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The Mortality Cost Metric for the Costs of War

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Abstract:

Estimates of the costs of war include the financial costs and the lives that are lost. Using estimates of the value of a statistical life and the value of a statistical injury, the health losses can be converted to a common monetary metric and added to the budgetary costs. Counting the monetary value of the direct war-related fatalities and injuries plays a relatively greater role for the Vietnam War than for the Iraq and Afghanistan conflicts. This article proposes an alternative war cost metric that also recognizes the lives that are also lost because economic resources are diverted to war efforts. All costs are converted to mortality costs using a measure of the mortality opportunity cost to the public of war-related expenditures. Recognition of these indirect mortality effects approximately triples the number of fatalities attributable to the post-9/11 wars. The relative role of these indirect mortality losses is less for the Vietnam War because of that war's higher rate of fatalities compared to financial costs.

Keywords: mortality risk, opportunity cost, value of a statistical life, war

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1 Introduction

Economic estimates of the costs of war have demonstrated that in monetary terms these costs are often quite substantial. Stiglitz and Bilmes (2008) concluded that the war in Iraq cost \$3 trillion after taking into account all of the economic impacts, such as veterans' disability costs and the interest on debt and borrowing.¹ A more recent assessment by Crawford (2017) of the post-9/11 wars found that the economic cost for the post-9/11 efforts had reached \$5.6 trillion. Accompanying the financial costs are the lives that have been lost.² The number of US military who have been killed in the post-9/11 conflicts is substantial but remains under 7000. There are also other health-related consequences, such as medical care and disability payment costs, many of which have been factored in to the estimates above. These health costs play a prominent role for all US wars from the Revolutionary War to the Iraq and Afghanistan conflicts (Edwards, 2014).

Although not all estimates of the costs of war fully account for the economic value of the lives lost, recent studies have recognized the economic value of these losses. The assessment of the cost of the Iraq and Afghanistan wars by Stiglitz and Bilmes (2008) and the multi-war analysis by Edwards (2014) monetized the lives that were lost using economic estimates of the value of a statistical life (VSL). Multiplying the number of lives lost by the VSL converts the lives lost into a monetary equivalent that can be added to the financial cost of the wars to calculate a more comprehensive monetary cost metric for the cost of war. Recognizing the financial value of these human losses adds a modest amount of financial costs to assessments for the Iraq and Afghanistan wars, but has a greater relative impact for the Vietnam War for which the number of military casualties was much greater.

The approach I introduce here is to use the total mortality cost rather than the financial cost as the numeraire for assessing the cost of wars. Instead of converting lives lost into dollars, I convert the war-related financial costs into lives that are lost because of the mortality-related opportunity costs associated with these expenditures.

There are different ways in which one could view the opportunity costs of war. For example, if the government's budget was fixed, the money spent on wars could have been allocated to other government programs, such as health care and programs that create jobs and promote infrastructure (Crawford, 2017; Garrett-Peltier, 2017). That perspective is often quite helpful, but it is not the approach taken in this article. The procedure used here is different in that it assumes that war-related expenditures are not drawn from other government budgets but instead are opportunity costs derived by imposing costs on US households. A pivotal component of the conversion of the costs of war into fatality equivalents is what I term the "mortality cost of expenditures." Having additional funds for the usual market basket of consumer goods promotes a variety of expenditures that enhance health, including better food, health care, safer residential areas, and safer products. Reducing

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the amount of funds households have available for such expenditures has adverse health impacts on the population. This article's review of the diverse empirical evidence on the mortality-income relationship finds that every shift of \$100 million from the public to war-related expenditures generates the loss of at least one expected death because of the reduction in household income. Using this relationship, it is possible to convert the financial costs of war into an expected fatality equivalent to be added to the direct health impacts of wars to obtain the total mortality cost of wars. Based on estimates of the mortality cost of expenditures, the indirect mortality costs generated by the substantial expenditures for the post-9/11 wars led to losses of life that are roughly double the level of the direct military fatalities.

Tallying the costs of war in terms of the lives that are lost rather than dollar costs provides a different perspective on the costs of war rather than an additional cost component. This different perspective may be consequential since how the costs of war are framed may affect how the public perceives these losses. In an era in which the government enacts tax cuts in 2017 that were officially billed at \$1.5 trillion, expenditures in the trillions may not appear to be a pressing concern, especially if the costs are spread out over a number of years. The mortality cost metric shifts the focus from dollars to lives. Such reframing of the loss may make the extent of the costs of war appear to be more consequential and less of an abstraction. The mortality cost metric also highlights the human costs associated with the financial expenditures, potentially diminishing the ability to maintain public support for wars by altering the capital-labor mix of war efforts.

