Trends in Military Allocations Since 1816:
What Goes Up Does Not Always Come Down

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In a world of economic scarcity and political insecurity, nations face difficult policy choices. One such dilemma is deciding what portion of their resources should be devoted to national defense. Although allocating resources to the military can have detrimental effects on national economies,[1] nations must maintain some level of military preparedness in order to protect themselves against possible external attack.

Military spending and the size of standing armies among major powers have increased greatly, beginning with the Congress of Vienna in 1816. In the absence of comparable increases in economic and population resources during this period (1816-1980), these increases in military expenditures seem to represent a disturbing trend toward greater militarization among the world's most powerful nations. If the growth rate in resource availability has corresponded to (or exceeded) that in military allocations, however, we might view the rise in the latter as a "natural" outcome of national economic development.

In this study, which will chart the evolution of military allocations

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of nations in the modern state era from the early 1800s to the present, we hope to determine if current levels are proportionately greater (relative to resource capability) than in previous epochs.

We have limited the scope of our study to "major power" nations, covering the period from the Congress of Vienna to 1980. Major powers, by far, account for the greatest amount of resources, worldwide, devoted to the military; they usually do not receive foreign military aid to alleviate domestic resource constraints.[2] These nations and their dates of membership as major powers are listed in Table 1.[3]

(We did not include the World War I and II years due to the difficulty of measuring military allocations during these periods. It is virtually impossible to isolate the resources devoted to the military during a "world war" because entire societies may be mobilized for the war effort.)

Indicators of Allocations and Resources

A nation appears to utilize two kinds of economic resources in supplying its military establishment: human and capital. Drawing from its population, a nation allocates manpower to its military. In measuring this allocation, it is desirable to incorporate all workers associated with weapons production and military supply, as well as the basic soldier. Since this information is not available nor easily discerned, however, we must use only the number of regular service personnel on active duty as an indicator of human resources allocated to the military. The active duty personnel will be compared to a nation's total population, the latter serving to indicate the gross population resources available to a state.

Table 1

Major Powers 1816 - 1980

Nation	Years as a Major Power
United States	1899 - 1980
Russia/USSR	1816 - 1917; 1922 - 1980
France	1816 - 1940; 1945 - 1980
United Kingdom	1816 - 1980
Prussia/Germany	1816 - 1918; 1925 - 1945
Austria/Hungary	1816 - 1918
Italy	1860 - 1943
China	1950 - 1980
Japan	1895 - 1945

To indicate capital allocations to the military, we use the obvious indicator of military expenditures. We recognize their inherent limitations, but we believe that there are satisfactory solutions to the problems of accuracy and comparability.[4] Our military expenditure figures have been adjusted for yearly price fluctuations and converted to a common currency. They were measured in British sterling from 1816 to 1919 and U.S. dollars thereafter. Because we are only interested in the basic trend, we use the exchange rate of $4 per pound sterling to ensure comparability over the whole period. Given the current alternatives, we believe that military expenditures are the best available indicator of resources devoted to the armed forces.

Finding an indicator of a nation's capital resource base is more problematic. The most conventional approaches have used gross national product (GNP) or government budgets to measure a nation's financial resources,[5] but we have serious reservations about either approach. First, national budgets are not sufficiently comparable, given the great range of items found in several types of economies. Socialist economies—as opposed to market economies—tend to channel a greater share of their resources through governmental budgets, thereby making the former's military allocations appear smaller than those in which the governmental role is more modest. Reliable annual estimates of GNP date back only to the inception of Keynesian economics (insufficient for a longitudinal study of this kind), and a high GNP based on a large service sector may give a false indication of the resources that can be converted for military purposes.

We felt that an indicator of industrial capability would provide greater comparability across time as well as across different economic systems. As is the case for our military and demographic data, we utilize the Correlates of War Project as our source on industrial capability. We draw on a fairly complete and apparently reliable set of data on iron-and-steel production since 1816 and energy consumption since 1860; combining these two indicators, we believe, makes a reasonably valid indicator of a nation's capital resource base. Thus, military expenditure levels will be compared to the industrial indicators, with special attention to changes over time.

