US military expenditures to protect the use of Persian Gulf oil for motor vehicles

Mark A. Delucchi [a,*], James J. Murphy [b]

[a] Institute of Transportation Studies, University of California, Davis, CA 95616, USA
[b] Department of Economics, University of Alaska-Anchorage, Anchorage, AK 99501, USA

ARTICLE INFO

ABSTRACT

Analyses of the full social cost of motor vehicle use in the US often estimate an "oil import premium" that includes the military cost of defending oil supplies from the Persian Gulf. Estimates of this cost have ranged from essentially zero to upwards of a $1 per gallon (about $0.25 per liter). In this paper, we attempt to narrow this range, by carefully answering the question: "If the US highway transportation sector did not use oil, how much would the US federal government reduce its military commitment in the Persian Gulf?" We work towards our answer in five steps, accounting for interests not related to oil, the interests of other oil-consuming countries, the interests of producers apart from the interests of consumers, and the interests of non-highway users of oil. We estimate that were there no oil in the Persian Gulf, then US combined peacetime and wartime defense expenditures might be reduced in the long run by roughly $27–$73 billion per year (in 2004 dollars), of which roughly $6–$25 billion annually ($0.03–$0.15 per gallon or $0.01–$0.04 per liter) is attributable to motor-vehicle use.

© 2008 Elsevier Ltd. All rights reserved.

1. Introduction

1.1. Background

With the United States bogged down with the war in Iraq, there is once again considerable debate about the political and economic costs of America's involvement in the Persian Gulf. Many contend that the US interests in the Middle East center primarily, if not exclusively, on the region's huge reserves of oil, and that as a result US military expenditures in the Persian Gulf amount to a massive "hidden cost" of oil use in the United States. For example, at a March 2006 hearing on "The Hidden Costs of Oil" by the US Senate Committee on Foreign Relations, three experts provided testimony on the external costs of oil; two mentioned the military cost of protecting Persian Gulf oil, and the third (Copulos, whose research is discussed here) provided estimates of the costs.[1] And in January 2007, discussions in the media about tax subsidies to oil companies again included debates about the relevance and magnitude of military expenditures arguably related to oil use (Clayton, 2007; Taylor, 2007). Policy makers and analysts are interested in these estimates of the

"hidden costs" of oil use because they help them understand relevant policy questions such as the real social benefits of reducing oil consumption or the amount that oil use would have to be taxed in order to bring the price of oil closer to its marginal social cost.

There is in fact a long history of estimates of the military costs of oil use in the US. Over a decade ago, MacKenzie et al. (1992) estimated that the unpaid military cost of vehicle use in the US in 1989 was $25 billion, or about $0.19 per gallon (about $0.05 per liter). On the other hand, around the same time, the Congressional Research Service (CRS, 1992) estimated that the military expenditure external cost of oil used in transportation was only $0.3–$5 billion per year. A few years later, the International Center for Technology Assessment (International Center for Technology Assessment, 1998) estimated that annual "defense subsidies" to oil, including wartime subsidies, were $55–$96 billion per year or $0.40–$0.70 per gallon. In a 2005 update, International Center for Technology Assessment (2005) estimated slightly higher annual total costs but a much lower cost-per-gallon range—$0.13–$0.23 per gallon—because they used a much larger estimate of annual oil consumption. And recently, two sets of researchers have come to dramatically different conclusions regarding the military cost of oil use in transportation. In their analysis of the social cost of alternative fuel vehicles, Ogden et al. (2004) estimate that the marginal external military cost of protecting Persian Gulf oil is $0.35–$1.05 per gallon of gasoline equivalent fuel. By contrast, Parry and Darmstadter (2003) assume that marginal changes in

transportation oil consumption and oil imports would have little effect on military spending for the Persian Gulf.

1.2. Overview of our analysis

The preceding summary highlights that estimates of the military cost of oil use in transportation range from essentially zero to upwards of a $1 per gallon (about $0.25 per liter). In this paper, we attempt to narrow this range. We develop our estimate of the military cost of using oil in highway transportation in five steps. We start with an estimate of the amount spent annually to defend all US interests in the Persian Gulf (step 1). In this first step, we discuss the conceptual issues involved in estimating the cost of defending a particular region, and review the best available estimates. We then deduct the cost of defending interests other than oil in the Persian Gulf, based on a careful consideration of the evidence as to what the US' main interests are in the Persian Gulf (step 2). Next we deduct the cost of defending against the possibility of a worldwide recession due to the effects of an oil price shock related to the use of Persian Gulf oil by *other* countries (step 3), the cost of defending the investments of US oil producers in the Persian Gulf (apart from the interests of US consumers) (step 4), and lastly the cost of defending the use of oil in sectors other than highway transportation (step 5).