This article begins in Section 2 with a summary of the financial and mortality cost of war for the conflicts in Iraq, Afghanistan, the combined post-9/11 conflicts, and Vietnam. These statistics establish the building blocks to be used in subsequent sections. Section 3 introduces the VSL concept and provides a summary of state of the art methods for empirical analysis of the VSL. Straightforward application of this measure to the counts of lives lost in Section 2 establishes the measure of the total financial loss of the wars, including the monetary equivalent of the mortality effects. Section 4 introduces the mortality opportunity cost concept and the empirical evidence underlying the relationship between mortality costs and government expenditures. The application of the mortality opportunity cost to analysis of the costs of wars leads to a much higher estimate of the lives lost, as these indirect mortality effects exceed the direct military losses. The relative role of these indirect mortality costs is greater for the post-9/11 wars than for the Vietnam War, which had a different capital-labor mix. Section 5 examines some of the implications of this approach for reframing analyses of the costs of war.

2 Summary of the financial and mortality effects

The principal components of the calculations of the costs of war will be the budgetary costs and the mortality cost estimates. Table 1 summarizes the official government estimates for the expenditures, military fatalities, and contractor fatalities for the conflicts in Iraq, Afghanistan, the post-9/11 wars, and Vietnam, where all costs are in current year dollars.³ The post-9/11 wars include other military operations as well, such as those in Syria and Pakistan as well as enhanced security for military bases. There are other military conflicts that are not included in my review, including operations in Yemen and Somalia (Bilmes & Intriligator, 2013). The expenditure totals for the non-governmental estimates are more comprehensive as they include not only direct budgetary costs but also costs such as disability expenses and the health care costs for veterans.⁴ A comprehensive historical analysis from the Revolutionary War through the Iraq and Afghanistan conflicts has found that veterans' benefits may account for one-third to half of the costs of US wars (Edwards, 2014). For each of the conflicts shown in Table 1, inclusion of these additional financial cost components more than doubles the financial costs of the wars. If these additional cost components are viewed as transfers and, as a consequence not pertinent to benefit-cost tests (U.S. Office of Management and Budget, 2003), then one can eliminate these cost components by focusing on the government estimates. If the costs are not adjusted for inflation, the budgetary expenditures for the Vietnam War are comparable to the expenditures in both Iraq and Afghanistan, and about two-fifths of the total budgetary costs of the post-9/11 wars. These financial cost estimates do not include the long-term increase in expenditures of the Department of Veteran Affairs and the Department of Defense (Bilmes, 2014), which arise due to influences such as likely long-term increases in military pay scales needed for recruitment for the war efforts and expanded medical insurance.

Table 1: Expenditures and deaths for wars.

	Expenditures (\$ billions)	Military fatalities	Contractor fatalities	Total fatalities
Iraq				
Government	820	4565	1664	6229
Non-government	2210	4555	3418	7973

Afghanistan				
Government	926	2408	1734	4142
Non-government	2150	2414	2867	5281
Post-9/11 wars				
Government	1950	6973	3398	10,371
Non-government	5630	6969	6285	13,254
Vietnam				
Government	738	58,220	–	58,220
Non-government	1420	58,318	–	58,318

The second column in Table 1 presents the military fatalities totals, which are almost identical for the two sets of estimates from governmental and non-governmental sources. To simplify the exposition, the official governmental estimates will be used as the reference point for the number of war-related deaths. The military death toll to date is just under twice as great for Iraq than Afghanistan, with 4565 killed in Iraq and 2408 killed in Afghanistan. Each of these death totals is more than an order of magnitude below the number of Vietnam deaths, which was 58,220. The shift to the use of contractors in more recent engagements is evident in the statistics in column 3 of Table 1. Contractor fatalities are greater in the non-governmental tallies than in the governmental statistics. These contractor fatalities even exceed the number of military fatalities for Afghanistan based on the non-governmental statistics. Because the non-governmental contractor deaths may include as many as three-fourths who are not US citizens, if the focus of any war cost assessment is only on US losses, including the non-governmental figures for contractor deaths overstates the loss of US lives.⁵

Because of the increased reliance on contractors, the total fatality levels shown in the final column of Table 1 are better measures of the total fatality costs associated with the wars. These fatality statistics do not, however, include any indirect effects on societal mortality rates arising from the opportunity costs associated with the financial outlays. Table 1 also excludes all nonfatal injuries associated with these wars.

