HOW IMPORTANT IS THE GUNBELT: SOME EMPIRICAL EVIDENCE

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A critique of Ann Markusen, Peter Hall,
Scott Campbell, and Sabina Deitrick's
The Rise of the Gunbelt
(New York and Oxford: Oxford University Press, 1991)

The Rise of the Gunbelt, a recently published work by Ann Markusen, Peter Hall, Scott Campbell, and Sabina Deitrick, paints a portrait of the geography of military procurement contracting in America. A significant aspect of this geography is the uneven distribution of contracts between regions. Markusen et al. describe the areas of concentration as a gunbelt, stretching "from the state of Washington through California to the desert states of the Southwest, on through Texas and the Great Plains, across to Florida, and discontinuously up the East Coast to New England" (p. 3). The stated purposes of the book are to describe this gunbelt, "what is it, where is it and what does it do?" and also to describe how the concentration of military spending has shifted over time and why these shifts have occurred (p. 4). The authors address these questions by presenting empirical data that show the uneven distribution of military procurement contracts and how this distribution has changed in the postwar era. A major strength of their work lies in the highly detailed case studies of several of the most significant agglomerations of military production activity. The case studies give anecdotal evidence that demonstrates how and why shifts in the concentration of procurement contracts have occurred.

While the authors succeed in answering many of the questions they pose for themselves in the introduction, their efforts are substantially undermined by their failure to address one simple question: how important is the gunbelt? This lacuna would not be so serious were it not for the many unsupported hyperbolic statements the authors make indicating that they believe the gunbelt to be of major significance. In the opening paragraphs of the introduction, they state that the gunbelt has been of "overwhelming importance" (p. 3) in causing the huge shift of population and economic vitality from the rustbelt to the sunbelt/gunbelt over the past forty years. "The gunbelt is a major *the* major phenomenon in the contemporary economic map of America" (p. 8, emphasis theirs). "In large part, . . . [the] differential growth rates and income effects [in the states over the past forty years] were the result of military spending differentials and the construction of high-tech industrial complexes" (p. 9). Indeed, the entire tone of the book indicates that the authors believe the gunbelt to have been of overarching importance in these shifts. *The Rise of the Gunbelt* goes beyond a simple description of the geography of military procurement to assert that such defense spending has been the one major determinant of differential rates of regional growth in the United States in the post-World War II era.

Markusen et al. fail to cite more than anecdotal evidence to support these claims, however. They do not discuss in any depth the empirical evidence available in the small but not totally insignificant literature surrounding the topic. They might also have conducted some relatively simple statistical tests

to provide at least a rough indication of the scale of the gunbelt's importance in regional economic change. This paper offers such a test, and will show that military spending does have a statistically significant correlation with regional economic growth. But it also shows that this correlation is small enough to support only a more qualified version of the authors' thesis. Bolton (1966) and O'hUallachain (1987) obtain similar results using different methodologies. These results provide evidence that the *Gunbelt* authors have overstated their conclusions, though in the process they have drawn attention to a significantly underexamined cause of regional economic change in the United States.

Testing the Importance of the Gunbelt in Regional Economic Change

In their examination of the rise of the gunbelt as a regional phenomenon, Markusen et al. focus most heavily on the post-World War II period. The authors cite two subperiods, in particular, as being significant in the gunbelt's growth and consolidation: the missile buildup of the mid-1950s and the Carter/Reagan buildup from the late 1970s through the 1980s (p. 9).[1]

Roger Bolton's 1966 doctoral dissertation provides a thorough examination of the impact of the 1950s cold war buildup on regional economies. He estimated the importance of growth in defense-related income to overall growth in income from other "exogenous" sectors.[2] His findings indicate that during the period from 1952 to 1962 almost half of the states had their income growth greatly or moderately stimulated by defense-related income.[3] He concludes, however, that "over the 1952-62 period as a whole, no state depended entirely – or even nearly entirely – on defense income for growth" (Bolton 1966: 104). He further states:

> The results of these tests imply a positive, but not strong, relationship between defense income and growth in total personal income, and a positive but even weaker relationship between defense income and per capita personal income" (p. 104).

