

Formulas for Estimating the Costs of War

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Synopsis: This paper presents a set of formulas for predicting the costs of war, based on the historical experience of the U. S. war efforts in Iraq (2003 - 2011) and Afghanistan (2001 - present). It concludes with an observation regarding the cost of any potential war against Iran.

We are all familiar with the wartime rhetoric of the early 2000's, when some prominent politicians and bureaucrats confidently predicted that the wars in Afghanistan and Iraq could be concluded quickly and with nominal monetary cost and sacrifices of lives. We are now a decade past those false rosy predictions, with one war concluded and the other to be concluded in a year or so. The costs and durations far exceeded what the politicians and bureaucrats predicted. With this history in mind, this paper presents some basic data-fit formulas that describe the nature of those two wars. The formulas are restricted to an analysis of the monetary costs of those two conflicts, and are subsequently used to estimate the character of a possible future conflict, should the politicians choose it.

The monetary costs of war generally fall into six categories: a) the direct monetary outlays for the military during the war; b) the costs of caring for the wounded and injured for the remainder of their lives; c) covert enterprises executed by the professional criminal class in the enemy nation against the enemy nation (that is, financing their traitors); d) bribes to foreign governments and officials to either assist our effort or deter them from aiding our enemy; e) domestic security measures to prevent infiltration, sabotage, and espionage; and f) the long-term costs of interest if any of the preceding categories are financed by borrowing rather than current-year taxation.

The following analysis is based on the facts and figures arising from the two recent wars in Iraq and Afghanistan. In both these cases, the U. S. military and its allies found it necessary to both defeat the enemy and establish sufficient presence in the country to prevent insurgencies or counterattacks. One of the failures of the war in Iraq was that such an insurgency stalled the American effort for two years until sufficient reinforcements were deployed in 2006. This analysis is based upon two very simple premises. First, the cost of war is related to the number of enemy fighters that can be deployed, which in turn depends on its overall population. Secondly, given the necessity to occupy, control, or at least influence the country's area, the cost should be related to land area. The population of Iraq is 30,400,000, it has a land area of 438,000 sq. km, and the war there lasted 8 years and 9 months. Similarly, the population of Afghanistan is 28,100,000 and occupies a land area of 652,000 sq. km; that war, when concluded, will have lasted 11 years. After some experimentation, an exceedingly simple model for the duration based on population and area became:

$$D = x\sqrt{PA} \quad (1)$$

where D is duration in years, P is population in total persons, A is area in sq km, and x is a single constant that fits the data for Iraq and Afghanistan. The question is -- does such a simple factor as x exist that applies to both wars? It turns out that it does: using the above statistics for population, area, and war duration for both nations, eqn. (1) can be solved for x; it turns out to be 2.4E-6 for Iraq, and 2.56E-6 for Afghanistan. For simplicity, we will use the average, ~ 2.5E-06. We have then, a simple approximate fit for the duration of both wars:

$$D = 2.5 \times 10^{-6} \sqrt{PA} . \quad (2)$$

As a check, this formula leads to 9.07 years for Iraq, and 10.7 years for Afghanistan (close enough). Keep in mind that the duration is an artifact of how these two wars were conducted: extensive use of the reserve (National Guard) units rather than a suitably large regular army and air force. The model would fail in any future conflict for which general conscription was employed to maximize the forces in the field, thus reducing the duration necessary to achieve the objectives. We have seen in the past two wars that both the regular forces and reserves were stretched very thin. This was a consequence of a reluctance to impose a draft system, and there was no popular call or motivation for expansion of the volunteer military beyond its configuration in 2001. Secretary of Defense Donald Rumsfeld (under President G. W. Bush) preferred to use as small a force as possible, which did not require an expansion of the regular forces; that policy has been continued under President Obama.

Brown University has published a study [1] in which they noted that the monetary outlays for the Iraq and Afghanistan wars were \$802.1 B and \$512.8 B respectively. On the other hand, the Congressional Budget Office has published respective figures of \$709 B and \$591 B. Since we are interested in an approximation, we shall simply average the two respective sets of figures, and arrive at total costs of \$755 B and \$551 B for Iraq and Afghanistan respectively.

It turns out that a formula for costs is not as simple as for duration. To make the model work, it is necessary to introduce a “complexity factor” that accounts for the fundamental differences between the two wars. First, Afghanistan is, and continues to be, a feuding tribal society with a very weak central authority. Even under Taliban rule, the national government, such as it was, did not have an effective command-and-control mechanism. Iraq, on the other hand, had a reasonably effective command system. Secondly, the enemy in Afghanistan was materially assisted by Pakistan, although the Taliban and al-Qaeda remained a loose confederation of small units fighting a guerilla war. In Iraq, the enemy was materially assisted throughout by Iran, which provided a fair amount of technological expertise for the small bombs placed on roads. Third, neither Iraq nor Afghanistan had a significant naval presence, and the U. S. effort could therefore be limited to ground and air forces. Fourth, Iraq is a nation with a reasonably well-educated population and has a fairly sophisticated technological base that the enemy could draw upon. The enemy in Afghanistan did not have these advantages (in fact the enemy in Afghanistan prided itself on keeping the nation in medieval conditions). Fifth, although the Afghan people disagreed among themselves as to the benefits of the Taliban government, they were nonetheless united in their resentment against invasion by foreigners. On the other hand, the invasion of Iraq was aided by the willingness of the Kurds in the Northern Alliance to participate in an open rebellion against the Iraqi government. Sixth, Iraq had an experienced professional military that often aided the enemy after their defeat and dissolution by the U. S. military; Afghanistan did not have a professional military establishment per se. Seventh, no other significant nation interceded directly with troops or equipment on behalf of either Iraq or Afghanistan against U. S. forces.

