U.S. Military Nuclear Materials Production Sites: Do They Attract Or Repel Jobs? (Some Suggestive Evidence)

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The common assumption that siting decisions for military facilities—in particular nuclear weapons production plants—have a positive impact on local employment has never been subjected to careful economic analysis. Comparisons of employment trends at selected sites with those of their host states and with trends at alternate sites that had been rejected for the same facilities, suggest two outcomes deserving further analysis: 1) at some sites, there is a slight, but not a significant, job attraction or recession resistance relative to the host state; and 2) at some sites there is significant evidence of job repellence, not only in comparison with the host state, but also in comparison with alternate, but rejected, sites. [M&GS 1995; 1:35-44]

Introduction

Caspar Weinberger, U.S. Secretary of Defense for most of the two Reagan administrations, once suggested that, in response to the call for military spending "cuts, cuts, cuts, I reply: jobs, jobs, jobs." Secretary Weinberger captured the prevailing attitude among many U.S. communities that had grown dependent on the military dollar. This attitude prevails not only in communities that host military bases but also in those that are home to private defense industry contractors, as well as in the 15 communities engaged in military nuclear production around the United States [1].

Officials at the U.S. Department of Defense, the U.S. Department of Energy (DOE) (which has administrative responsibility for military nuclear production), and especially community leaders, state and local economic development administrators, chamber-of-commerce officials, and others are singularly beholden to the jobs argument. Curiously, few ask whether or not a military nuclear site is a *net* generator of jobs. By and large the argument in favor of military nuclear production merely looks at the new jobs "created" through construction or other activities at the sites or at jobs "saved" by means of continued operations. Few ask the counter-factual question: how many jobs would have been generated had there been no military nuclear installation in the community?

This paper reports on ways to think about generating an answer to this counter-factual question so that the net job generation effect can be assessed. But as regards empirical evidence, the author restricts himself in this paper to an examination of unemployment rates around military-nuclear sites[1]. What fol-

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[1] A full examination of the intertwined economic, political, and cultural issues raised by the siting and operation of a major plant is beyond the scope of this paper.

Table 1. U.S. Principal Military Nuclear Facilities

Weapons Research and Design
1. Los Alamos National Laboratory, NM (operated by the University of California)
2. Sandia National Laboratory, NM (AT&T)
3. Lawrence-Livermore National Laboratory (University of California)

Materials Production
1. Hanford Plant, WA (Westinghouse)
2. Savannah River Site, SC (Westinghouse)
3. Fernald, OH (Westinghouse)
4. Idaho National Engineering Laboratory (EG&G, Westinghouse)

Weapons Manufacturing
1. Rocky Flats Plant, CO (EG&G)
2. Oak Ridge Reservation, TN (Martin Marietta)
3. Mound Plant, OH (EG&G)
4. Pinellas Plant, FL (General Electric)
5. Kansas City Plant, MO (Allied Signal Corp.)
6. Pantex Plant, TX (Mason & Hanger-Silas Mason)

Warhead Testing
Nevada Test Site, NV (Reynolds Electric)

Waste Disposal
Waste Isolation Pilot Plant, NM (Westinghouse)

Source: U.S. Congress 1991 [2]

lows is a brief description of the U.S. military nuclear materials production sites; an overview of some economic and methodological issues; a presentation and examination of some suggestive empirical evidence; and a concluding discussion.

Table 2. The Impact Counties

1. Idaho (Idaho National Engineering Laboratory, INEL)	
Location:	Southeastern Idaho, in the desert region due west of Idaho Falls. Idaho Falls is located in a well-populated strip between Yellowstone National Park and INEL
Site County:	Major buildings are in northern Butte county
Surrounding Counties:	Bannock (S), Bingham (SSE), Bonneville (SE), Clark (NE), Jefferson (E)
Major Population Centers:	Pocatello (Bannock) and Idaho Falls (Bonneville)
2. Ohio (Fernald)	
Location:	Southwestern Ohio, between population centers Dayton and Cincinnati
Site County:	Butler county
Surrounding Counties:	Hamilton (S), Montgomery (NE), Preble (NW), Warren (E)
Major Population Centers:	Dayton (Montgomery) and Cincinnati (Hamilton)
3. South Carolina (Savannah River Site, SRS)	
Location:	Midwestern South Carolina along the Savannah River
Site County:	Southern Aiken and Northern Barnwell counties
Surrounding Counties:	Allendale (S), Bamberg (SE), Richmond, GA (W)
Major Population Centers:	Aiken, SC, and Augusta, GA (Richmond county)
4. Washington (Hanford)	
Location:	Midsouthern Washington. To the northwest is the U.S. Military Reservation Yakima Firing Center, to the west and southwest is the huge Yakima Indian Reservation
Site County:	Northern half of Benton county
Surrounding Counties:	Franklin (E), Grant (N), Yakima (W)
Major Population Centers:	Kennewick, Pasco, and Richland (the so-called Tri-Cities area), in southern Benton and Franklin counties.

Note: N, S, E, W, NE, NW and so on are the common directional signs for North, South, East, and West and subdirections.

