Economic Multipliers and the Economic Impact of DOE Spending in New Mexico

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Summary of Conclusions

This study was conducted as part of a Nuclear Watch of New Mexico project to evaluate the Department of Energy's (DOE) economic impact on the state of New Mexico.[i] As part of that ongoing project, this study examines the economic multipliers the DOE uses in its public relations and legal documents. The DOE's economic impact analysis program for New Mexico closed its doors at the end of 1999, after funding for the program was eliminated. As a result, the DOE's data is now four years old. Despite the age of its economic multiplier data, the DOE continues to make claims based upon them. In documents intended to meet compliance with the National Environmental Policy Act (NEPA), the DOE uses its economic data to support conclusions that expanded activities at the Los Alamos National Laboratory, the Sandia National Laboratories, and the Waste Isolation Pilot Plant, will greatly improve the economic viability of New Mexico.

This study examines the veracity of the DOE's multipliers, and subsequent DOE claims based upon that data. According to the senior researcher, who was initially contacted in late 2001, the underpinning data and economic model had never been electronically archived and was subsequently lost when computer replacements were completed. A Freedom of Information Act request was later submitted, which the DOE responded to in December 2002. The response included the complete data and economic modeling software developed by the DOE. However, time and funding ran short for this study, which prohibited a conclusive analysis of the data. As a result, it is impossible to directly analyze the accuracy of the data and model. In order to address this problem, this study undertook the task of examining data developed in seven independent reports, for regions and activities similar to those found in New Mexico. The

seven reports were written by the State of Nevada, the University of Alaska, the University of Arkansas, the University of Oklahoma, the University of Missouri, KPMG Peat Marwick for an Intel plant based in Rio Rancho, NM and a study conducted jointly by researchers at the University of Texas, Dallas, and the Korea Local Administration Institute, Seoul, South Korea, as well as the DOE's own studies.

All seven of the reports have been found to come to a common conclusion: the private sector tends to yield economic multipliers in the range of 1.5 to 2.0. Furthermore, these reports determine that the public sector tends to have multipliers below 1.5. This is contrasted with the DOE claimed multipliers, in its studies, of 2.4 to 3.5 for Fiscal Year 1998. These claims are not consistent with the findings of multiple, independent researchers. The DOE has greatly exaggerated its economic impact on New Mexico, misleading the public and lawmakers.

This report makes a conservative re-adjustment of the DOE multipliers. It adjusts them to reflect the findings for the private sector. With that adjustment, it is found that the DOE is overstating its total economic impact of $10 billion on New Mexico by as much as $6 billion; its impact on wages by as much as $1.25 billion; and its impact on jobs by as much as 45,000 full time positions. Furthermore, it is even possible that the DOE may actually be harming the State due to the added burden its activities place on New Mexico's infrastructure, as well as the potential economic development gains the State is foregoing as a result of the DOE's focus on military-related rather than civilian-oriented research and development (R&D).

What Are Economic Multipliers?

In the most general sense, an economic multiplier is a quantitative measure of economic impact that explicitly recognizes that economies (local, state, regional, national, or global) are interconnected networks of interdependent activity. When a change takes place in one part of such a network, its effects propagate throughout the system. These effects typically result in a larger total impact than the original change would have caused in isolation.

For example, when 200 workers are hired for a new road building project, employment tends to increase by more than the 200 jobs directly tied to building the road. This happens because, as materials

and equipment needed to build the road are purchased, this new spending creates additional jobs in the industries that supply those materials and equipment. People put to work by the road building project also spend the income they earn on ordinary consumer goods and services. This spending tends to create jobs in the businesses that produce those goods and provide those services. We can therefore define the "employment multiplier" as the number that is multiplied by the number of jobs directly involved in road building to yield the total number of jobs created, directly and indirectly, as a result of the project. If the total number of jobs created were 300, the employment multiplier in this example would be 1.5 (1.5 x 200 = 300). In a similar way, we can define an "income multiplier" that allows us to calculate total income generated by the project as a multiple of income directly generated; and an "output multiplier" that allows us to calculate the total value of output produced as a multiple of the value of the direct output (in this case, the value of the road).