Bolton's work was well-researched and rests on strong empirical evidence. His statistical tests were in accordance with accepted practice. Because Bolton dealt so thoroughly with the question of the impact of the 1950s buildup, this paper will concentrate on the period stretching from 1977 through the mid-1980s, which Markusen et al. cite as the second significant gunbelt era.

Testing the Impact of Defense Spending on Regional Growth: 1977-1986

This paper presents a simple test of the impact of defense spending on regional growth between 1977 and 1986. This period stretches from the beginning of the Carter/Reagan buildup through the most recent year for which strong data on regional growth were available.

The following implicit hypothesis of Markusen et al. will be tested: defense spending, particularly procurement spending, has been the one major determinant of differential rates of regional growth in the United States from 1977 to 1986.

If this hypothesis is to be accepted, then a region's proportional share of defense spending should correlate strongly with its proportional share of growth.

In order to test the hypothesis, measures of both defense procurement spending and regional growth are needed. It will then be possible to use ordinary least squares regression to test the degree to which defense-procurement spending explains variation in regional growth. Unfortunately, data availability constrains the selection of both the unit of analysis and the specific variables.

The Unit of Analysis

The ideal unit of analysis for such a test would be that of the integrated regional economy. In statistical terms, this corresponds most closely to the metropolitan statistical area as defined by the Bureau of the Census. While measures of metropolitan area growth are available, data regarding military procurement are not.[4] The state is the lowest level for which data regarding military procurement are available, and it is therefore at the level of the state that the hypothesis will be tested. In their own presentation of the empirical evidence showing the uneven distribution of procurement contracts, Markusen et al. use both the state and, more often, the multi-state census region as the unit of analysis.

The Defense Procurement Variable

In addition to the difficulties associated with the level of analysis, there are other problems associated with the defense procurement variable. The Department of Defense publishes annual procurement figures under the title *Prime Contracts by State*. These data are reported according to the location of the prime contractor and do not necessarily reflect the actual location of all production; considerable amounts of subcontracting occur in the industry. Bolton went to considerable pains to adjust his data in order to correct for some of these problems, and was successful in creating a set of estimates that more accurately reflected the location of actual production (Bolton 1966: Ch. 5). However, such complicated adjustments are outside of the scope of this study.

Since there is evidence that subcontracting tends to follow the same patterns as prime contracting (Malecki 1984; Karaska 1967), and that good time series data on subcontracting do not exist, the prime contract data must stand in default as the best available approximation of military procurement spending, though results shall be interpreted with some caution due to this problem. The *Gunbelt* authors make a somewhat more detailed examination of this issue, and also conclude that the prime contract data is the best available approximation of spending (Ch. 2).

It should also be noted that while the Department of Defense is responsible for the lion's share of defense dollars, both NASA and the Department of Energy are also involved in defense procurement to a limited extent. NASA is involved in satellites and the space shuttle and the DOE is involved in nuclear weapon production (Malecki 1984: 34.). This provides an additional caveat to an over-interpretation of test results.

If these problems do in fact seriously skew the defense spending variable, the r-squared and t-statistics obtained in the regression analysis will be biased towards 0. Failure to find significant relationship (low t-statistic) between the variables could be due to such problems, but significant findings cannot be the result. The strength of the correlation (r-squared statistic) could also be underestimated, but the scale of the underestimation would have to be somewhat similar to the deviations of subcontracting patterns from those of prime con-

tracts. These possible biases will be considered in further detail in the interpretation of regression results.

One final problem is the time lag that often exists between the awarding of the contract and the actual purchase of goods and services by the contractor. This is controlled for in the test in two ways. First, cumulative figures, reflecting prime contract awards over the entire ten-year period, will be used instead of single-year figures. Second, results involving various time lag rates will be reported, including models with no time lag, a one-year, a two-year, and a three-year lag rate. Bolton reported in 1966 that almost all the contract is usually paid within three years, and this seems a logical limit to expected impacts.