U.S. Military Nuclear Materials Production Sites: A Description

The United States houses 15 principal military nuclear facilities (see Table 1). They consist of three weapon research and design laboratories, four weapon materials production plants, six weapon manufacturing and assembly plants, one warhead testing site, and one especially designated waste disposal plant.

As of early 1991, these facilities employed about 116,000 people. Contrary to widespread public perception, many of these plants are very closely located to major population and employment centers. The Feed Materials Production Center in Fernald, Ohio—now closed—lies 20 miles northwest of Cincinnati. The Rocky Flats, Colorado plant—which was shut down in 1992—lies a mere 16 miles from downtown Denver. The Oak Ridge Reservation, in Tennessee, lies 20 miles west of Knoxville (population 350,000). The Savannah River Site (SRS)—now on non-producing, stand-by status—lies only 13 miles south of Aiken, South Carolina and 20 miles southeast of Augusta, Georgia, a metropolitan area of more than 400,000 people to the northwest of SRS[2] [2,3].

Some Economic and Methodological Issues

In this paper only the materials production sites are examined, i.e., Fernald, Ohio, Savannah River Site (SRS), South Carolina, Hanford, Washington, and the Idaho National Engineering Laboratory (INEL), Idaho[3]. Table 2 lists the four sites examined and names the "site county" or counties. "Surrounding counties" are some of the counties immediately surrounding the site county. "Site county" and "surrounding counties" make up the "impact counties" of the site.

Not all surrounding counties are included in the impact counties. Indeed, just which counties to include or exclude presents a difficult, and unresolved, methodological issue. For example, Butler county, which houses Ohio's

[2] The Census of April 1, 1990 for the Augusta MSA includes Columbia, McDuffie, and Richmond counties in Georgia and Aiken county in South Carolina. The population was counted as 396,809 on April 1, 1990.

[3] Because of the different primary mission of the various sites (design, production, assembly, testing, waste storage), it would be inappropriate to lump data from all sites together in a single study even though, in principle, all military-nuclear sites face the same issues taken up in this paper.

Fernald Plant, borders on Indiana's Union and Franklin counties. But the plant occupies only 0.2 square miles, employs only 1,000 people, and is economically linked largely to events in Dayton and Cincinnati so that it would seem inappropriate to include the Indiana counties in this study.

Similar, and yet contrasting, is the case of South Carolina's Savannah River Site (SRS). To the west, directly across the river lies Georgia's Burke county, host to a civilian nuclear power plant, Plant Vogtle, built in the early 1980s. But there is no physical connection across the river linking SRS and Burke county. In contrast, about 20 miles northwest of SRS lie Georgia's Richmond and Columbia counties, where many SRS employees reside. Richmond county is included in SRS's impact area but Burke county is not. Likewise, since Columbia county serves largely as a "bedroom" community, rather than as an industrial location and generator of jobs, it is not included as one of SRS's impact counties. (The effect of including or excluding Burke and Columbia counties from the SRS impact counties is discussed below.)

As mentioned, officials with responsibility for regional economic development are amongst the most vocal proponents of keeping the military dollar flowing into their respective community, mostly on the argument that such facilities retain and create jobs. But do they? Could it be that more jobs would have been created were such plants not sited in the local economy? What empirical evidence might one wish to gather to answer that question? What theoretical guidance might one employ to create testable hypotheses about what one expects the empirical data to show?

Since we are dealing with jobs, one would need to collect data on employment, associated industry settlement and job creation, on unemployment rates, and on wage-rate, income, poverty statistics, and the like[4]. For illustrative purposes this paper focuses only on unemployment rates as one of the pertinent economic variables to be examined. Importantly, these data need to be collected for three geographic areas: (a) for the immediate area in which the actual sites were planted, (b) for the military-nuclear sites relative to the states in which they are located, and (c) for those potential sites that were among the finalist sites but ultimately were not chosen to host the military-nuclear facility.

A comparison of the first two—impact-counties versus host-state—permits one to gauge whether the impact-counties retain and create more or fewer jobs than the remainder of the host-state (see below). For example, if military nuclear sites are "job-neutral," one would expect that unemployment rates (or any of the other relevant economic variables) should not differ statistically between impact-counties and all state counties. But if military nuclear sites generate a "job-positive" impact (attracting jobs), one would expect a statistically measurable difference in favor of lower unemployment rates in the impact-counties. And if military nuclear sites are "job-negative" (repelling jobs), one would expect a statistically significant difference in favor of higher unemployment rates in the impact-counties relative to the state as a whole.

An immediate objection might be that the sites were perhaps deliberately planted in rural, undeveloped, high-unemployment, low-wage labor-pool areas in the United States, and that therefore the statistical dice are loaded against the site-counties. It is very important to note that that is not necessarily the case[5] [4]. As already pointed out, many sites were located close to major population/economic centers. In addition, declassified archival material from the Atomic Energy Commission (AEC) that describes the site-selection process and the site-selection criteria is unambiguous in explaining that the primary

[4] An employment rate is not simply "1 minus the unemployment rate," since the two rates are computed from differently collected data. For example, both employment and unemployment can rise and fall simultaneously in the same direction. Similarly, wage-rates and incomes are fairly dissimilar data-series, where "income" includes the substantial effects of taxation and transfer-payments.