1.3. Our approach is unique in several respects

We start by asking the question: "If the US did not have any military objectives related to the Persian Gulf, how much might Congress reduce defense spending?" This phrasing properly identifies the decision-making authority (Congress) and the practical question of reducing spending if a regional problem were mitigated. We make clear that this problem is *not* the same as the pricing problem of allocating joint production costs because Congress would not be trying to price defense output, but rather would be trying to understand how long-run defense costs actually are related to the magnitude of a regional threat.[2] And finally, we recognize that producers have interests in Persian Gulf oil apart from the interests of consumers, and that Persian Gulf oil is of interest to the US even apart from the interests of US producers and consumers. We emphasize, though, that our five-step analysis is more illustrative than rigorously quantitative.

1.4. Notes on the conceptual framework

In this analysis we estimate the total dollar cost and the average cost per gallon of defending Persian Gulf oil used by motor vehicles in the US. We estimate the total defense cost associated with total current oil consumption by motor vehicles *not* because we think that eliminating oil use in transportation is a realistic policy option, but because the total is a common (albeit arbitrary) point of reference that gives a sense of the scale of the problem (many analyses of the social cost of motor vehicle estimate total costs), and because one must estimate the total in order to calculate the average cost per gallon, which under some conditions may approximate the marginal cost per gallon of partial changes in oil use.

Whether our average cost-per-gallon estimate approximates the marginal cost of a partial reduction in oil use depends on the properties of the total defense cost-vs.-oil-use function, which is unknown. Because we are not estimating an actual total-cost

function, we cannot *formally* answer questions about how defense expenditures would change if there were a partial reduction in oil consumption. But we can offer general observations. If total defense costs are approximately linear in oil consumption, then the marginal cost is close to our estimate of the average cost. However, if the total cost function is nonlinear, then marginal and average cost diverge. In Section 7.1, we discuss why the total cost function might be nonlinear.

Second, we estimate the military costs of protecting *Persian Gulf* oil because we contend that these dwarf the costs of protecting oil from other regions and because it is more difficult to estimate those other costs. We discuss this further in Section 7.1.

Finally, we estimate the cost of changes in the petroleum use by the US motor vehicle sector *only*; we do not analyze cases in which changes in petroleum use by the US motor vehicle sector cause changes in petroleum use in other sectors or other countries. If there is such a linkage, and if total cost is proportional to total oil consumption, then the cost per gallon of US motor fuel use will be proportional to the ratio of total affected petroleum use to US motor vehicle petroleum use.

2. Step #1: The military costs of protecting the Persian Gulf

2.1. A framework for estimating the military costs of protecting the Persian Gulf

Throughout the 1990s, total Department of Defense (DoD) outlays excluding veteran's benefits (which we will include in our estimates of "wartime" expenditures) averaged about $275 billion (in current year dollars), increasing to well over $500 billion by 2007 (Bureau of the Census, 2007). The portion of this total "attributable" to the Persian Gulf is difficult to estimate because the Defense budget is not itemized by region or mission, but rather by general function or cost area, such as operations and maintenance (see any of the *Annual Defense Reports*, www.dod.-mil/execsec/adr_intro.html). Many of the functional areas cover more than one region or program, and hence one faces the difficult task of understanding how Congress—which authorizes defense spending—might view military costs by region.

To develop our estimate of the cost of defending the Persian Gulf, we begin by asking the question: "If the US did not have any military objectives related to the Persian Gulf, how much might the US reduce defense spending?" Stating the question in this way properly acknowledges the role of Congress and the President in determining expenditures: the President proposes a budget plan, and Congress ultimately approves a budget and authorizes spending. More importantly, this phrasing directly implies that the key task for Congress and the President is to determine just how the deployment of military resources is related to the kind and magnitude of various regional threats. That is, this is not the pricing problem that a producer faces when he has joint products produced in fixed proportions from a single process because Congress would not be trying to price military output. Rather, Congress' situation is that of a producer who is trying to figure out how a permanent drop in demand for one of his many products would affect his long-run production costs, assuming that output of the other products remains the same. Analogously, Congress' job is to figure out exactly what resources go to the production of "Persian Gulf protection," holding other protection services constant, and thusly to determine how much money can be saved when less Persian Gulf protection is required.