Without recounting the trial and error that went into its development, I will simply present the cost model and show how it works. The average cost per year (driven partly by the availability of personnel and equipment as noted above) is:

$$C_A = 11780g\sqrt{PA} \quad (3)$$

where C_A is the average annual cost in dollars, g is the “complexity factor”, P is population in persons, and A is area in sq. km as before. The complexity factor g is given by:

$$g = \frac{\sum f}{2} \quad (4)$$

where f is a parameter describing the general attributes of the enemy. The value of f is always an integer, incrementing by one for each of the following factors of the opposing nation: a) a central command and control system; b) a viable navy; c) technological ability; d) material assistance by a significant ally; e) active involvement with military forces by a significant ally; f) a unified national culture in opposition to U. S. forces; and g) the existence of a professional military establishment. For the Iraq war, $f = 4$ (command and control, technological ability, material assistance, and a professional military) and for Afghanistan, $f = 2$ (material assistance by an ally and a unified national culture). Then, for the Iraq war, the value of g is 2, and we arrive at the formula:

$$C_A = (2.0)(11780)\sqrt{PA}. \quad (5)$$

If we plug in the values for Iraq's population and area, a figure of $8.55E+10$ prevails, which is \$85.5 B annually. For the 9.07 years per the model above, we obtain \$775.8 B, a reasonable approximation to the \$755 B cited previously. Repeating the process for Afghanistan, we have $f = 2$ and hence $g = 1$. The annual cost in dollars for the war in Afghanistan per the model is:

$$C_A = 11780\sqrt{PA}, \quad (6)$$

and substituting the appropriate values for Afghanistan's area and population, obtain \$50.4 B annual cost, which for 10.7 years per the model above, leads to a total cost of \$539.5 B, a reasonable estimate to the \$551 B cited above.

Combining eqn. (2) for the duration and eqn. (3) for the annual cost, the formula for the total cost is:

$$C_T = 0.02945gPA \quad (7)$$

where C_T is the total cost in dollars, g is given by eqn. (4), A is area in sq. km, and P is total population in persons. This model excludes monetary inflation.

There is some talk about a war against Iran over its nuclear program. If this model is correct, and if such a war were to be conducted in the same manner as the wars against Iraq and Afghanistan, the costs become very large. Assuming Iran would obtain material support from either Russia or China, and given that Iran has a fairly high technological level, a solid command-and-control system, a viable navy, a unified national culture, and a professional military, it is easy to see that the parameter f is 6 and the complexity factor g is 3. Iran's population is 74.1 million and its area is 1,628,000 sq km. From eqn. (7), we have then:

$$C_T = (0.02945)(3.0)(74.1 \times 10^6)(1.628 \times 10^6) = \$10723 \text{ B} = \$10.72 \text{ T}. \quad (8)$$

This is clearly an impractical number. I do not claim that it is an accurate cost prediction. The important point is that if this crude model is even plausible, it indicates that the potential total cost of a war against Iran is very high if done in the same way as the wars against Iraq and Afghanistan -- probably unaffordable. The only rational cause for a potential expense this large would be if Iran were to pose an existential threat to the U. S.

If the politicians desire a war against Iran, it is practical only if the "complexity factor" g is reduced to a small number, such as 1.0 or 1.5. There are a few possible scenarios by which that could be accom-

plished. First, a U. S. alliance with Russia and China against Iran; second, an attack against Iran's client states and organizations (Syria, Lebanon, and Hamas/Hezbollah) in conjunction with a naval war, blockade, and containment of Iran proper; third, an internal rebellion within the Iranian military to ruin the command and control system while finding a diplomatic way to keep China and Russia on the sidelines; or fourth, manipulation of economic conditions sufficient to produce an internal popular revolt while keeping Russia and China from intervening. There are doubtless many others as well, and I have excluded interested parties such as Israel willing to aid the U. S. In any case, if the politicians choose a war against Iran, it seems likely that it will have to be fought in a very different manner, and with much different planning, than the ones against Iraq and Afghanistan.

As mentioned earlier, there are other costs besides direct outlays. From the history of the Afghanistan and Iraq wars, the total cost, spread over 40 years, to care for the wounded and disabled veterans and benefits to veterans in general is about 60% of the total direct costs incurred during the war [1]. For these two wars, these post-war personnel costs between now and 2050 will be approximately \$750 B. The cost of payoffs to foreign entities to sway their involvement is difficult to estimate since so much of it must be kept secret until well after hostilities have ended. Domestic security costs are also difficult to predict. After the 11 Sep 2001 attack, the Department of Homeland Security (DHS) was created and funded at a total cost of \$400 B over the past ten years (some of which would have occurred anyway, since DHS is a combination of organizations that already existed). It is unlikely that such a large expense would have to be duplicated in a future war, unless the enemy finds a way to subject the U. S. population to attacks on a scale beyond small bombs planted in pizza parlors.

[1] Catherine Lutz and Neta Crawford, co-directors of the Eisenhower Research Project at Brown University, led a study to determine the overall costs of both wars. Their results are posted at www.costsofwar.org.