[5] It would require a separate study to make the argument that military nuclear facilities were located in structurally disadvantaged, high unemployment areas. Increasingly the sites were to have a major population center nearby, so as to be able to draw on an existing labor force and real-estate market. Otherwise, as the experience of constructing Hanford showed, the government would also be responsible for building an entire city to house the site-employees. Having an existing labor and housing market nearby was especially true for the construction of the Fernald plant (see [4]:62-63). For safety reasons, the sites had to be somewhat isolated but not so isolated as to make it near impossible for anyone to get and work there.

It should also be noted that many high-unemployment, low-wage labor-pools are found not only in rural areas but also in major cities, in particular inner cities. Additionally, the military nuclear plants were in need of highly trained or trainable personnel, again a reason to locate these plants reasonably close to education facilities, such as local colleges, vocational schools, and a ready labor pool with construction and building experience.

selection criteria were military (freedom-from-attack[6]) and engineering (water quality), and not economic[7]. A priori, then, there is no particular reason to expect that more or fewer jobs should be retained and created at the impact-counties relative to all state counties[8].

In addition to comparing the impact-counties with the remainder of the host-state, a comparison of the economic development of the potential sites with the actual site could also be made (see below). In the case of SRS, for example, the AEC identified more than 100 sites that met some initial set of criteria for the plutonium and tritium production to be carried out. As the criteria were developed, applied, changed, and applied again during the second half of the year 1950, a list of four final prospects emerged, referred to as "South Carolina No. 5," "Illinois No. 59," "Texas No. 125," and "Wisconsin No. 205." The first one, "South Carolina No. 5," is today's Savannah River Site. "Illinois No. 59" referred to a site along the Wabash River, 21 miles southwest of Terre Haute, Indiana. A site along the Red River, 23 miles west of Paris, Texas, formed "Texas No. 125," and "Wisconsin No. 205" was to make use of Lake Superior waters, 21 miles east of Superior, Wisconsin[9] [5].

The central idea here is the following. If a military nuclear site is "job neutral," then one would not expect to note a statistically significant difference in economic performance variables between an actual site and the potential sites. Rather, one would expect about equal economic performance at the four sites since the 1950s. If, however, the military nuclear plant "attracts" jobs, the impact-counties around SRS should be better off today than those around "Illinois No. 59," "Texas No. 125," and "Wisconsin No. 205." Alternatively, if SRS "repels" jobs, we should expect to see the opposite effect[10] [6,7].

The remainder of this paper illustrates the issues raised with an examination of unemployment rates of impact-counties at the actual sites, host-states, and potential sites. Ideally, one would like to compare unemployment rates (and other economic variables) over long periods of time, including the years before the four sites were built (i.e., pre/post analysis). But regrettably, it is only since the mid-1970s that county-level unemployment data are regularly estimated for all U.S. counties. At least with regard to unemployment data, it is thus not possible to determine whether or not unemployment rates in the impact-counties "always" varied systematically from the remainder of their respective host-states. Focusing on different economic variables, it

[6] For the Savannah River Site (SRS), security considerations played the single most important role: the site had to be safe from new Soviet long-range bombers that, by 1950, were able to reach the Hanford site in Washington state. Thus, the new site that was to duplicate some of Hanford's functions (plutonium production) and to take on new functions (tritium production) was to be located within the "First Defense Zone" (see [9]). But within that zone—a sizeable area including much of Georgia, South Carolina, North Carolina, Tennessee, Kentucky, Alabama, Mississippi, Nebraska, and even a chunk of Texas—engineering considerations formed the primary criteria.

[7] U.S. Senator Strom Thurmond and his staff kindly assisted in obtaining the AEC archival material that describes the site-selection process of the Savannah River Site. For a more readily available history of site-selection, also covering sites other than SRS, see [4].

[8] Georgia Power Company built a civilian nuclear power plant, Plant Vogtle, in Burke county in the early 1980s, directly across the Savannah River from the Savannah River (military nuclear) Site. A former senior Georgia Power executive, familiar with the planning and decision-process that led to the siting and construction of Plant Vogtle, indicated in an interview with the author that the primary siting-concern concerned the water supply (engineering concern); the second-most important concern was to locate in a rural area, not too distant from a population center (Augusta) (geography); and the third-most important consideration was that economic growth in East-Central Georgia (the Augusta MSA) required building a new plant in that area to avoid the cost of transporting electricity over long distances to that growth-area (load-distribution).

The availability of a ready labor-pool was not an important consideration because construction crews generally are regarded as mobile, moving in and out of major construction areas. Neither did the nuclear-related specialty occupations at SRS influence Georgia Power's siting decision of Plant Vogtle, since the intention was not to attract any of SRS's workers to the electric company, but rather to hire and train their own employees.

Another factor, proving its value to the company only after the fact, was that the population accepted the civilian nuclear power plant more readily than other communities might have, probably because of its long exposure (since 1950) to nuclear issues in connection with the SRS operations.

