total value added, and total economic output. They estimate, for example, the number of industry jobs created in LA-1 as a result of each million dollars spent, as well as the number of jobs created by secondary industries and by households with industry employees. The equations performed on the data are in the bottom section of the window.

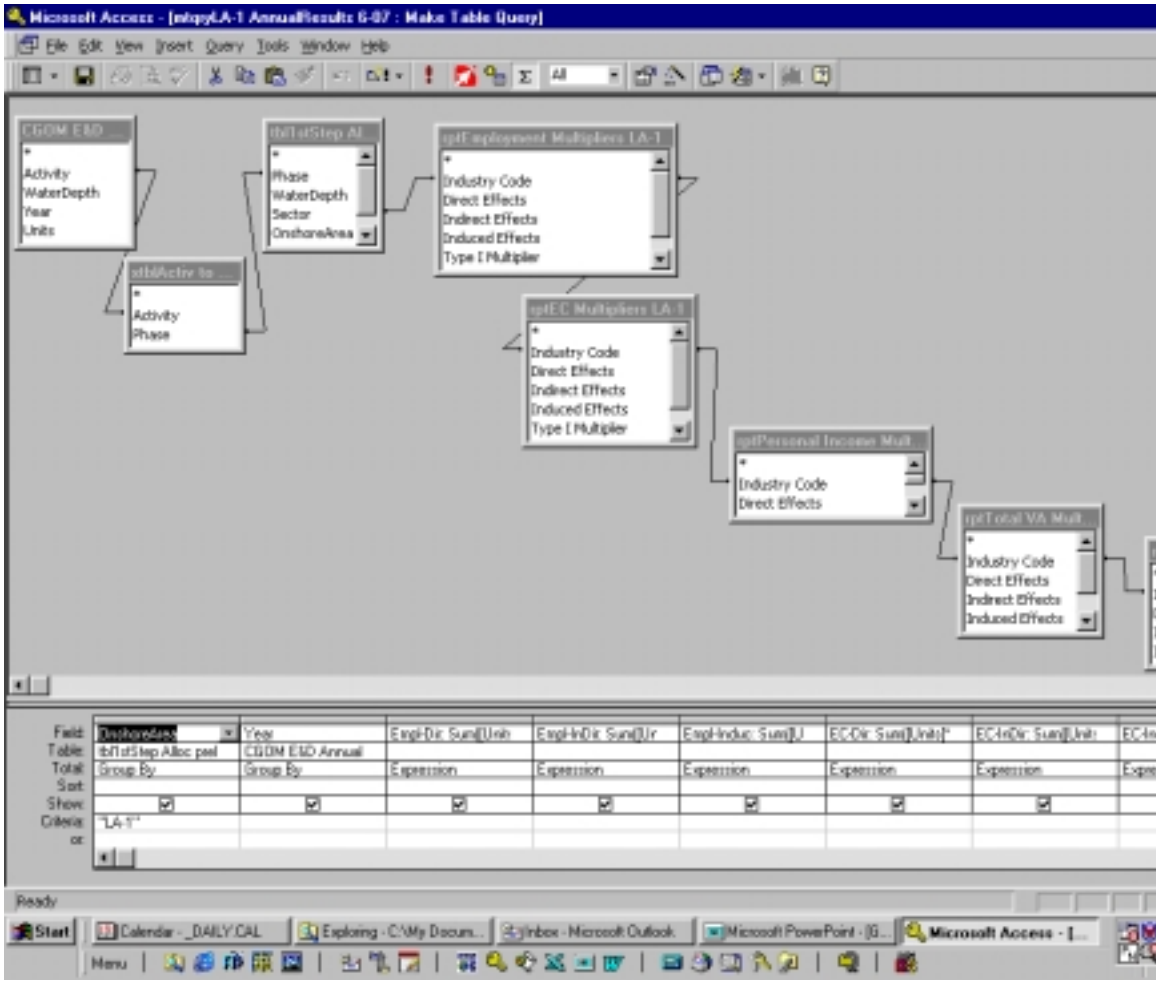
The models for the Arctic and the Sub-Arctic OCS are similar in concept, but the linkages between the first-step and second-step components are more complex. The two major differences between the Alaska models and the GOM models are that the direct expenditures for the former are estimated and allocated by the stand-alone Arctic and Sub-Arctic Impact Models for Petroleum in Alaska (IMPAK), developed in MS Excel by JFA, and that Personal Consumption Expenditures (PCE) are independently estimated.[8] The MS Access model uses direct expenditures on capital, materials, and purchased services from IMPAK to stimulate the indirect IMPLAN multipliers and uses payments to labor (PCE) to stimulate the induced IMPLAN multipliers. The Arctic IMPAK estimates the direct expenditure and employment effects of proposed activities in the Beaufort Sea on the North Slope Borough, while the Sub-Arctic IMPAK estimates the direct effects of proposed activities in Cook Inlet on Anchorage, on the Kenai Peninsula Borough, and on the Kodiak Island Borough. Both models estimate direct expenditures in the Rest of Alaska and in the Rest of the U.S.

At present, the estimated effects of proposed activities in other Alaska OCS planning areas, such as the Chukchi Sea and the Gulf of Alaska, are estimated using the existing models and certain rules of thumb for adapting the results.