A principal implication of the figures reported in Table 1 is that the post-9/11 conflicts have a different mix of war costs than in the case of Vietnam, which would remain the case even after adjusting for differences in price levels. The share of financial costs relative to mortality costs is much greater for the post-9/11 efforts. For any optimizing war-related activities, there is always the choice of the optimal capital-labor mix (Rohlf, Sullivan, & Kniesner, 2016). While the study by Rohlf et al. (2016) focused on capital-labor choices within World War II battles, there are similar decisions with respect to the emphasis on financial and human costs that are made across wars. The allocations for the post-9/11 conflicts place a pronounced emphasis on the capital cost component. The decreased role of labor costs is even greater if contractor fatalities are viewed as financial costs rather than human costs, both because they are not military personnel and many may not be US citizens. This shift in the capital-labor mix may reflect a different shape of the underlying production function than in the case of the World War II battles or the Vietnam War. If new technologies provide more effective substitutes for personnel than previously, then for any desired level of military effort there will be a greater emphasis on the capital component. However, the change in the capital-labor mix may also be driven by a shift in societal preferences or a desire to alter the mix to retain public support for the efforts. There may be an increased desire to reduce the number of US soldiers who are killed in order to maintain political support. Similarly, the increased reliance on contractors may be driven by war-related efficiency concerns, but also may be an attempt to shift some of the mortality costs outside of the US military, sometimes to contractors who are citizens of other countries.

The direct health costs of wars also include nonfatal injuries of those who are injured or wounded, but not killed. The first column of statistics in Table 2 lists the estimated number of injuries based on US Department of Defense statistics for both the government and non-government rows in the table. The direct health costs of war continue to loom large for the Vietnam War. The 303,644 nonfatal injuries for the Vietnam War are about six times greater than the combined total for the post-9/11 wars.

Table 2: Nonfatal injuries and total direct fatality equivalents.

	Number injured/wounded	Equivalent fatality impact of injuries	Total direct equivalent fatalities
Iraq			
Government	32,328	207	6436
Non-government	32,328	207	8180
Afghanistan			
Government	20,431	131	4273
Non-government	20,431	131	5412
Post-9/11 wars			

Government	52,718	338	10,709
Non-government	52,718	338	13,592
Vietnam			
Government	303,644	1943	60,163
Non-government	303,644	1943	60,261

The second column of Table 2 converts these injuries into fatality equivalents based on the economic value of injuries relative to that of fatalities.⁶ Disability compensation and treatment costs should already be included in the financial calculations, maintaining the parallel with the value of statistical injuries, which do not include workers' compensation or health care costs. Because of the much greater economic valuation of fatalities compared to nonfatal injuries, the addition of the fatality equivalents to the total number of fatalities leads to the total fatality equivalents in the final column of Table 2 that are very similar to the direct fatality estimates in Table 1.

3 Monetizing war-related fatalities

Calculating the monetary value of the war-related fatalities follows the same kind of procedure that is routinely used by government agencies in regulatory impact analyses to evaluate the benefits of reducing mortality risks. In the case of prospective analyses of government regulations, the procedure involves multiplying the expected number of fatalities that are prevented by an estimate of the VSL (U.S. Office of Management and Budget, 2003; Viscusi, 2018). The economic rationale for this procedure is based on a VSL reflecting the individual's willingness to pay for small changes in risk, and the government regulations being assessed also involve small changes in risk. The economic assessment of the lives lost in military efforts is not a prospective valuation of expected lives that may be lost but instead is an attempt to evaluate the economic loss associated with the fatalities. The lives that have been lost are identified deaths that have occurred with certainty rather than unidentified lives threatened by small risks of death. The use of the VSL in this context reflects the valuation that would be generated by the thought experiment of assessing how much it is worth to avert the risk of these deaths based on an *ex ante* assessment of the costs of the military effort and the subsequent risks to combatants' lives.