[9] The sites are described in a note and attached report to members of the AEC, distributed by its secretary Roy B. Snapp on November 17, 1950 (see AEC, 1950). The first batch of sites, including the Red River site in Texas, lay within the "First Defense Zone," out of range of Soviet bombers. An expanded search located the Illinois, South Carolina, and Wisconsin sites, the first two being right on the edge of the "First Defense Zone."

[10] In this context it is of interest to note the now commonly accepted position that closures of U.S. domestic military bases unleash forces leading, within three to five years, to more jobs in the area of the former base than there were before its closure. One of the most frequently cited sources for this result is [6]. Lynch is a former official at the Pentagon's Office of Economic Adjustment (OEA) whose responsibility includes assisting in the economic transition of base-closure communities. The experiences involved in the U.S. base closure rounds of 1988, 1991, and 1993 are well summarized in [7].

might be possible to employ the decennial census data to examine pre- and post-conditions, but that is beyond the purpose and scope of the present paper.

For the four military nuclear materials production sites, as well as for the three potential sites that were "finalist" sites for what became SRS, monthly county-level unemployment data for January 1981 to June 1993 have been collected[11]. Whereas it would have been preferable to be able to work with a time-series reaching back to the 1930s for a pre/post analysis, the chosen time-period (1981-1993) does include two nation-wide recessions (1981/82 and 1990/91) and periods of economic recovery. It also covers a period of remarkable economic events: the collapse of OPEC as from 1982 with its attendant domestic effects on the U.S. oil-industry, the U.S. savings and loan institutions debacle, and the U.S. farm crisis of the mid-1980s, to name a few. The data involve eleven states—Idaho, Georgia, Illinois, Indiana, Minnesota, Ohio, Oklahoma, South Carolina, Texas, Washington, and Wisconsin—more than a fifth of the entire U.S.

Table 3. Unemployment Rates in States and Impact Counties, 1981-1993

	IDAHO			OHIO			S. CAROLINA			WASHINGTON		
Year	*State*	*Impact*	*Diff.*	*State*	*Impact*	*Diff.*	*State*	*Impact*	*Diff.*	*State*	*Impact*	*Diff.*
1993	7.48	6.23	-1.25	6.97	6.55	-0.41	6.80	9.35	2.55	8.05	12.20	4.15
1992	6.34	6.63	0.29	7.23	6.59	-0.63	6.48	8.74	2.26	7.22	10.64	3.43
1991	6.18	5.35	-0.83	6.38	5.74	-0.65	5.98	8.70	2.72	6.23	10.41	4.18
1990	5.66	5.19	-0.47	5.66	5.14	-0.52	4.88	6.66	1.78	5.33	9.55	4.23
1989	5.10	5.60	0.50	5.53	5.05	-0.49	4.72	6.72	2.00	6.18	10.53	4.36
1988	6.30	6.26	-0.04	6.03	5.40	-0.62	4.79	6.40	1.61	6.41	10.22	3.81
1987	8.04	7.52	-0.52	7.00	5.95	-1.05	5.43	7.45	2.02	7.71	11.19	3.48
1986	8.64	7.69	-0.95	8.13	6.92	-1.22	6.45	8.21	1.76	7.93	10.95	3.01
1985	7.83	6.73	-1.10	8.88	7.72	-1.15	6.84	8.82	1.98	8.46	11.64	3.18
1984	6.98	7.11	0.12	9.42	8.25	-1.17	8.14	9.02	0.88	9.59	13.39	3.80
1983	9.89	8.98	-0.91	12.21	10.53	-1.68	9.65	11.60	1.95	10.96	14.18	3.22
1982	9.75	8.21	-1.54	12.51	11.57	-0.94	11.13	12.40	1.27	12.18	15.03	2.84
1981	7.64	7.48	-0.16	9.63	8.74	-0.88	7.92	8.77	0.86	9.18	10.46	1.28
Mean	7.37	6.84	-0.53	8.12	7.24	-0.88	6.86	8.68	1.82	8.11	11.57	3.46
P-value		0.318			0.315			0.020			0.000	
St.Dev.	1.48	1.13	0.63	2.31	2.05	0.37	1.93	1.77	0.57	1.98	1.67	0.82
C.V.	0.20	0.17	-1.20	0.28	0.28	-0.42	0.28	0.20	0.31	0.24	0.14	0.24

Note: "State" refers to the state average unemployment rate (including the impact counties). "Impact" refers to the average unemployment rate in the impact counties as listed in Table 2. "Diff." refers to the difference between the impact counties' and the state's average unemployment rates. A negative sign means that the impact counties' unemployment rate was lower than that of the state as a whole. (Data for 1981 to 1992 are averaged for 12 months; for 1993 averaged for January to June.)

Source: Author's computations from U.S. Dept. of Labor, Bureau of Labor Statistics.