In addition to the direct effect of an economic activity, there are also indirect effects and induced effects. Indirect effects are the impacts on the chain of suppliers to the economic sector whose activity we are considering to be the direct effect; induced effects are the changes in consumer spending that are generated. For example, if we are looking at the job impacts of a new manufacturing facility being built in New Mexico, the direct effect is the number of jobs created by the facility itself. The indirect effect is the number of jobs created at those firms that supply the facility with materials, equipment, etc. (and at the firms that supply those suppliers). The induced effect is the number of jobs created as a result of the additional spending done by households whose income has gone up because of the direct and indirect effects, including the jobs created due to higher spending by those households now earning more money because their members work at the firms that sell products to consumers.

There are three basic categories of multipliers. They differ in their method of integrating these various effects. Type I multipliers include only direct and indirect effects, and therefore tend to be the smallest. Type II and Type III multipliers include direct, indirect and induced effects, though they differ in the way that the induced effects are calculated. Type II multipliers are based on the assumption that there is a linear relationship between income and consumption spending, i.e. an X% increase in income will produce an X% increase in consumer spending. This is somewhat unrealistic. Consumer spending tends to rise

more slowly than income; as income rises, an increasing part of the additional income goes towards paying off debts or supplementing savings. Thus, Type II multipliers often overestimate the induced effect. Type III multipliers try to correct for this problem, and as a result are typically somewhere between 5%-15% smaller than the corresponding Type II multiplier.[ii] But while there is only one way for a relationship to be linear, there are many ways for it to be nonlinear, and therefore, a corresponding multitude of methods of calculating Type III multipliers. Because of the differing methods of calculating Type III multipliers, there is some controversy surrounding the "correct" method. In theory, Type III multipliers are likely to be more accurate.

Using and Abusing Multipliers

Economic multipliers are extremely simple and convenient tools for calculating the total economic impact of an activity from the known data on direct jobs, income, output, etc., involved in that activity. But their simplicity is misleading and their convenience seductive. To be accurate, multipliers must be based on a thorough and realistic understanding of the underlying interconnected networks of interdependent activity that constitute the economy of the region. They are calculated on the basis of a mathematical model of the relationships in that economy, ordinarily using Input-Output Analysis, a modeling technique developed by Nobel Laureate Wassily Leontief.[iii] While input-output models are far from perfect, if they are constructed properly and without bias, they are capable of providing useful estimates of economic impacts, and thus providing reasonably accurate estimates of economic multipliers.

Aside from their inherent imperfections, there are two fundamental sources of error in economic multipliers derived from input-output models: 1) inaccuracies in the data used to estimate the input-output coefficients of the model[iv]; and 2) flaws in the design and structure of the model itself. When economic impact analysis is used for a political purpose, such as demonstrating the importance of a particular government or private sector activity (or set of activities) in order to build public support for the establishment, continuation or expansion of that activity, there is a great temptation to overstate the positive economic impact of the activity by overestimating the multipliers associated with it. Unfortunately, that is extremely easy to do. Aside from simply arbitrarily selecting a large value for the multipliers, it is possible to inten-

tionally "cook the books" by manipulating the structure of the model or by manipulating the data used to derive the model's coefficients (or both). Of course, it is also possible for multipliers to be overstated unintentionally, as the result of ordinary human error in the design of the model, or in the collection, entry or analysis of the underlying data.[v]

In any case, it is worth keeping in mind that multipliers are not a measure of how valuable a particular activity is to the economy, but rather only a measure of the extent of its quantifiable input-output interactions with other economic activities. Even more important, when trying to assess whether a particular activity is a boon or a burden to the region's economy, its impact should be compared with those of a plausible alternative and not with the complete lack of activity. Economic analysts must always think in terms of alternatives. Almost any public or private economic activity that provides some jobs and gives rise to some income will look better than the complete lack of activity. The only exception is an activity that imposes such heavy additional cost (say for infrastructure development or environmental cleanup) that these costs overwhelm the benefits derived from its payroll and purchase of non-labor inputs. In the case of the major DOE facilities in New Mexico, it is a distinct possibility that the impact of the extensive environmental contamination caused by more than five decades of operation will counterbalance at least some of their apparently positive economic impacts.