The summary breakdowns of war-related deaths in columns 2, 3, and 4 in Table 1 provide the fatality cost components for calculating the monetary value of the mortality loss. The fatalities to be monetized include the US military deaths, contractor deaths, and total fatalities to military personnel and contractors. Excluded from consideration are the post-war deaths due to suicides attributable to the combat experiences and war-related illnesses. These deaths are consequential and potentially pertinent to assessment of the overall costs of war but are not included here. Also excluded are the deaths to enemy combatants, non-combatant civilians, or military from other allied countries. Thus, the focus is on calculating a US-centric measure of the financial cost of the war, with the only exception being that there are some non-US deaths included in the estimates of the number of contractor fatalities.

The monetary value that I will assign to these lives is based on current estimates of the VSL, which is the risk-money tradeoff for small risks of death. Most of the VSL estimates used by government agencies are based on labor market estimates of the wage-risk tradeoffs implied by workers' job choices. Other sources of this evidence include market studies of the price-risk tradeoffs embodied in the higher prices that consumers are willing to pay for safer cars and for houses in safer neighborhoods and stated preference studies of how much people are willing to pay for hypothetical risk reductions. The approach taken here is to use labor market estimates of the VSL. Thus, the monetization of fatalities is in terms of actual revealed preference evidence pertaining to the willingness-to-pay value of preventing the risks of death.

One alternative approach that more closely mirrors how courts provide compensation in wrongful death cases would be to value the fatalities based on a human capital measure such as the present value of the lifetime earnings that are lost due to the fatality. While this financial loss measure is a meaningful approach in wrongful death cases for which the objective is to compensate the victim's family for the financial impact of the death, the value of preventing an expected fatality is much greater. The monetary loss measure ignores the value that the deceased places on his or her own life. More generally, it is not tied to a willingness-to-pay value for reducing a small probability of death, which is the pertinent benefit approach for government policies generally. These differences in methodological approach are quite influential, as the VSL exceeds the economic estimates of the wrongful death awards by roughly an order of magnitude.

An even more modest financial cost measure of the value of fatalities would be to use the compensation amounts that the survivors of deceased military are paid. After a fatality to military personnel, there is a \$100,000 payment that is designated as a death gratuity⁷ and a \$400,000 in life insurance payment to the victim's

heirs.⁸ As in the case of court awards in wrongful death cases, these amounts are directed at meeting some of the financial losses incurred by the survivors and are not a measure of the value of preventing a person's death.

Although it is feasible to derive estimates of the VSL based on stated preference values or revealed preference estimates, the focus here is on the wage-job risk tradeoff rates in the labor market, which can be used to estimate the amounts that workers require to accept jobs posing risks of death. The estimates reported in Viscusi (2018) indicate a labor market VSL of \$10 million (\$2017). This value is based on the wage premium estimates that workers receive for job risks derived from statistical analyses using the Census of Fatal Occupational Injuries (CFOI) data, which consists of a comprehensive census of all job-related deaths, each of which is verified using multiple sources. Unlike VSL estimates based on other labor market risk data or stated preference studies, the \$10 million VSL estimate is also robust with respect to potential adjustments for publication selection biases that may influence the set of estimates that are submitted for publication and are ultimately published.

The approach used here to value mortality risks is consistent with the procedures that government agencies use in evaluating mortality risk reduction benefits for US government regulations (U.S. Office of Management and Budget, 2003). The VSL levels used by government agencies are also very similar to the \$10 million figure specified above. The U.S. Department of Transportation (2016) relies on the labor market estimates based on the CFOI data and has adopted an agency-wide value of \$9.6 million (\$2015), or \$10.0 million (\$2017). The U.S. Department of Health and Human Services (2016) does not specify its procedure, but it adopted a value of \$9.6 million (\$2014), or \$10.1 million (\$2017). The Environmental Protection Agency (EPA) drew on both labor market estimates and stated preference studies and had used higher values than the Department of Transportation (DOT) or the Department of Health and Human Services (HHS) for almost all regulatory impact analyses since 2009. However, after previously using higher levels of the VSL than either DOT or HHS, in 2018 the U.S. Environmental Protection Agency (2018) under the Trump administration lowered the VSL to \$7.4 million (\$2006), or \$9.0 million (\$2017). Thus, my VSL estimate based on an assessment of the current state of the literature is also generally in line with the values used by US government agencies.