Comparing Unemployment Rates (Impact-Counties vs. Host-State)

Idaho

In 1988, the Idaho National Engineering Laboratory (INEL) employed 10,203 people, which constituted 10.6% of total impact-counties employment[12] [8]. The data in Table 3 list, for 1981 to 1993, average state unemployment rates, including the impact counties. The table also lists the unemployment rates for the same years only for the impact counties as well as the difference between the two rates for each year. Unemployment rates in the INEL impact counties are generally lower than for the state as a whole with the exceptions of 1984, 1989, and 1992. By and large, the difference in unemployment rates is small, reaching one percentage point or more in only two of the 13 years examined (1982 and 1993). A simple t-test for two independent samples (df=24) yields a probability-value of 0.318, suggesting that the difference in unemployment rates between the impact-counties and the state as a whole is not statistically significant.

It is interesting to observe that the largest differences in favor of the INEL impact-counties occurred in 1982 and 1993, one a year of a deep nation-wide recession, the other a year of substantial recovery and growth. It is also interesting to note that the impact-counties saw much smaller increases in unemployment rates during the 1981/82 and 1990/91 recessions, and their aftermath, than the remainder of the state experienced. From 1981 to 1983, state unemployment moved up by two-and-a-quarter percentage points from 7.64% to

[11] Unemployment data are by no means straightforward numbers. Even today, county-level unemployment rates are projected down from the state-wide samples by means of various regression models and are frequently revised and further adjusted over time. The author worked with monthly, seasonally unadjusted Bureau of Labor Statistics data as reported at year-end. Ordinarily, these data would include the first revision of the monthly data. States undertake a second revision much later on, however, when the estimated monthly county-level unemployment rates are adjusted to the so-called Current Population Survey (CPS). Whereas on occasion these revisions can be substantial in any single month, the author's experience working with Georgia county-level unemployment data and the Georgia Department of Labor in other respects does not suggest that these revisions would substantially affect the results reported in this paper.

[12] In contrast to the present paper, [8] uses Bannock, Bingham, Bonneville, Butte, Custer, Jefferson, and Madison as its seven-county "primary impact area." The author has excluded Custer and Madison counties from the present study, because these counties are geographically and economically removed from the INEL site. Indeed, Custer housed only 0.6% and Madison only 1.2% of all INEL employees in 1988. Clark county, to the north of INEL, is included because of its geographical vicinity to the INEL site, even though, in 1988, it appears that no INEL employee resided there.

9.89%, but the impact-counties' rate increased by only one-and-a-half percentage points from 7.48% to 8.98%. This is even more pronounced in the 1989 to 1993 time period in which state unemployment jumped by 2.4 percentage points, but the impact-counties' rate increased by only 0.63 percentage points. It appears as if unemployment rates in the impact-counties have not only been lower than in the state of Idaho as a whole, but also show some amount of "recession-resistance." Indeed, the coefficient of variation (C.V., i.e., standard deviation divided by the mean) is somewhat smaller for the impact-counties than for the state, suggesting that unemployment cycles exhibit smaller amplitudes in the impact-counties than in the state.

That unemployment around INEL should be lower than in the host-state as a whole is not terribly surprising for much of INEL was sited on what formerly was the Arco Naval Proving Ground, a federal facility [4]. In other words, this is an example where the facility was, in fact, deliberately located in an area with low economic activity and where future economic activity largely revolved around "guaranteed" federal employment at INEL.

Ohio

Unlike INEL, Fernald was deliberately located in the strong and well-established labor market near Cincinnati [4]. But other than that, the case of Ohio is very similar to that of Idaho. As in the case of Idaho, the difference between unemployment rates in the Fernald impact-counties and the state of Ohio is small and in favor of the impact-counties, fluctuating between 0.5 and 1.2 percentage points, reaching a level of more than 1.5 percentage points but once, in 1983. And as for the case of Idaho, here, too, we find some "recession resistance" in the impact-counties, i.e., the recessions of the early 1980s and early 1990s are associated with unemployment rates that increase more rapidly in the state than in the impact-counties. Nonetheless, for the years 1981 to 1993, the p-value is 0.315 (df=24), suggesting that the unemployment rate differences between the state and the site are not statistically different.

South Carolina

In 1990, employment in Aiken, Allendale, Bamberg, and Barnwell counties stood at 64,730, 4,820, 6,450, and 8,910 people, respectively. Richmond county, in Georgia, had an employment level of about 113,830, so that the total impact counties' employment reached, roughly, 200,000 people[13] [10]. Even though employment at SRS is given at 20,000 [2], actual employment on the site reached about 26,000[14], because the site includes Bechtel Construction employees, Wackenhut Security Service employees, University of Georgia Ecology Laboratory employees, and U.S. Department of Agriculture forestry employees. Consequently, about 13% (26,000/200,000) of the impact counties' employees are SRS employees.

Comparing unemployment rates between South Carolina at large and the impact counties, one makes observations strikingly different from the Idaho and Ohio cases. Initially, the unemployment differential is about 0.9 percentage points in disfavor of the SRS impact counties, then rapidly increases during the 1981/82 recession to almost two percentage points, stays at about that level during the "boom" years of the Reagan administration, and finally rises once more in disfavor of the impact counties to about two-and-a-half percentage points. On average, the impact counties' unemployment rate exceeds the state's unemployment rate by 1.82 percentage points.