Assessing Economic Multipliers of DOE Activity in New Mexico

The most recent available estimates of the economic impact multipliers associated with DOE activities in New Mexico as a whole are contained in a report issued by the DOE Albuquerque Operations Office in 1999.[vi] This report gives the value of the employment multiplier for DOE activities in the State in 1998 as 3.58; the economic output multiplier as 3.39; and the income multiplier as 2.39.[vii] All three of these multipliers are unusually high. Despite the fact that the DOE's multipliers are high and the division within the Albuquerque Operations Office is closed, DOE continues to make claims based on the multipliers drawn from these studies.

The fact that these are all Type II multipliers implies that they are likely to be overstated by 5%-15% for that reason alone. But they even seem quite high compared to other Type II multipliers. In an

effort to explore the validity of these multiplier estimates, an attempt was made to examine the input-output model on which they were based. Apparently, the analysts who prepared these estimates did not use a standard, commonly used input-output model such as the IMPLAN model (originally designed by Wilbur Maki and now maintained by the Minnesota IMPLAN Group) or RIMS II (the U.S. Bureau of Economic Analysis, Regional Input-Output Modeling System). Instead, they used a model they specially developed for this analysis. According to the report, "The multipliers used to determine impacts result from the inter-industry, input-output models developed jointly by economists at DOE/AL and New Mexico State University (NMSU)".[viii] There is nothing inherently wrong with using specially created input/output models. They can be very useful. Unfortunately, the special model used in the DOE analysis was not available for review at the time of this writing. [ix] Unless a model is accessible to others, there is no way to verify whether it was properly designed and hence whether its results are credible. Given the inability to access the model, the next logical step in attempting to analyze the validity of the multipliers is to examine the data underlying the model. This too proved impossible, since DOE initially denied that the model existed and did not provide the model until a Freedom of Information Act request was completed in December 2002.

The only remaining method of evaluating the validity of the DOE impact multipliers, short of entirely redoing the study (which would require funding and staffing far in excess of that available to Nuclear Watch of New Mexico) is by comparing them with other multipliers arrived at in other relevant studies. It is possible to get some feel for the plausibility of the DOE multipliers in this way.

KPMG Peat Marwick conducted one such relevant study from 1993-1995 of the economic impact of the expansion and retooling of Intel's Rio Rancho Chip Fabrication facility in New Mexico. Using the IMPLAN input-output model, this study produced estimates of indirect and induced effects. Although the report of the study did not explicitly give values for the economic multipliers, taken together with their data on direct effects, these estimates of indirect and induced effects can be used to calculate economic multipliers for the facility. In this way, the employment multiplier was calculated at 1.99 in 1993 and 1.89 in 1995. The personal income multiplier was calculated at 1.67 in 1993 and 1.45 in 1995.[x] The change (decrease) seen during the two years studied reflects a change in the level of activity at the Intel plant,

specifically a change in the number of construction jobs. These multiplier estimates can then be compared with the estimates for DOE activities in New Mexico in 1998 (employment multiplier of 3.58 and income multiplier of 2.39, as given above). Using the higher of the Intel Report estimates to be conservative, the DOE estimated employment multiplier is roughly 80% higher [(3.58-1.99)/1.99], while the DOE estimated income multiplier is 43% higher [(2.39-1.67)/1.67].[xi]