Adjusting the VSL for differences in price levels will maintain comparability with the financial cost statistics. Operation Iraqi Freedom was from 3/19/2003 to 8/31/2010, Operation New Dawn was from 9/1/2010 to 12/31/2011, and Operation Inherent Resolve is from 6/15/2014 to present. The Afghanistan conflicts consisted of Operation Enduring Freedom from 10/7/01 to 12/31/14 and Operation Freedom's Sentinel was from 12/31/2014 to present. Using 2010 as the reference year, the VSL in \$2010 is \$8.9 million. The Vietnam War ended in 1975. The first application of the VSL for federal government regulations was the \$3 million VSL in 1982 (Viscusi, 2018). That estimate, which was based on labor market estimates of the VSL, is similar to current values after pertinent adjustments.⁹ Let us use a VSL of \$1.6 million, which is the 1982 number in 1974 dollars.

The approach here of using civilian labor market estimates of the VSL to value military deaths is consistent with current governmental practices of using a uniform VSL for all different segments of the population. Even though individuals' willingness to pay to avoid fatality risks may display substantial heterogeneity, for purposes of policy analysis, government analyses treat the monetization of risks to all individuals identically. Thus, there is no adjustment of these values for individuals' personal characteristics such as age, race, income, and gender. There have been two exceptions to this uniformity. In the case of age, EPA has presented sensitivity analyses using lower VSL estimates for those age 65 and over in two regulatory impact analyses, but the adverse public reaction to the devaluation of older people's lives led to a halt in this practice.¹⁰ It is likely that any assessment technique that valued lives of military personnel at less than the values applied to civilian deaths would generate a similar hostile reaction. The other exception to the use of a uniform valuation of mortality risks is that the Food and Drug Administration sometimes has used the value of a statistical life year rather than the VSL when very small changes in life expectancy are at risk. This approach is pertinent in some situations, such as when evaluating the benefits of a new drug that will prolong life by several months or other medical context involving small effects on life expectancy, but focusing on the value of a statistical life year would not be pertinent for military deaths given the substantial loss in life expectancy associated with military fatalities.¹¹

Although I will follow standard government practices in using a population-wide VSL estimate, it should be noted that the specific VSL that is reflective of the preferences of those killed in wars may be different. The VSL levels of people in their early 20s is lower than the average VSL for the population, as the VSL tends to track lifetime income patterns and displays an inverted-U shaped trajectory with respect to age (Aldy & Viscusi, 2007; Viscusi, 2018). This age-related factor would tend to produce a lower VSL for risks to military personnel. In addition, there is a positive income elasticity of the VSL that several studies estimate to be around 0.6 in the United States, with some income elasticity estimates being higher (Masterman & Viscusi, 2017; Viscusi, 2018; Viscusi & Aldy, 2003). Because military personnel have lower earnings than average civilian workers in the samples used for obtaining VSL estimates, recognition of income differences also would make the VSL for the military somewhat lower than that of a population-wide estimate.

In addition to the matter of heterogeneous preferences regarding mortality risks based on age and income, there also may be complications arising from the nature of military deaths. If people suffer fatal battle-related in-

juries, there may be prolonged periods of morbidity effects, particularly when medical treatment is not prompt and effective. For typical worker injuries, the risk of the morbidity consequences associated with fatalities constitute about one-fourth of the VSL (Viscusi, 2018). If military personnel incur longer and more painful periods of suffering before their deaths, the pertinent VSL should reflect these differences if there is going to be a departure from current standardized VSL practices. To the extent that the morbidity consequences of military deaths are greater than for the average fatal job injury, this factor would tend to boost the military VSL.

Whether the military do have a different VSL has been the focus of a few studies regarding estimates of the VSL based on the particular populations represented in the military. Rohlfs (2012) found that in the case of the Vietnam War, the VSL for those who avoided the draft by going to college was \$1.6–\$5.1 million, and the VSL for those who enlisted voluntarily was \$7.2–\$11.9 million. There have also been efforts to use the VSL to guide estimates of military decision making, such as the study by Kniesner, Leeth, and Sullivan (2015) that developed a benefit-cost analysis of force protection investments involving the replacement of wheeled ground vehicles used for day-to-day operations. Their analysis considered a range of VSL estimates and employed a threshold VSL figure of \$7.5 million.