The Growth Variable

A variety of measures can be used to show economic growth. Among these are employment growth, income growth, and growth in gross product. Since gross product numbers are the most comprehensive measure, and official gross state product figures recently became available from the U.S. Department of Commerce, these have been chosen as the growth variable.[5]

Standardizing the Variables

In order to produce a reliable result from the regression analysis, it is necessary to standardize the variables. This will avoid undesirable effects such as those resulting from inflation or size (i.e. large states have large amounts of spending). Also, the variables will be expressed as cumulative sums over the ten-year period to avoid the time-lag constraints identified previously.

Because of difficulties in deciding exactly which deflator was most appropriate for the prime contracts variable,[6] it was decided not to adjust for inflation per se. Instead this variable was expressed in terms of each state's share of national prime contracts in each year, obviating the need for inflation adjustment. Averaging these shares over ten years gave an average share figure for each state. This was then divided by each state's share of GNP in the initial year in order to arrive at a location quotient for prime contracting.[7] The logic of the location quotient can be expressed as: each state's share of prime contracts compared to its initial share of the economy. This location quotient is the independent variable in the regression equation.

A similar location quotient method was also used to standardize the gross state product data. These data were obtained in inflation adjusted (1982 = 100) form, so no further adjustment for inflation was made. In order to calculate the location quotient, the gross growth experienced by each state was calculated by finding the difference between its gross product in the initial year and the final year. This gross growth was then expressed as a percentage of total gross growth in the country to arrive at each state's share of national growth. This figure was divided by each state's share of the national economy in the initial year to arrive at a location quotient for growth. The logic of this location quotient can be expressed as: each state's share of national economic growth compared to its initial share of the national economy. A state that accounted for 10 percent of economic growth in the nation, while itself only comprising 5 percent of the national economy at the beginning of the period, would therefore have a location quotient of 2.00, indicating that it had twice as large a share of national growth than would have been expected, given its initial

share of the national economy. This location quotient for growth is the dependent variable in the regression equation.

Interpreting the Results

Table 1 shows the results of the regression equations for each of the four lag scenarios. All lag scenarios show that there is a statistically significant relationship between a state's proportional share of military spending and its proportional share of growth in gross product. In all cases the significance is at the p = .01 level or greater. In no case is this relationship particularly strong, however; r-squared never rises above 0.22. The data clearly show that military spending is not the *overriding* determinant of growth; other factors account for a far greater proportion of the variation in growth rates than does military spending.

The lag effects are interesting: the amount of correlation rises as the lag increases. This indicates that the effects of contracts awarded in one year are felt over subsequent years, and not primarily in the initial contract year alone. Contracts awarded from 1977 to 1984 are more strongly correlated with growth from 1980 to 1986 than contracts awarded from 1977 to 1986 are correlated with growth from 1977 to 1986.

Table 1

Regression Results using Lag Variables

X = Location Quotient, Military Contracts
Y = Location Quotient, Regional Growth

Scenario	Constant	Standard Error of Y	X Coefficient	Standard Error of X	R squared	t-statistic	t Significance Level
Scenario 1:							
No Lag	0.74	0.63	0.38	0.13	0.15	2.92	p = .01
Contracts 1977-1986							
Growth 1977-1986							
Scenario 2:							
1-Year Lag	0.61	0.71	0.48	0.14	0.19	3.35	p = .01
Contracts 1977-1985							
Growth 1978-1986							
Scenario 3:							
2-Year Lag	0.53	0.76	0.53	0.15	0.20	3.47	p = .01
Contracts 1977-1984							
Growth 1979-1986							
Scenario 4:							
3-Year Lag	0.51	0.65	0.48	0.13	0.22	3.71	p = .001
Contracts 1977-1983							
Growth 1980-1986							

As stated previously, the problems with the prime contracting data serving as a proxy for military procurement spending give a strong caveat to an overinterpretation of these results. In statistical terms, all that has been shown is that the relationship between proportional gross product growth and a state's proportional share of prime contracts is significant but not strong. Work locations in states that differ from that of the main headquarters of the prime contractor, the significant amount of subcontracting that occurs and procurement spending by NASA and the Department of Energy add uncertainty to the picture. As stated previously, any biases resulting from these problems would tend to underestimate both the significance and size of the correlation between defense spending and regional growth. Since results were found to be highly significant, even with these biases in the data, the only question that remains is whether or not the size of the correlation is underestimated by these flaws. The significant question is whether subcontracting, out-of-state production, and procurement spending by other agencies could really change the pattern of spending enough to make the correlation much higher. Given the findings of Malecki (1984) and Karaska (1967) that subcontracting follows patterns similar to those of prime contracting, this seems unlikely. The test results reported here provide, therefore, a crude, but likely relatively accurate, measure of the extent to which defense procurement patterns explain differential rates of regional economic growth.