For the 5-year program's equitable sharing analysis, the models will allocate impacts to the onshore "regions" used in equitable sharing analyses previously upheld by the court. These are much larger geographical areas than those for

(continued on page 22)

Figure 1
Sample View of Microsoft Access Model for Gulf of Mexico



Regional Economic Impact Modeling *(continued from page 21)*

EISs. These regions are:

- Region I—Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia
- Region II—North Carolina, South Carolina, Georgia
- Region III—Florida
- Region IV—Texas, Louisiana, Mississippi, Alabama
- Region V—California
- Region VI—Washington, Oregon
- Region VII—Alaska.

The requirement for an equitable sharing analysis applies only to a new 5-year program, while the NEPA analysis (EIS) must be done for both the 5-year program and the pre-sale decision processes.

Looking Forward

The new consistent approach to regional economic impact modeling will be thoroughly tested over the next year or two, as MMS conducts at least two iterations of the equitable sharing analysis and the EIS for the 5-Year Oil and Gas Program for 2002-2007–which must be in place by mid-2002. A multi-sale EIS analysis also will be completed for proposed sales in the Western and Central GOM planning areas. During this period, MMS will be looking for ways to improve upon the initial models that have been developed under this approach.

Some of these improvements will come from better data. For example, MMS is confident that its allocation of expenditures to specific onshore areas is fairly accurate overall; however, it may be appropriate to further refine the allocations according to planning area and water depth of the oil and gas resources in question, as well as by sector. We expect to find that the owner of a shallow-water oil and gas lease can choose from a number of manufacturing and service facilities in nearby GOM areas but that the choice for deep-water projects may be limited to a very few facilities. This may be especially true for drilling equipment and platforms. A case in point is the Shell Mars Tension Leg Platform. Its 15,650-ton hull was fabricated in Italy; its 7,200-ton deck was fabricated in Morgan City, Louisiana; and its 12 piles and 12 tendons (weighing a total of almost 10,000 tons) were fabricated in Ingleside, Texas.

In other cases, these improvements may come from refinement of existing data, for example, developing cost functions for specific technology (e.g., jack-up rigs). For analyses of identified projects, these would be better than the weighted averages for mixed technology that are used for more general proposals, like lease sales. Given that the existing models use a static input-output model to approximate a dynamic process, MMS intends to develop a methodology to spread certain E&D expenditures across years, where appropriate (e.g., for fabricating and installing platforms in deep water).

Other changes will result from the incorporation of additional research results on commuting (and spending) patterns for offshore workers, wage rates in related industries, State and local government revenue collection and expenditure patterns, and offshore contractor expenditure patterns that may be masked in existing data.

Finally, MMS hopes to take advantage of more sophisticated features of MS Access and Visual Basic software, as well as improvements to IMPLAN Professional software and data. Future versions of IMPLAN Pro may allow MMS to create multi-regional models, which would capture more of the inter-regional trade interactions. MMS also can develop uniform input formats and Visual Basic programming instructions within MS Access to make models easier to update and easier to link to new E&D scenarios, as well as to make them more user-friendly.

Footnotes

[1] For the purposes of this paper, an oil and gas project includes all activities necessary for a company to discover and produce oil and/or natural gas resources from a single field, beginning with exploratory drilling and ending with removal of the drilling structure.

[2] The activities in an E&D scenario for the Alaska OCS are equivalent but, especially in the Arctic, not identical. For more detail, see the paper by Skolnik & Holleyman, in the proceedings of the 24th International IAEE Conference.

[3] Multipliers estimate the extent to which initial spending reverberates through the economy. For example, an indirect multiplier of 1 would indicate that for every initial dollar spent on oil and gas activities, another dollar is spent by businesses in the local economy.

[4] A static model approximates an outcome for which all changes occur at once, as opposed to a dynamic model, which allows for changes and variable interactions over time and is thus much more complex. An input-output model estimates the monetary interactions among all industries required to achieve a specified change in output in one or more sectors.

[5] The MMS calls the spending estimation and allocation to industry sectors a "cost function" to avoid confusion with the similar "production function" for each sector in the second-step model. Because the analysis of direct effects also requires allocation of expenditures to the appropriate onshore geographic areas, this is also sometimes inferred by the term "cost function."

[6] MS Access stores data in tables (data sets) that can be manipulated by queries (sets of programming instructions). For example, the E&D table contains the activity level estimates for a specific E&D scenario. Another table can contain the estimated amount spent in each industrial sector for each kind of activity. An MS Access query can be designed to multiply the values in the E&D table by the corresponding values in the other table to produce an estimate of the total amount spent in each sector as a result of all the projected oil- and gas-related activities in the E&D scenario.

[7] Specification of the Florida areas sometimes varies, expanding to as many as four areas.

[8] Due to the extent that sector production functions in Alaska differ from the national averages used in IMPLAN, direct expenditures from either IMPAK are allocated well beyond the first round of spending. The goal of both JFA and CES was to allocate expenditures down to the sector level at which the IMPLAN production functions would be as accurate as their OCS cost functions. For Alaska, this often required JFA to effectively create new industries.