Readers who wish to adjust the VSL based on these estimates could do so quite directly since such sensitivity analyses alter the estimates proportionally. However, for purposes of my analysis, I will treat the monetized value of the fatalities in the same manner as do all government agencies by using the standardized single population-wide estimate of the VSL described above. The value of reducing the fatality risk for those killed while in the military consequently is consistent with the values attached to the risks of life to their civilian counterparts, many of whom also engage in risky pursuits such as dangerous jobs. Accidents and non-battle deaths are also major contributors to the observed fatality rates for military personnel, as they are responsible for the majority of the Iran and Afghanistan war fatalities (Stiglitz & Bilmes, 2008). The nature of these hazards and the populations incurring these risks in the military are often quite similar to the civilian risks that are valued by government agencies (DeBruyne, 2018).

A previous analysis by Stiglitz and Bilmes (2008) of the mortality costs of the Iraq and Afghanistan Wars monetized these fatalities with a VSL of \$7.2 million. They calculated that the value of the 4300 American deaths to date exceeded \$30 billion, as compared to the financial budgetary cost of the fatalities of \$2.15 billion. After also including the deaths to 1000 military contractors, they calculated a total fatality cost of above \$50 billion (\$2007).¹² The mortality costs are clearly substantial, but they comprise only a modest component of their \$3 trillion estimate for the Iraq and Afghanistan Wars.

Table 3 summarizes the components of my estimates of the monetized value of the fatalities that are directly related to the different conflicts. In each case, the procedure is to monetize the fatalities by multiplying the direct equivalent number of fatalities in the final column of Table 2 by \$8.9 million for the various post-9/11 conflicts and by \$1.6 million for the Vietnam War. The first column in Table 3 summarizes the monetized value of the military fatalities. The total costs of the direct military fatalities are \$57–\$73 billion for Iraq, \$38–\$48 billion for Afghanistan, \$95–\$121 billion for the post-9/11 wars, and \$114–\$115 billion for Vietnam.

Table 3: Monetary equivalent costs of war.

	Fatality costs (\$ billions)	Total costs (\$ billions)	Fatality cost share
Iraq			
Government	57.28	877	0.07
Non-government	72.80	2283	0.03
Afghanistan			
Government	38.03	964	0.04
Non-government	48.17	2198	0.02
Post-9/11 wars			
Government	95.31	2045	0.05
Non-government	120.97	5751	0.02
Vietnam			
Government	114.31	852	0.13
Non-government	114.50	1535	0.07

Monetization of fatalities uses \$1.9 million for the Vietnam War and \$8.9 million for the other conflicts.

The second column of Table 3 adds these monetized fatality costs to the budgetary costs, and the final column summarizes the fatality costs share of the total financial plus fatality costs. The percentage role of the monetized fatality costs for entries corresponding to the various post-9/11 conflicts is fairly modest. For the governmental fatality estimates, the fatality costs share is 7% for Iraq, 4% for Afghanistan, and 5% for the post-9/11 wars. However, for the Vietnam War the fatality cost share is 13%. The non-governmental statistics show a similar relative pattern, with cost shares of 3% for Iraq, 2% for Afghanistan, 2% for the post-9/11 wars, and 7%

for the Vietnam War. These differences reflect the marked change in the capital-labor mix between the Vietnam War and more recent conflicts.

4 The mortality opportunity cost of expenditures

Diverting funds to war-related efforts has real opportunity costs in that these funds cannot be used for other expenditures, many of which are health-enhancing, such as medical care, better food, and safer products. The role of these opportunity costs has been most prominent with respect to discussions of regulatory policy in situations in which restrictive legislative mandates prohibited the agency from basing policies on benefit-cost tests.¹³ Sufficiently substantial regulatory expenditures on health and safety regulations could potentially have a counterproductive effect by increasing rather than decreasing individual mortality rates. A less controversial application of the approach would be to assess the health-related opportunity costs of wars since there is no pretense that wars are health-enhancing. The main economic task is to select the level of expenditures that imposes a mortality opportunity cost. There are, of course, other dimensions on which welfare is reduced by not having these funds, but this approach enables expenditures and direct war-related deaths to be converted to a common metric.

The opportunity cost value per expected death that will be used here is based on the theoretical relationship between the VSL and the income loss that generates an expected death. As shown in Viscusi (1994), this value is the VSL divided by the marginal propensity to spend on health equal of 0.1. This formulation remains consistent with current health expenditure data (Broughel & Viscusi, 2017). Thus, for the time periods considered here, one expected death would be the health-related opportunity cost of a war-related expenditure of \$89 million in the post-9/11 conflicts era and an expenditure of \$16 million during the Vietnam War. Analyses that also account for the unhealthy consequences of higher income levels suggest that the mortality opportunity cost threshold (Lutter, Morrall III, & Viscusi, 1999) is lower, leading to greater mortality costs from wars than the values presented here.