The results of this test can be compared with those reported by O'hUallachain (1987), who found a correlation of similar magnitude (r-squared = 0.27) and significance ($p = 0.001$) when he examined the effects of military production on manufacturing employment. It should be noted that O'hUallachain was able to correct for some of the subcontracting problems associated with the military spending variable by using data on state shipments to the Department of Defense. This data captures some of the effects of first-round subcontracting, but was available for only one year: 1983. However, this improvement in his independent variable is offset by some serious conceptual problems with the dependent variable.[8]

The similarity between the results found by O'hUallachain and those of the test reported here is rather remarkable, especially given the qualitative difference in using employment and gross product as dependent variables.

Both sets of results are consistent with those of Mehay and Solnick (1990), who tested the impact of defense spending on state economic growth between 1976 and 1985. In their multivariate analyses of determinants of growth in personal income and manufacturing employment, they found that Department of Defense investment outlays had a statistically significant effects.[9] However, because of their multivariate methodology, it is impossible to ascertain the relative contribution of this variable to their model.

In interpreting the strength of the correlation between military contracting and growth, it is important to consider that it would be highly unlikely for any one variable to be able to account for all of the variation in a complex phenomenon such as regional growth. Differential growth rates are likely to be accounted for by a myriad of factors, some quantifiable, others less so. In such a case, the r-squares found here, in the range of 0.15 to 0.22, could be subjectively viewed as relatively high, considering that few other variables are likely to explain as much of the variation in growth. Such an assertion is,

however, merely a subjective interpretation unless it is accompanied by a more thorough statistical examination of the importance of other factors.

Conclusion

This paper has given evidence regarding the relationship between military procurement spending and regional growth. These results, along with those of Bolton (1966), O'hUallachain (1987), and Mehay and Solnick (1990), support the overall theme of *The Rise of the Gunbelt* while suggesting that Markusen et al. overstate the gunbelt's significance as the one major cause of disparities in regional economic growth.

One of the reasons that defense spending may not contribute as much to regional growth as might be expected could be related to multiplier effects. Because of Pentagon bureaucracy, an emphasis on secrecy, diversion of skilled employees from other sectors, and relatively high salary levels, it may be that military spending does not ripple through the economy to the extent that other types of spending do, and that fewer jobs are created per dollar of military spending than other types of investment. By raising the wage levels and competing for skilled workers, military contracting might actually inhibit other types of industry from expanding in an area.

With 15 to 22 percent of the variation in regional growth explained, it is clear that the empirical data indicate that military procurement spending explains only a fraction of the variation in regional growth between 1977 and 1986. Markusen et al. have identified an important factor that has contributed to the enormous changes in the industrial geography of the United States in recent years, but it is only one factor. There are likely to be many people who would prefer to ignore the significance of this politically charged sector of the economy entirely. Markusen et al. present a fine description of the geography of military procurement, but by not presenting any empirical evidence regarding its significance, *The Rise of the Gunbelt* allows these doubters to continue to ignore the importance of this spending. Skeptics could easily dismiss the work of Markusen et al. as mere anecdote and unsupported hyperbole. This would be a shame. This paper has shown that there is indeed support for a more qualified version of the *Gunbelt*'s thesis, and to have the work dismissed would impede, rather than further advance, the goal of understanding the causes of regional economic shifts in the U.S. While Markusen et al. have drawn attention to a conspicuously underexamined cause of these shifts, their work would have been far stronger had they systematically investigated the empirical significance of the gunbelt phenomenon whose other characteristics they describe so well.

NOTES

[1]Markusen et al. indicate that during other periods, such as the Korean and Vietnam War eras, procurement was less heavily skewed towards gunbelt areas because of the need for the types of basic armaments supplied by plants in the industrial heartland, as opposed to the more high-tech missile and space systems in which gunbelt states tend to specialize.