We ran initial regression analyses for each major power during its tenure in that subsystem to test the assumption that a nation's military allocations are, largely, a function of its resource base. We first regressed military personnel on total population, believing that the number of military personnel in a state depends on the number available for military service, as well as the number that need protection by that service.[6]

An overall R^2 of .84 confirms our assumption that total population is a good predictor of manpower levels in a nation's military.

In two other regressions, military expenditures, instead of military personnel, are the "outcome" variable; iron-and-steel production and energy consumption serve as the separate "predictor" variables. Separate regressions were conducted for each dependent variable because of the problems associated with multicollinearity (r=.91). We reasoned that the size of a nation's military sector is influenced by its capacity to produce weapons and supply its troops, and the R^2 values (iron-and-steel=.73 and energy=.67) are once again consistent with our postulate.[7]

Having apparently established a link between a nation's resource base and its military allocations, we looked for changes in that relationship over time. Our regression analyses were stratified by four historical epochs: 1816–1860, 1861–1914, 1919–1939, and 1945–1980. Each of the four regression lines defines the "normal" pattern of military allocation (vis-à-vis resource capability) for its respective period. By looking at the differences between the lines, we can identify important

Table 2

Parameter Values for Various Military Allocation Ratios

EPOCHS	INTERCEPT	SLOPE
Personnel		
Total Population		
1816 - 1860	-109.0	.014
1861 - 1914	137.0	.006
1919 - 1939	153.0	.004
1945 - 1980	1387.7	.003
Expenditures		
Energy Consumption		
1816 - 1860	*	*
1861 - 1914	88,792	.44
1919 - 1939	675,160	.53
1945 - 1980	5,273,400	37.30
Iron/Steel Production		
1816 - 1860	33,972	21.20
1861 - 1914	90,072	7.80
1919 - 1939	573,870	18.20
1945 - 1980	998,550	627.60

*Data unavailable for the years 1816-1860.

changes in the normal military allocation over the 165-year period.

We are concerned with changes both in the slope and the intercept of the regression lines. An increase in the intercept from one epoch to the next can mean an increase in the minimum size of an army or the minimum military expenditure; in other words, the military allocation of a major power controlling for its available resources. Increases in the slope over time signify that a state is allocating more proportionately to its military, as its resource base grows, than it did in the past. For example, whereas 100 units of economic growth once might have led to 10 units of military allocation, the same 100 units now could lead to 30 additional units of such allocation. That is, new resources are increasingly being channeled into military endeavors when compared with previous eras.

Results

As shown in Table 2, the slope for military personnel allocations decreases slightly, while the intercept increases over time. This demonstrates that the minimum size of an "average" major power's army is increasing, but the army's size does not increase relative to the population as much as previously. Major powers now are more likely to keep substantial numbers of men under arms (witness the large force of NATO and Warsaw Pact troops stationed in Europe) with only minor adjustments for national demographic changes.

Although the size of armies is less sensitive to population differences, major powers are still putting a greater percentage of their men under arms than ever before. Since 1945, there has been a substantial increase in military personnel among major powers. Table 3 shows military personnel as a percentage of total population for each of the epochs.

Table 3

Military Personnel as a Percentage of Total Population for Major Powers, 1816-1980

Epochs	Military Personnel/ Total Population
1816-1860	.97%
1861-1914	.94
1919-1939	.72
1945-1980	1.23

Collectively, these results illustrate that nations now allocate more human resources to their military than in previous eras. Yet, large standing armies are currently maintained by all major powers (regardless of population size), replacing a strategy of reserve mobilization.

Turning to military expenditures, we find a clear "ratchet" effect upward. The increasing values of the intercepts indicate that the minimum economic allocation to the military is increasing. The slope values reveal that over the past 165 years, nations accelerated their allocations to the military as new resources became available. The increasing slope values indicate that the difference in military expenditures among different-sized powers is increasing over time, suggesting a major-power subsystem that is increasingly differentiated, as well as more militarized. For example, the slope and intercept from the iron-and-steel production regression have increased by a factor of almost 30 since the first epoch. In effect, military allocations have skyrocketed above the growth rate in economic production.