An alternative approach would be to estimate empirically the income loss that generates one expected death. Following this approach leads to a higher mortality cost of wars than those presented here. Because of the potential simultaneity of income and health, these studies that provide direct estimates of the income-mortality relationship face considerable econometric challenges. Estimates of the income loss that leads to one expected death include the following: \$3–\$7 million (\$1980) in Keeney (1990), \$12 million (\$1990) in Chapman and Hariharan (1994), \$9–\$12 million (\$1991) in Lutter and Morrall (1994), \$7–\$15 million (\$1990) in Chapman and Hariharan (1996), \$5–\$14 million (\$1991) in Keeney (1997), \$4–\$48 million (\$1995) in Elvik (1999), \$7–\$10 million (\$1996) in Gerdtham and Johannesson (2002), and \$20–\$50 million (Au\$2010) in Ashe, de Oliveira, and McAneney (2012). These estimates all imply a lower income loss level that is associated with an expected death, which would imply a higher mortality cost of wars than the calculations presented here.

Table 4 presents the mortality cost effects of wars based on the mortality opportunity cost threshold figures of \$89 billion for the post-9/11 conflicts and the \$16 million figure for the Vietnam War. Column 1 of Table 4 presents these indirect fatality levels for each situation. Because of the inclusion of additional costs in the non-government estimates, these values tend to be about double the mortality cost estimates based on the government cost estimates. However, a substantial component of the additional costs in the non-government estimates consist of transfers such as disability payments to veterans. As a result, the non-government financial costs overstate the net financial opportunity cost and will overstate the indirect fatality costs of military expenditures. Even the lower government estimates imply a substantial opportunity cost of lives lost of 21,910 deaths from the post-9/11 wars and 46,125 for the Vietnam War. Column 2 adds the direct reported fatalities to these opportunity cost effects. The substantial role of the indirect mortality losses is conveyed by the statistics in the final column of Table 4. The indirect mortality cost share based on the government cost estimates ranges from 0.59 to 0.71 for the post-9/11 wars, with a low value of 0.43 for the Vietnam War. The indirect fatality share based on the non-government cost estimates are greater, in part because they also include transfer payments, but the indirect costs shares follow a similar pattern.

Table 4: Total mortality costs of wars.

	Indirect fatalities	Total fatalities	Indirect fatality share
Iraq			
Government	9213	15,649	0.59
Non-government	24,832	33,012	0.75
Afghanistan			
Government	10,405	14,678	0.71

Non-government	24,157	29,569	0.82
Post-9/11 wars			
Government	21,910	32,619	0.67
Non-government	63,258	76,850	0.82
Vietnam			
Government	46,125	106,288	0.43
Non-government	88,750	149,011	0.59

The calculations thus far are based on the conceptualization that instead of using the funds for war, consumers would be able to spend the money as they do with other income. Suppose instead that the opportunity cost is not from an average market basket of consumer goods but rather from funds that are directed at promoting health. Such an approach would generate an upper bound estimate of the mortality cost of wars. The funds could, for example, be used to promulgate risk and environmental regulations or other health-enhancing policies that just pass a benefit-cost test so that the average cost per life saved equals the VSL. In that instance, the indirect fatalities estimates in Table 4 would be multiplied by 10, leading to effects such as 219,100 deaths because of expenditures on the post-9/11 wars. As a consequence, the current figures in Table 4 may well understate the potential opportunity costs involved depending on how these resources would otherwise be allocated. The estimates in Table 4 assume that the expenditures would have been no more effective in enhancing health than the average market basket of consumer goods, whereas targeted health-enhancing efforts could generate greater mortality opportunity costs.

5 Conclusion

Application of the measure of the mortality opportunity cost of expenditures to analysis of wars makes it feasible to convert the human health costs and the financial cost into a common fatality cost metric. Recognition of the health-related opportunity costs of military expenditures implies that the total number of fatalities that are attributable to wars greatly exceeds the direct estimates of the war-related deaths. For the recent post-9/11 conflicts, the majority of the deaths can be traced to the opportunity costs associated with the budgetary allocations for the military efforts. The indirect fatality share is greater for these more recent conflicts than for the Vietnam War.