[2]Bolton uses the term "exogenous" to refer to those sectors that comprise a state's export base, as per economic base theory.

[3]It should be noted that Markusen et al. actually cite these results of Bolton's, though they confuse the results for some states and regions, and misreport which specific

areas had their "growth greatly stimulated" or "growth moderately stimulated." The majority of these discrepancies were in support of their thesis.

[4]It should be mentioned, however, that information on *total* federal government procurement is available by MSA, and that if this could be adjusted to reflect only military procurement, then tests using this data would undoubtedly be superior to those reported here.

[5]Additionally, Bolton (1966) examined income effects while O'hUallachain (1987) examined employment effects, leaving gross product effects the one major area as yet unexamined. The gross state product data are published by the Department of Commerce's Bureau of Economic Analysis. Figures used for this study were obtained in computer-readable form from the Regional Research Institute at West Virginia University.

[6]Some researchers use the deflator for government purchases for this purpose, but it was not clear that defense dollars are subject to this type of inflationary pressure in the local economies in which they are spent. The consumer price index and the GNP deflator did not seem perfectly appropriate either.

[7]Originally, a state's average share of GNP over the entire period in question was used as the denominator in calculating both the location quotients, but some concerns arose over this formulation. Since the hypothesis being tested predicts that a state's share of GNP will increase if it has disproportionately high amounts of military spending, the average share of GNP will be skewed upwards by this increase. Since the denominator is therefore larger, the importance of military spending is underestimated. Thus, the second versions of the location quotients were calculated, using as the denominator the state's share of GNP in the *initial* year only. Results of the regression analyses showed slightly improved correlation and significance in each of the four lag scenarios, when the location quotient variables were calculated using this initial-year share approach (average increase in r-squared < .03). Since correlation is slightly higher with the initial-year formulation, it is this formulation that is presented in the text. Data and results using the entire period GNP share formulation are available from the author.

[8]As his dependent variable, O'hUallachain uses the percentage growth in manufacturing employment for the period 1977-1984. This variable is flawed in two ways. First, it is hard to see how military production in 1983 could be expected to impact growth in manufacturing employment in earlier years. While O'hUallachain does not draw attention to this discrepancy in time periods, he does support himself somewhat by asserting that locational patterns of production did not change much between 1977 and 1984. The second problem relates to the well-known difficulties associated with using growth rates that can fluctuate significantly when derived from a small initial base, such as that found in states with smaller manufacturing sectors.

[9]Their DOD investment variable included spending related to prime contract procurement, research and development, and military construction. According to Mehay and Solnick, procurement spending accounts for almost 78 percent of this variable (p. 485). They also tested a DOD operations and maintenance variable which largely measured the effects of DOD payroll and found it to be less significant. Mehay and Solnick used three specific model types in order to correct for problems such as serial correlation and heteroscedasticity. They assert that the Parks model provides the best estimates. Their OLS and covariance models do not find a statistically satisfactory level of signifiance for the DOD investment variable.

REFERENCES

Bolton, Roger E. 1966. *Defense Purchases and Regional Growth.* Washington, D.C.: The Brookings Institution.

Karaska, Gerald. 1967. "The Spatial Impacts of Defense-Space Procurement: An Analysis of Subcontracting Patterns in the United States." *Peace Research Society Papers.* 8: 108-22.

Malecki, Edward J. 1984. "Military Spending and the U.S. Defense Industry: Regional Patterns of Military Contracts and Subcontracts." *Environment and Planning C: Government and Policy.* 2: 31-44.

Markusen, Ann, Peter Hall, Scott Campbell, and Sabina Deitrick. 1991. *The Rise of the Gunbelt*. New York: Oxford University Press.

Mehay, Stephen L., and Loren M. Solnick. 1990. "Defense Spending and State Economic Growth." *Journal of Regional Science*. 30: 477-487.

O'hUallachain, Breandan. 1987 "Regional and Technological Implications of the Recent Growth in American Defense Spending." *Annals of the Association of American Geographers* 72: 208-23.