These results demonstrate that major powers are allocating proportionately more of their economic resources to their militaries than predecessors in earlier historical epochs. Capital allocations have increased at a greater rate than human resource allocations. These findings can be explained in a number of ways.

Some Possible Interpretations

It is all but impossible from this brief analysis to determine the underlying causes of the tremendous increase in military allocations among major powers. To fully analyze the possible causes is beyond the scope of a single study. Nevertheless, it is worthwhile to discuss a few interpretations and offer a preliminary evaluation of each.

The case for the ratchet effect is blurred because the dependent variable is money, and inflation may account for the apparent rise of military allocations over time. Surely, some of the increases in military spending can be accounted for by inflation, but its effect on defense spending is not uniform, frequently exercising little impact on military allocation increases.[8] To remove the influence of inflation, we ran regression analyses using a nation's percentage of major-power system totals for each variable, instead of the raw values. This technique controls for any problems peculiar to the monetary measure. The patterns found with the raw data were replicated with the percentage shares. Although not increasing by a factor of 30 over 165 years, allocations to the military are still 5 or 6 times greater (relative to resource capability) now than

in 1816, using indicators controlled for inflation. Based on this analysis, our findings cannot be completely dismissed as an artifact of our measure of capital allocations to the military.

A popular explanation of increases in government allocations for a wide variety of areas is bureaucratic incrementalism. Accordingly, we would expect slow, but consistent, increases in military allocations over the 165-year period. This pattern was not evident in any of our preliminary analyses. We ran regressions for 5-year blocks in each of the four epochs. The slopes and intercepts were generally close to those for the whole epoch, suggesting that incrementalism was not a factor. While the need for more sensitive, empirical tests is obvious, we believe the incrementalist explanation is ill-applied historically to nations that lack a sophisticated government apparatus, particularly nineteenth century Europe. Incrementalism, however, may help account for some increase in military allocation that occurred after the Second World War. Similar explanations, such as those based on military-industrial linkages, would seem to have the same limited applicability in accounting for this historical trend.

A Marxist interpretation would argue that the growth of capitalism carries with it an accompanying growth in military allocations, primarily for the pursuit of imperialism. Thus, their rise is seen as an outgrowth of the capitalist development of major powers. There is some evidence that increased military allocations accompany an expansion of overseas markets,[9] but most studies do not find a wide-ranging effect.[10] Furthermore, the Soviet Union exhibits the same pattern of rising military allocations as its capitalist counterparts.

In another plausible interpretation of our results, it is important to note that World Wars I and II were periods of dramatic increases in military spending and the base size of armies.[11] We ran regressions for the five years before and after the breaks between epochs. In most cases, there was an upward jump of at least 100 percent in the values of the slope and the intercept. Although wartime inflation can account for some of this increase, it cannot explain increases of this magnitude, nor in the size of armies.[12] The tremendous defense burdens acquired during a war are apparently not fully shed once the war is terminated. In most cases, military allocations decline in the first few years following a war, but they never return to prewar levels. States may become accustomed to a wartime economy and continue after hostilities cease with some military production still in operation.

Beyond the immediate effects of major-power war on military allocations, much broader long-term forces are evident: the development of

technology and alterations of military strategy, particularly notable after the Second World War. Nations apparently no longer rely on large-scale troop mobilization to prepare for war, but rather maintain sizable standing armies instead (witness the tremendous value of the intercept in the most recent epoch). The mission of the military has been redefined from war-making to deterrence or peacekeeping.[13] Consequently, large numbers of available troops (regardless of the population of the nation) are required to fulfill this mission.

The change in emphasis over the last 150 years from manpower to weapons technology is indicated by the *de*creasing slopes of the personnel allocation indicator and the *in*creasing slopes for the spending indicator. The advent of nuclear weapons and other qualitative improvements in weaponry have contributed to this changeover. Success in combat between major powers has become more dependent on weaponry than sheer manpower. In particular, control of airspace has been critical in warfare, providing a new method of attack and functioning as a necessary condition for control of the ground.[14] Control of airspace, of course, is accomplished by superiority in aviation technology, pilot skill, and a numerical advantage in aircraft, not by manpower. Accordingly, new economic resources are being channeled into weapons development and procurement, rather than numerical increases in troop strength. Races for technological superiority also generate a more protracted and expensive competition. One might hypothesize that the competition in military manpower has more natural bounds (e.g., food, transport, logistics, etc.), whereas the number of missiles and warheads seems unlimited.