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Not only is the unemployment rate substantially higher, but recessions tend to hit harder and linger longer in the impact-counties, and recoveries do not seem to catch on as well. Table 3 shows that the unemployment differentials grew during the 1981/82 and 1990/91 recessions. Thus, recessions "hit harder." The table also discloses that following the 1981/82

[13] The Richmond, Georgia figure is estimated as a 60% labor force participation rate of a population of 113,831 for the 1990 census [10]:14. A similar employment level estimate of 200,000 people is obtained from the Augusta MSA employment level of 206,700 people in 1988 [3]:3.

[14] Personal communication from Ms. Ferrara, SRS Public Affairs Office, August 1991.

recession, unemployment in the state dropped off faster than in the impact counties, thereby increasing the unemployment rate difference described earlier. The recession "lingers." By the same token, during the "boom" phase of the mid- to late-1980s, the difference in unemployment rates between the impact counties and the state drops below one percentage point only once (quite in contrast to the cases of Idaho and Ohio)[15].

Finally, and again in marked contrast to the Idaho and Ohio cases, the difference in unemployment rates is statistically significant (p=0.020; df=24).

Washington

According to a recent study by the Pacific Northwest Laboratory—the laboratory is operated by the Battelle Institute and funded by the DOE—the population of Benton and Franklin counties reached about 150,000 by the April 1990 census. The labor force would have been around 90,000 (60% of the population). Hanford's employment exceeded 15,000 or 17% of the counties' labor force [11].

As regards unemployment rates, one notices with some astonishment that the difference between state unemployment and impact counties' unemployment rates deteriorates progressively from 1.28 percentage points in 1981 to 4.15 points in 1993. In absolute values, also, the impact-counties fared badly: the unemployment rates range between 10% and 15% and drop below 10% but once, in 1990.

As was the case for South Carolina, here, too, recessions hit harder, linger longer, and recoveries are hardly recoveries. The p-value indicates statistical significance of the unemployment differential (p=0.000; df=24).

In summary, two distinct trends appear prominently in an examination of the unemployment rates. One set of military-nuclear materials production sites, namely INEL and Fernald, did slightly better than the remainder of their respective states. Another set of military-nuclear materials production sites, Hanford and SRS, did notably worse and increasingly so, especially in the case of the Hanford Nuclear Reservation in Washington State.

Except for Fernald, Ohio, unemployment rates vary less in the impact-counties than they do in the respective states as a whole, as measured by the respective coefficients of variation (C.V.). This effect is particularly pronounced in the Hanford and SRS areas, suggesting that unemployment rates there not only are high but also tend to be "stuck" at that higher level, i.e., less flexible to upward or downward movements relative to the respective state performance. The author's interpretation is that Hanford and SRS offer some job protection and stability in bad times, but do not offer much by way of additional jobs in good times. The same observation holds for INEL in Idaho, but less strongly so, whereas the Fernald region, perhaps because of its relatively small size, behaves virtually the same as the rest of Ohio.

If one now accepts that SRS and Hanford show a statistically significant unemployment premium, the question then becomes why that is so, and why INEL and Fernald do not show that difference. Local economic development officials and business persons in the SRS area regularly suggest that the high wage-rates offered at SRS discourage industries from locating in the SRS impact-counties. But if that is so, should that not also be the case at INEL and Fernald, and if not, why not? But to pursue these questions is beyond the scope of the present investigation.

Comparing Unemployment Rates (An Actual Site Against Potential Sites)

Whereas the analysis above compared unemployment rates between the impact-counties and those of the host-state, this section compares unemployment rates among the four sites that were the "finalist" sites for what eventually became the Savannah River Site (SRS). Similar examinations could, in principle, be carried out not only for variables other than unemployment rates, but also for the "finalist" sites for what became Hanford, INEL, and Fernald.

As mentioned before, it is unclear, method-

[15] In accordance with Table 2, the South Carolina information in Table 3 includes Richmond county in Georgia, but excludes Columbia and Burke counties. Including these two counties and comparing the impact-counties' unemployment rate to the average Georgia and South Carolina state-wide unemployment, we still find an "unemployment premium" of 1.45 percentage points in disfavor of the impact-counties. Also, as before, the coefficient of variation is much smaller for the impact-counties (0.14) than for the two states combined (0.20).

If, in Table 3, one excludes Richmond county in order to focus solely on the South Carolina counties, the unemployment premium becomes larger. For the average of the years 1981 to 1993, unemployment rates in the impact-counties were 2.31 percentage points higher than in South Carolina state (and, again, the coefficient of variation is smaller in the impact-counties, 0.23, than in the state as a whole, 0.28).