Consideration of financial expenditures and the number of fatalities of the different conflicts highlights the shift in the capital-labor mix toward less reliance on human health costs and greater utilization of financial expenditures. This change may reflect characteristics of the conflicts in terms of collaboration with local forces, changes in strategy, or differences in available technology. But the decreased role of war-related deaths could also arise if there were more adverse political repercussions from financial costs relative to personnel costs. Converting all costs of war into a common metric makes clear that there are additional health-related costs that should be taken into account.

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Notes

1 Under “realistic-moderate” assumptions, Stiglitz and Bilmes (2008) estimate a total budgetary cost of \$2655 billion for the Iraq War, \$841 billion for the Afghanistan War, and \$3496 billion for the Iraq and Afghanistan Wars. Stiglitz and Bilmes (2008) also monetize the fatalities using a value of a statistical life measure.

2 These assessments differ a bit in terms of their coverage. Unlike the Crawford (2017) estimates, the Stiglitz and Bilmes (2008) estimates also include oil and energy costs of \$400 million per year, demobilization costs of \$20 billion, no fly zone savings of \$10 billion per year, and macroeconomic effects of higher oil prices (\$263 billion). Nordhaus (2002) also examines the macroeconomic consequences of the Iraq War, which are substantial as well.

3 The governmental estimates for Iraq, Afghanistan, and post-9/11 wars are drawn from Belasco (2014) for expenditures and U.S. Department of Labor, Office of Workers’ Compensation Program (2018) for contractor fatalities. Governmental estimates for military fatalities are found on the U.S. Department of Defense website, <https://dod.defense.gov/News/Casualty-Status/>. The governmental estimates for Vietnam are drawn from Daggett (2010) for expenditures and U.S. National Archives and Records Administration (2018) for military fatalities.

4 The non-governmental cost estimates for Iraq and Afghanistan are based on Crawford (2014), and the overall cost of the post-9/11 wars is based on Crawford (2017). Finally, the non-governmental cost estimate for Vietnam comes from Edwards (2014).

- 5 Table 1 of Lutz (2013) pertains to only US contractors, excluding non-US contractors so that the government contractor fatality estimates should be less susceptible to including non-US fatalities.
- 6 The VSL discussed in Section 3 below is \$10 million in \$2017. The value of statistical injuries for lost workday work injuries is \$64,000 in \$2017. This number is based on \$45,000 in \$2000, which is the midpoint value of the \$20,000 to \$70,000 range in Viscusi and Aldy (2003). Multiplying the number of injuries by 0.0064 converts the number of injuries into a fatality equivalent. Because of the minor role of nonfatal injuries, even doubling their relative value has little effect on the overall mortality cost of wars.
- 7 "Military Compensation – Death Gratuity," *U.S. Department of Defense* (last accessed January 16, 2019), <https://www.militarypay.defense.gov/benefits/death-gratuity/> [https://perma.cc/M6TH-2TT9].
- 8 "Military Compensation – Servicemembers Group Life Insurance (SGLI)," *U.S. Department of Defense* (last accessed January 16, 2019), <https://militarypay.defense.gov/Benefits/Servicemembers-Group-Life-Insurance/> [https://perma.cc/CA7B-EJK2]. Unless the person opts out, this life insurance is for all military, not just those killed in combat.
- 9 The \$3 million figure is \$7.8 million in \$2017. After adjusting for increases over time in gross national income per capita, the VSL figure would be above \$10 million.
- 10 The more noteworthy example was the use of a 37% VSL discount for those over age 65 in the EPA analysis of the Clear Skies initiative. See Viscusi (2018).
- 11 One example of the use of the value of a statistical life year is in U.S. Department of Health and Human Services, Food and Drug Administration, "Use of Materials Derived from Cattle in Human Food and Cosmetics," *Federal Register* 81, no. 53 (March 18, 2016): 14718–14732.
- 12 Their \$7.2 million VSL figure would be \$8.45 million in \$2017, adjustments for increases in per capita income over time would increase the VSL amount further. The data presented in this paragraph include all of the statistics reported by the Stiglitz and Bilmes (2008) on pages 93–96 as components of their calculations.
- 13 The first proposal that this approach be used in regulatory analysis is the letter of James MacRae, Acting Administrator and Deputy Administrator, Office of Information and Regulatory Affairs, U.S. Office of Management and Budget, to Nancy Risque-Rohrbach, Assistant Secretary for Policy, Department of Labor, March 10, 1992.

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