The KPMG Peat Marwick study is hardly an anomaly. Indeed, when comparing economic studies from a range of other sources, it appears that the numbers arrived at by the DOE are the unusual ones. In a brief paper prepared by two economists at the University of Arkansas, the average economic multiplier for manufacturing industry in the State of Arkansas is given as 2.0.[xii] This is roughly the same as the employment multiplier given for the Intel manufacturing facility in New Mexico in the KPMG Peat Marwick study, and lies well below the DOE's multipliers. The population of Arkansas is only about 850,000 greater than New Mexico. It ranks 33rd among the states, while New Mexico ranks 36th by population (one useful criterion for establishing the reasonableness of comparing the two states).[xiii] A study done by analysts at the University of Oklahoma, using the IMPLAN model, estimated a Type III output multiplier (which would tend to be slightly lower than a Type II multiplier) for the aircraft manufacturing industry in Oklahoma (an important source of jobs and income in the state) at 1.75.[xiv] That too is in the general ballpark of the multipliers calculated from the Intel Report, especially given that it is a Type III multiplier. The Oklahoma study is substantially below the DOE's multiplier estimates. Oklahoma ranks 27th among the states in population.[xv]

To the extent that the Intel facility might be expected to be roughly comparable in its input/output impacts to that of DOE facilities in New Mexico taken as a whole, there does appear to be considerable exaggeration in the DOE multiplier estimates. But are these facilities actually likely to be similar in input-output impact? In general, private sector facilities such as the Intel Plant tend to have larger local economic impacts than public sector facilities such as the DOE especially when the public sector facilities are those of the national government. The reason is straightforward. Federal facilities tend to have supply chains that are typically national (or international) in scope. They tend to buy less from suppliers in the area in which the facilities are located. The choice of firms to supply public sector facilities is also often affected

by political considerations, rather than simply by the considerations of minimizing cost that tend to play a key role in the choice of suppliers by private sector firms. These considerations imply that the DOE estimated multipliers may be even more exaggerated than the comparison with Intel indicates.

Though they focused only on Midwestern, non-metropolitan counties, a study by analysts at the University of Missouri for 1984-86, estimated a federal government employment multiplier of 1.34 and a federal government earnings multiplier of 1.21.[xvi]

These government spending multiplier estimates may not be directly comparable with the DOE New Mexico multiplier estimates, since they deal with non-metropolitan counties, not the whole state (which would tend to make the multipliers smaller because there is less economic activity in predominantly rural regions). Nevertheless, the same study shows a comparably calculated private sector manufacturing employment multiplier of 1.54 and earnings multiplier of 1.72. This means, for calculations that reflect a comparable economic base, their private sector employment multiplier estimate is 15% higher than for the public sector, and the private sector earnings multiplier is 42% higher than the federal earnings multiplier (as expected). This provides greater evidence for the claim that public sector multipliers tend to be smaller than those for the private sector. That gives further credence to the argument that the DOE New Mexico multiplier estimates, which are much larger than those reported by Intel and a range of other reputable economic studies, are exaggerated.

Another way to get at this issue is by considering other public sector statewide economic impact studies. The Institute of Social and Economic Research (ISER) of the University of Alaska at Anchorage did one such study, "Alaska's Dependence on State Spending."[xvii] Alaska and New Mexico both have fairly low populations and only a few major population centers. Alaska ranks 48th among the states in population.[xviii] There are relatively high levels of government spending within both states, though in Alaska most of the spending appears to be by the state rather than the federal government. The report begins with the statement, "It would be hard to exaggerate Alaska's economic dependence on state government spending."[xix] Yet, despite this declared dependency, the study uses a multiplier of 1.35 for both employment and income.[xx] The DOE New Mexico study multiplier for employment is thus 165% larger than that estimated for Alaska [(3.58-1.35)/1.35]; the DOE New Mexico income multiplier is 77% larger

[(2.39-1.35)/1.35]. This too further illustrates the likelihood that the DOE multiplier figures for New Mexico are considerably overestimated.