Table 4. Unemployment Rate Differentials, SRS and Three Potential Sites, 1981-1993

	S. Carolina No. 5		Illinois No. 59		Texas No. 125		Wisconsin No. 205	
	SC counties	GA/SC	IN counties	IN/IL	TX counties	TX/OK	WI counties	WI/MN
Year	only	counties	only	counties	only	counties	only	counties
1993	3.20	2.55	1.59	1.01	-0.83	0.18	2.80	2.79
1992	2.71	2.26	0.74	1.19	-0.30	0.36	1.13	1.72
1991	3.56	2.72	0.39	1.56	-0.28	0.12	1.15	1.67
1990	2.10	1.78	0.30	1.69	-0.54	0.06	1.45	1.74
1989	2.12	2.00	0.97	2.45	-0.59	1.15	1.08	1.55
1988	1.53	1.61	2.06	3.06	-0.60	0.26	1.80	2.22
1987	2.22	2.02	2.33	3.78	-0.85	0.65	2.75	3.12
1986	2.18	1.76	2.16	4.46	-1.38	-0.08	2.20	3.39
1985	2.38	1.98	2.29	4.46	0.07	1.49	3.66	4.46
1984	1.37	0.88	1.66	2.98	-0.39	1.16	3.97	4.45
1983	2.73	1.95	0.74	1.98	-0.85	0.94	3.03	3.93
1982	2.50	1.27	-0.42	0.66	-0.37	0.81	1.67	2.91
1981	1.42	0.86	0.49	0.18	0.83	1.78	1.93	2.82
Mean	2.31	1.82	1.18	2.27	-0.47	0.68	2.20	2.83
St.Dev.	0.65	0.57	0.89	1.40	0.53	0.59	0.97	1.03
C.V.	0.28	0.31	0.76	0.62	-1.13	0.86	0.44	0.36

Note: Numbers refer to the difference between the average impact counties' and the average state's unemployment rates. A negative sign means that the impact counties' unemployment rate was lower than that of the state as a whole. (Data for 1981 to 1992 are averaged for 12 months; for 1993 averaged for January to June.) For the two-state columns, the numbers refer to the difference between average unemployment rates in all of the two-state impact counties relative to the unemployment rates averaged for the respective two states.

Source: Author's computations from U.S. Dept. of Labor, Bureau of Labor Statistics.

ologically, which counties to include or exclude in one's delineation of "impact-counties." Using the AEC's finalist site descriptions, and county-maps, of "Illinois No. 59," "Texas No. 125," "Wisconsin No. 205," and of course "South Carolina No. 5," one can easily come up with two, three, or perhaps more sets of "reasonable" groups of impact-counties. The Illinois site might have affected Clark, Crawford, Cumberland, Jasper, Lawrence, and Richland counties in Illinois, and, across the Wabash river, Knox, Sullivan, and Vigo counties in Indiana, the population center (Terre Haute) being on the Indiana side of the river. The Texas site might have affected Collin, Delta, Fannin, Grayson, Hunt, and Lamar counties in Texas (the population center is Paris) and Bryan, Choctaw, and Marshall counties across the Red River in Oklahoma. The Wisconsin site along Lake Superior (the major population center is Superior) might be looked at as Bayfield and Douglas counties in Wisconsin and Carlton county in Minnesota, and/or the Duluth (Minnesota)/Superior (Wisconsin) MSA. Finally, the South Carolina site (see Table 2) involves Aiken, Allendale, Bamberg, and Barnwell counties in South Carolina (the major population center is the city of Aiken) and Richmond county in Georgia.

The author adopted the following rule: to report unemployment rates for the just-listed impact-counties of that state from whose population center much of the labor force would have been drawn (i.e., Aiken, South Carolina; Paris, Texas; Terre Haute, Indiana; and Superior, Wisconsin) and separately for the combined areas (South Carolina/Georgia; Texas/Oklahoma; Indiana/Illinois; and Wisconsin/Minnesota). Comparing, in Table 4, the average unemployment rate differentials (or unemployment premium) for 1981 to 1993 for the South Carolina counties (2.31%) with the ones in Indiana (1.18%), Texas (-0.47%), and Wisconsin (2.20%), it is uncanny to observe that without exception the unemployment premium in the South Carolina impact-counties around the present-day Savannah River Site is larger, relative to the rest of the state, than is the case for the potential sites in Indiana, Texas, and Wisconsin.

In the case of Texas, the negative signs mean that unemployment rates in those counties were, on average, less than those for the remainder of Texas. Moreover, we observe a "bulge" of relatively high unemployment differentials for the Indiana and Wisconsin counties in the mid-1980s, the time of the farm crisis in the American midwest, suggesting that had it not been for that crisis the difference of the potential sites to the South Carolina site would have been even more striking. Running the simple t-tests for two independent samples, the difference between the South Carolina site and the Wisconsin site is not statistically different ($p=0.742$; $df=24$), but the differences to the Indiana counties of the Illinois site ($p=0.001$; $df=24$) and to the Texas counties ($p=0.000$; $df=24$) are.

But when one compares differently defined impact-counties, namely those for the two-state areas—reported in the second column per site in Table 4—the numbers suggest different conclusions: that the unemployment premium is lower in the South Carolina/Georgia case than in the Illinois/Indiana or Wisconsin/Minnesota cases but remains higher as compared to Texas. (The Illinois/Indiana and Wisconsin/Minnesota results obtain largely because of the very large unemployment rates in the rural Illinois and Minnesota counties during the farm crisis years. In the late 1980s and early 1990s, the unemployment premium is lower at the potential sites than at present-day SRS.)