More than merely affecting the motives for military competition, the growth of technology may have altered the scope of the resource allocation required to equip and maintain a nation's military establishment. "Instead of equipping the man, we now man the equipment."[15] Highly sophisticated missile systems and submarines require more resources in their development and maintenance than equipment for a foot soldier or even a tank. As the technological development of weaponry has progressed, so too have the quantitative resource prerequisites for its support.

Summary and Conclusions

In analyzing the trends in major-power military allocations from 1816 to 1980, we found that while the base size of national armies was increasing, new population resources were channeled less and less into

military manpower. A ratchet effect upward in capital allocations to the military across four different historical epochs was evident. Minimum economic allocations to the military rose along with the proportion of new resources, stemming from the growth of a nation's industrial base.

Overall, there are proportionately (26.8%) more military personnel (relative to total population) among major powers now than in 1816, and economic growth currently produces almost 30-fold the military allocations of 165 years ago. Thus, military allocations (relative to resource capability) have increased since the Congress of Vienna, with most coming in the last 40 years and in the capital-intensive areas of the military.

A large portion of the increase can be explained by inflation. Rather than a 3000 percent increase in capital allocations, it is more on the order of 500 percent or 600 percent, when controlled for inflation. This rise is not easily explained by reference to an incrementalist or a Marxist model. It is clear, however, that participation in the two world wars led major powers to retain part of their wartime defense burden long after the conflicts had terminated. The resultant impact raised military allocations at least 100 percent, less an allowance for inflation during the war years.

Technological changes are the likely cause of the remaining increase in allocations and the shift from a labor-intensive to a capital-intensive military establishment. Control of airspace has become a prerequisite for success in combat, thereby decreasing the importance of ground troops. The reliance on nuclear weapons systems, instead of manpower, has led armament competition to be more intense and protracted, also resulting in larger military appropriations. Sophisticated weapons systems require more resources in development and maintenance than the equipment of a foot soldier.

A change in the military's mission, from war-making to peacekeeping and deterrence, has led all major powers to maintain large standing armies. Yet, because of the shift from labor- to capital-intensive warfare, new economic resources are increasingly being diverted from quantitative troop improvements.

According to the findings, therefore, major powers are devoting proportionately more of their capital economic resources to our militaries than ever before. A next step should be to more closely evaluate whether such increased military allocations have made the world more secure and whether they yield benefits for national and world economies. If not, we might begin to reevaluate the structure and strategies of major-power military establishments.

Notes

1. The effect of military spending on a nation's economy has long been a controversial issue. An early study, Bruce Russett, *What Price Vigilance?: The Burdens of National Defense* (New Haven: Yale University Press, 1970), described the negative effects that military spending has on capital investment and employment. Similar findings are contained in Center for Defense Information, "Jobs and the Pentagon: Is Military Spending Good for the Economy?" *The Defense Monitor* (September-October 1977). Nevertheless, other works have claimed that defense spending can have a positive impact on economic growth; see Emile Benoit, *Defense and Economic Growth in Developing Countries* (Lexington, Mass.: Lexington Books, 1973); and Gavin Kennedy, *The Military in the Third World* (London: Duckworth, 1974). These two works, however, are open to criticism with respect to their assumptions and methodologies. A reanalysis of these studies arrives at an opposite conclusion; see Saadet Deger and Ron Smith, "Military Expenditure and Growth in Less Developed Countries," *Journal of Conflict Resolution* 27, 2 (1983): pp. 335-353.

   Recent work gives an equally ambiguous picture of military spending and the economy; see Robert DeGrasse, Jr., *Military Expansion, Economic Decline* (New York: Council on Economic Priorities, 1983); and P.C. Fredericksen and Robert Looney, "Defense Expenditures and Economic Growth in Developing Countries," *Armed Forces and Society* 9, 4 (1983): pp. 633-645. Overall, it appears that defense spending can have detrimental effects on a nation's economy, but they are neither uniform nor necessary. For a review of this issue and others related to military spending, see Miles Wolpin, "Comparative Perspectives on Militarization, Repression, and Social Welfare," *Journal of Peace Research* 20, 2 (1983): pp. 129-156.