It is unfortunate that both the input-output model and the data, used in conjunction with the DOE study of New Mexico, was not provided in a timely fashion. That fact has made it necessary to try to evaluate the plausibility of the DOE's economic impact multipliers in this roundabout way. Though each of these comparisons has its limitations, the whole pattern nevertheless demonstrates that it is very likely that DOE's multiplier estimates are far too high. If that is the case, the DOE's estimates of the economic impact of its facilities on New Mexico are correspondingly exaggerated.

One interesting additional piece of information makes the DOE estimates of its positive economic impacts on New Mexico seem even less plausible. The results of a 1993 analysis by Hicks and Lee of the regional economic impacts of Federal R&D spending across the nation shows federal civilian-oriented R&D to have an impact on employment approximately thirteen times larger than the employment effect of federal defense-related R&D.[xxi] The impact of civilian-oriented federal R&D on average annual income is estimated to be ten times larger than that of federal defense-related R&D.[xxii] These estimates are based on regression analysis, not input-output matrices, and are for nine multi-state regions that in combination cover the whole U.S.[xxiii] But since DOE spending in New Mexico is heavily weighted in the direction of defense-related R&D (e.g. at Los Alamos and Sandia Laboratories), this study strongly implies that there is a substantial loss of both employment and income to the State of New Mexico from present DOE R&D activities compared to what the State would likely experience if that R&D were focused on civilian-oriented work instead.[xxiv]

Suppose the DOE multipliers are adjusted downward to the range of 1.35-2.00 to make them more compatible with the multiplier estimates in the various studies we have cited (which seem relatively consistent with each other). This is a conservative adjustment as it does not take into account the evidence that federal spending, and even more so federal defense spending, has a much smaller economic impact. Instead, this adjustment merely reflects the data from the private sector activity in regions similar to New Mexico. The estimated impact of the DOE on aggregate economic activity in New Mexico would drop from $10.24 billion in 1998 (according to the DOE study) to somewhere between $4.06 billion–$6.02 bil-

lion; estimated personal income generated by DOE activity in 1998 would drop from $2.89 billion in 1998 (according to the DOE study) to somewhere between $1.63 billion-$2.42 billion; and estimated employment resulting from DOE activity in 1998 would drop from 72,453 jobs in 1998 (according to the DOE study) to somewhere between 27, 289 - 40,418 jobs.[xxv] These adjusted estimates imply that the DOE has overstated the economic impact of its facilities in New Mexico by roughly $4 billion-$6 billion in terms of economic activity and by roughly $500 million to $1.25 billion in terms of personal income. Similarly, the DOE study may have overstated the job generating effects of the DOE activities in the State by some 32,000-45,000 jobs.

Presuming that these corrected multipliers are more accurate, the clear implication is that the DOE activities offer no net gain. It is even possible that there is a significant net loss to the State as compared to the economic impacts of private activities of comparable scale, if such private sector activities can be recruited to replace them. As an example of a loss to the State, the New Mexico Environment Department's Hazardous Waste Bureau will spend $860,000 of State funds during 2002 on environmental regulation at the Los Alamos National Laboratory.[xxvi] It is reasonable to expect further extensive costs associated with the Sandia National Laboratories within this Bureau alone. Even more striking is that if we apply the Hicks-Lee study and replace the present DOE defense-related R&D activities with civilian-oriented R&D, such as renewable energy R&D,, there is the promise of very large economic gains to New Mexico in terms of both employment and income.