In terms of statistical significance, this means that the significant difference between the South Carolina and Illinois sites (p=0.001) turns into a statistically insignificant one (p=0.297); that the insignificant difference between South Carolina and Wisconsin (p=0.742) turns into a significant one (p=0.005); and that the difference between South Carolina and Texas stays statistically significant as one switches from one to the other definition of impact-counties.

Noting these results, and observing that the unemployment premium grew over time in the SRS impact-counties, but declined at the Illinois, Texas, and Wisconsin potential sites, the author would cautiously suggest that of the four "finalist" sites, the one actually chosen—SRS—demonstrates a higher unemployment premium than the ones not chosen.

Conclusion

To the question, "Do U.S. military nuclear materials production sites attract or repel jobs?" one must answer in a roundabout way. There are several possible avenues to seek an answer. One is to compare the job development in the impact-counties surrounding the site with job development in the state hosting the site; a second is to compare that development in the impact-counties with those at finalist sites that ultimately were not selected to become the actual site; a third is to seek recourse to the experience at non-nuclear military sites, such as the base closure experiences in the U.S.; a fourth is to examine cases of other large scale public or private—but non-military—industries in an area: for example, what is the effect of a civilian nuclear power plant on economic variables in the impact-counties and alternative potential sites?

Could it be that more jobs would have been created were such plants not sited in the local economy?

In this paper, for the first time to the author's knowledge, the question is raised "what might have been the economic consequence of not hosting a military nuclear site?" and some economic and methodological issues are discussed, illustrated with an examination of but one of the many economic variables (unemployment rates) that a fuller study, aimed at deriving more definitive conclusions, should consider.

Within the limitations of the present study, it is the author's interpretation of the empirical results presented above that in the cases of the Savannah River Site in South Carolina and the Hanford Nuclear Reservation in Washington, there is evidence of a "job repellence" effect (statistically significant unemployment premiums relative to the respective host state). Conversely, no evidence is found that Fernald and INEL are "job attractors" (statistically insignificant differences to the host-state). The results can also be interpreted to mean that unemployment rates in the chosen site in South Carolina probably are significantly higher than those in the "finalist" sites in Illinois, Texas, and Wisconsin that were not chosen to host what became SRS.

Readers should be cautioned once more that any geographic region can do very well economically in spite of relatively high unemployment rates. But for those concerned about questions of employment, earned incomes, and unemployment, the results reported in this paper may be of some interest and bear further investigation.

Finally, it should be noted that employment at Hanford has recently risen substantially as its mission has been reformulated from plutonium production to waste management and environmental remediation. Similar prospects are expected at SRS. This is important because reoriented missions are likely to attract new firms and employees that hope to benefit from spill-over learning effects in the increasingly important area of environmental protection. Thus, whereas in the past Hanford and SRS probably were "job repellents," in the future they may truly attract new and high-quality jobs. ❧

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References

1. Gertcher FL, Weida WJ. Beyond deterrence: the political economy of nuclear weapons. Boulder, CO: Westview Press. 1990.
2. U.S. Congress Office of Technology Assessment. Complex cleanup: the environmental legacy of

nuclear weapons production, OTA-O-484. Washington, DC: U.S. Government Printing Office. 1991.
3. University of Georgia College of Business. Augusta economic yearbook: 1992. Athens, GA: Selig Center. 1992.
4. History Associates. History of the production complex: the methods of site selection. Rockville, MD: History Associates, Inc. 1987.
5. Atomic Energy Commission. Site selection for Dupont production facility: note by the secretary. Washington, DC: U.S. Department of Energy Archives. November 17, 1950.
6. Lynch J ed. Economic adjustment and conversion of defense industries. Boulder, CO: Westview Press. 1987.
7. Cunningham K. Base closure and reuse: 24 case studies. Washington, DC: Business Executives for National Security. 1993.
8. Idaho State University College of Business. INEL: socio-economic impacts of the Idaho national engineering laboratory. Pocatello, ID: Center for Business Research and Services. 1989.
9. South Carolina Employment Security Commission, Labor Market Information Division. South Carolina's labor market review, 1991. Columbia: SCESC. 1991.
10. University of Georgia College of Business. Georgia business and economic conditions vol. 51, no. 5 (September-October 1991). Athens, GA: Selig Center for Economic Growth. 1991.
11. Pacific Northwest Laboratories Battelle Institute. Tri-cities economy: review & outlook. Richland, WA: Pacific Northwest Laboratories. 1991.

Seen in the News

Global warming could lead to an increase in the spread of infectious diseases such as malaria, schistosomiasis, and yellow fever according to recent studies described in Science. Even a modest warming trend could extend the ranges of mosquitos, flies, and snails that transmit these diseases. For example, a 1-degree C increase in the average temperature in Rwanda in 1987 has been linked to a 337% rise in the incidence of malaria in that year. The WHO is expected to issue a major report later this year, and the Clinton White House will sponsor a conference on health and climate change this spring in the U.S. (*Science*, Feb. 1995, pg. 957)