2. One exception to this may be the NATO Alliance, which has allowed Great Britain (and previously France) to carry a much lower defense burden than the United States.

3. The list of major powers is taken from Melvin Small and J. David Singer, *Resort to Arms: International and Civil Wars, 1816-1980* (Beverly Hills, Calif.: Sage Publications, 1982).

4. All data in this study are derived from the Correlates of War Project, a data-based research group housed at the University of Michigan and dedicated to the investigation of the conditions associated with the outbreak of war. Staff members have gathered data on all nations (including economic, demographic, and industrial), as well as on all international and civil wars, since 1816. (Additional information is available from J. David Singer, Director, Correlates of War Project, University of Michigan, Ann Arbor, MI 48109.)

   An analysis of the issues involved in measuring military expenditures and the other indicators used in this study is presented in the forthcoming Correlates of War Project coder's manual on national capabilities.

5. For example, see Erich Weede, "National Position in World Politics and Military Allocation Ratios in the 1950s and 1960s," *Jerusalem Journal of International Relations* 2, 3 (1977): pp. 63-80; Rudolph Rummel, *The Dimensions of Nations* (Beverly Hills, Calif.: Sage Publications, 1972); Alan Newcombe and James Wert, "The Use of an Inter-Nation Tensiometer for the Prediction of War," *Peace Science Society (International) Papers* 21 (1973): pp. 73-83.

6. The relationship of military personnel to total population and the conditions that make for an optimal percentage of men under arms were first explored by Stanislav

Andreski, *Military Organization and Society* (Berkeley: University of California Press, 1968). For more recent work on how population resources affect military personnel, see, for example, David K. Whynes, *The Economics of Third World Military Expenditure* (Austin, Tex.: University of Texas Press, 1979); and Gilbert Kutscher, "The Impact of Population Development on Military Manpower Problems," *Armed Forces and Society* 9, 2 (1983): pp. 265-274.

7. The results for each major power did not differ significantly from the aggregate results reported here.
8. See Harvey Starr et al., "The Relationship Between Defense Spending and Inflation," *Journal of Conflict Resolution* 28, 1 (1984): pp. 103-122.
9. See Nazli Choucri and Robert North, *Nations in Conflict* (San Francisco: W.H. Freeman and Co., 1975).
10. The Marxist interpretation is investigated in Clark Nardinelli and Gary Ackerman, "Defense Expenditures and the Survival of American Capitalism," *Armed Forces and Society* 3, 1 (1976): pp. 13-16; and Ron Smith, "Military Expenditure and Capitalism," *Cambridge Journal of Economics* 1 (1977): pp. 61-76.
11. Russett, *What Price Vigilance?* discovers the same phenomenon in his study of U.S. military allocations.
12. Inflation in U.S. dollars (the currency of measurement here) was 13 percent per year during World War I and only 5 percent or 6 percent per year during World War II, according to First National City Bank of New York, *Monthly Economic Letter* (December 1969): p. 140.
13. For elaboration on this point, see Morris Janowitz, "Toward a Redefinition of Strategy in International Relations," *World Politics* 26: pp. 471-508. Discussion of the decline in the significance of military manpower is found in Morris Janowitz, "Volunteer Armed Forces and Military Purpose," *Military Review* 52, 7 (1972): pp. 15-22; and Catherine Kelleher, "Mass Armies in the 1970s: The Debate in Western Europe," *Armed Forces and Society* 5, 1 (1978): pp. 3-30.
14. This point and others related to mass armies are summarized in the first chapter of Jerald Bachman, John Blair, and David R. Segal, *The All-Volunteer Force, A Study of Ideology in the Military* (Ann Arbor: University of Michigan Press, 1977).
15. David R. Segal, "Military Organization and Personnel Accession: What Changed with the AVF...and What Didn't," in *Conscripts and Volunteers*, ed. Robert Fullinwider (Totowa, N.J.: Rowman and Allanheld, 1983), p. 17.

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