Conclusions

The very impressive positive economic impacts of the DOE activities in New Mexico presented in the 1998 DOE study cannot be evaluated directly because both the model used to generate them and the data input into that model were at first claimed not to exist, and later not provided in a time frame that allowed for incorporation into this study. If the multipliers used by the DOE are compared with those developed in the variety of public and private sector economic impact studies that are generally consistent with each other, we find that the DOE multipliers seem implausibly large. Adjusting the estimates of the DOE economic impacts on New Mexico downwards in accordance with the range of multipliers derived in

these studies substantially reduces the estimated impact of the DOE on economic activity, personal income, and employment in the State. Furthermore, when compared with either private sector replacement activity or a re-orientation of the DOE R&D spending away from defense-related and toward civilian-oriented R&D, it appears that New Mexico gains little. Additionally, there is much evidence to indicate that the State suffers substantial economic loss (in terms of opportunity lost and the burden on infrastructure) as the result of the DOE activities in New Mexico.

Endnotes

[i] Nuclear Watch of New Mexico is a Santa Fe, NM based non-profit that conducts analyses of U.S. nuclear weapons policy implemented by the Los Alamos and Sandia National Laboratories and the Waste Isolation Pilot Plant. Nuclear Watch of New Mexico's mission is to shed light onto the continued maintenance, development, re-design, and new designs of U.S. nuclear weapons and to educate the public on the ramifications U.S. nuclear weapons policy has on the local, state, national, and international level.

[ii] Horton, Gary A., "Economic Impact Analysis: Assessing the Effects of Economic Impacts: The Derivation and Application of Economic, Fiscal, Resource and Environmental Impact Multipliers;" Division of Forecasting and Economic Impact Analysis, Nevada Division of Water Planning; www.state.nv.us/cnr/ndwp/forecast/econ_pg.4.htm.

[iii] Leontief, Wassily, The Structure of the American Economy, New York, Oxford University Press, 1951.

[iv] The coefficients represent the fraction of one economic sector's output that becomes the input of another sector, or equivalently, the fraction of one sector's inputs that derive from the output of another sector.

[v] It is important not to overlook this possibility. I have done extensive research on the nature of human error and its implications. See Dumas, L.J., Lethal Arrogance: Human Fallibility and Dangerous Technologies, New York, St. Martin's Press/Palgrave, 1999.

[vi] Lansford, Robert R., Adcock, Larry D.; Ben-David, Shaul; and Temple, John, The Economic Impact of the Department of Energy on the State of New Mexico Fiscal Year 1998 (August 5, 1999). Funding for the economic studies program was apparently cut off in 1999.

[vii] Ibid, p.36-37.

[viii] Ibid., p.viii.

[ix] In a communication from Larry D. Adcock (the individual in charge of the DOE economic impact studies) to Colin King, Research Director, Nuclear Watch of New Mexico, Mr. Adcock indicated that the model no longer exists. Mr. Adcock told Colin King that the model was stored on old computers that were replaced and that the data was never archived on diskettes, CD ROMs, or any other form of mobile storage medium. Colin King then filed a Freedom of Information Act (FOIA) request for the model and supporting data. A response to that FOIA was provided in December 2002 which included all the modeling data for 1996 through 1998. However, given the complexity of unraveling DOE's unconventional model, time and funding did not allow for a complete analysis of the data at the time of this writing.

[x] The values were derived from calculations by Colin King, Research Director, Nuclear Watch of New Mexico, based on the analysis of the KPMG Peat Marwick Intel Report.

Colin King's derivations follow from this data published in the KPMG Peat Marwick report:

	1993	1995
Intel direct employment (including construction)	3,071	5,577
Indirect and induced employment	3,045	4,941
Total of all employment	6,116	10,518
Direct wages	$150.4 million	$382.6 million
Direct output	$369.1 million	$1,019.6 million
Intel's total wages and output	$519.5 million	$1,402.2 million
Indirect and induced wages	$100.8 million	$170.5 million
Indirect and induced output	$199.4 million	$333.2 million
Total indirect and induced	$300.2 million	$503.7 million

To calculate the employment multiplier for 1993:

6,116 (total employment)/3,071 (direct employment) = 1.99 (employment multiplier)

For 1995:

10,518 (total employment)/4,941 (direct employment) = 1.89 (employment multiplier)

To calculate the personal income multiplier for 1993, use both the direct + indirect & induced wage earnings:

$251.2 million (direct + indirect & induced wages)/$150.4 million (direct wages) = 1.67 (personal income multiplier)

For 1995:

$553.1 million (direct + indirect & induced wages)/$382.6 million (direct wages) = 1.45 (personal income multiplier)

To calculate the economic multiplier for 1993, use total direct wages and output + total indirect & induced wages and output:

$819.7 million/$519.5 million = 1.58 (economic multiplier)

For 1995:

$1,905.9 million/$1,402.2 million = 1.36 (economic multiplier)

[xi] It is possible that the Intel Report also overestimated the economic impact of the facility in the longer term, since it was based on data taken from a time during which the facility was under construction. Both the construction jobs and the income earned by those working on construction disappear after construction is completed. If construction was more labor intensive than manufacturing at the facility (which seems likely), the employment and income impacts of the facility on New Mexico may have been overstated by KPMG's study.

[xii] Wayne P. Miller and Tracy Armbruster, "Economic Multipliers: How Communities Can Use Them for Planning," University of Arkansas Cooperative Extension Service, 1999. (www.uaex.edu/other_Areas/publications/html/fscdd-6.asp)

[xiii] U.S. Census Bureau, U.S. Department of Commerce, Statistical Abstract of the United States: 2001 (p.21, Table No.18).

[xiv] David Penn and Michael Price (of the University of Oklahoma), "Economic Impact of Aviation and the Aerospace Industry in Oklahoma" (Final Report for the Oklahoma Aeronautics and Space Commission, Oklahoma Department of Transportation, September 1999).

[xv] U.S. Census Bureau, U.S. Department of Commerce, Statistical Abstract of the United States: 2001 (p.21, Table No.18).

[xvi] Curtis Braschler, John Croll, Bryan Phifer and John Kuehn, "Economic Base Multipliers and Community Growth," 1999, University Extension, University of Missouri-Columbia, p.2.

[xvii] Institute of Social and Economic Research (ISER), University of Alaska at Anchorage, "Alaska's Dependence on State Spending," ISER Fiscal Policy Papers, No. 5, April 1991.

[xviii] U.S. Census Bureau, U.S. Department of Commerce, Statistical Abstract of the United States: 2001, p.21, Table No.18.

[xix] Institute of Social and Economic Research (ISER), University of Alaska at Anchorage, "Alaska's Dependence on State Spending," ISER Fiscal Policy Papers, No. 5, April 1991, p.1.

[xx] Ibid., p.3.

[xxi] Donald Hicks and Si-Gyoung Lee, "Regional Economic Impacts of Federal R&D by Funding Source and Performer Type," Regional Studies, Vol. 28.6, p. 623.

[xxii] Ibid.

[xxiii] Using multi-state regions would tend to make the effects look larger, but they would tend to have the same effect on the impacts of both federal civilian-oriented and defense-related R&D. Since we are looking only at these two in comparison with each other, there is no reason to believe that the relative impacts are exaggerated because of the use of larger-than-state regions.

[xxiv] In the mid-1990's, the author was a consultant under contract to the Industrial Partnership Office at Los Alamos National Laboratories (LANL), precisely on the issue of how the LANL could shift its research in directions more compatible with the needs of the civilian sectors of the economy. Such expanded civilian research possibilities certainly exist for the Labs. Unfortunately, the project was defunded while still in its embryonic stage. If the Hicks-Lee study is correct, the decision to halt the project may have imposed a much higher cost on New Mexico than is generally appreciated.

[xxv] Based on data in Lansford, Robert R., Adcock, Larry D., Ben-David, Shaul, and Temple, John, The Economic Impact of the Department of Energy on the State of New Mexico Fiscal Year 1998;August 5, 1999, Table 1, p. ix.

[xxvi] Revenue and Expenditures spreadsheet, Hazardous Waste Bureau, New Mexico Environment Department, Fiscal Year 2002.

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