The task of figuring out how changes in threats affect the use of military resources is straightforward as regards those resources that are obviously, immediately, specifically, and directly related

---

[2] Note, too, that we are not asking whether defense expenditures constitute an unfair "subsidy" that ought to be eliminated, but rather simply whether they are a cost of oil use in the economic sense of "cost."

to a particular threat. The challenge is to figure out how "multi-purpose" costs that nominally pertain to more than one region or function are related to changes in a regional threat. Different analysts have handled this problem differently (some within the context of a "joint allocation" problem), and as a result estimates of the peacetime costs of maintaining a military presence in the Middle East have ranged widely, from as little as $0.5 billion to over $100 billion per year (Delucchi and Murphy, 2008).

Here, we distinguish two kinds of multi-purpose costs: the cost of non-combat DoD-wide overhead, and the cost of combat military programs or missions that serve more than one region. This distinction is pertinent to an analysis of the defense budget because a non-trivial fraction of the budget comprises overhead, administration, non-combat units, defense agencies, and other DoD-wide activities that are not attached to any one mission or program or region.

Let us consider first military programs that nominally protect more than one region, with an eye towards understanding the cost of protecting the Persian Gulf. In its own analysis of the cost of defending the Gulf, the DoD argued that all programs that covered the Persian Gulf *and* other regions would be fully funded regardless of US interests in the Persian Gulf (reported in the US Government Accountability Office, 2006). However, this actually would be true only if all of the following conditions held: (a) all multi-regional programs were sized to deal with the "biggest" regional threat, and the Persian Gulf was not the biggest regional threat; (b) forces and programs were developed to respond to only *one* regional problem at a time; and (c) no programs had any components specifically for the Persian Gulf mission. We doubt that all of these conditions hold, at least to the extent that the DoD averred. Indeed, it is much more likely that the opposite is true: that the procurement and deployment of military resources in the eyes of military planners as well as the eyes of Congress depends directly on the nature and extent of each and every perceived threat to US interests.

Next, we consider "overhead" costs. Because these costs are not assigned to any one mission or program or region, it is not immediately obvious how Congress and the President would budget for them if the US were no longer interested in the Persian Gulf. What is clear, though, is that in the long run there are few if any truly fixed costs. The number of planners, administrators, policy analysts, managers, and office workers, and the amount of resources devoted to them (including buildings and bases), are related to the amount of combat personnel and equipment being planned, administered, and managed. Indeed, it is not clear if there are any truly fixed costs—those that are the same regardless of the size of defense forces or the magnitude of a threat—except perhaps those related to upper-level administration (e.g., the salaries of senior staff in the Department of Defense), which are only a small fraction of total defense costs. Thus, we disagree with the conclusion of the DoD (GAO, 1991) that virtually all military costs are fixed in the long run. Ravenal (1991) summarizes our critique of the DoD position well:

> When attempting to justify its entire defense budget request, or when demonstrating to our allies that we are paying a disproportionate share of the costs of an alliance, the Pentagon prefers to state its costs fully. But when defending against proposed cuts, it claims that deleting this or that unit or program from the force structure or the budget would save only the tip of its marginal costs (p. 19).

We conclude, then, that Congress would in fact reduce outlays for general overhead and support if the US no longer had an interest in the Persian Gulf, and that it would do so relatively quickly. The federal budget is so tight, and the potential "peace dividend" so large, that it is not unreasonable to expect that Congress would take the opportunity to reduce DoD overhead.

2.2. Review of original estimates of the cost of defending the Persian Gulf

Ravenal (1991) and Kaufmann and Steinbruner (1991) have written widely cited book-length analyses of the US military budget, including estimates of the portion attributable to US interests in the Persian Gulf during peacetime. Both groups use what might be called a total cost approach, in which fixed costs (i.e., costs that supposedly do not vary with the magnitude of regional threats, such as DoD overhead, and forces with multiple missions), are allocated to all of the affected programs and thereby counted as economic costs of the mission or program. With this approach, they estimate that the cost of defending the Middle East was $50–$60 billion in the early 1990s (Table 1). A more recent analysis by Copulos (2003) is based on a similar total cost allocation approach and results in a similar estimate of $52–$62 billion in 2003 (Table 1).

By contrast, the DoD's own assessment of what it spends to defend the Persian Gulf in peacetime includes only those forces or programs that would be eliminated immediately and entirely if the US had no interests in the Persian Gulf, and excludes all expenditures for DoD-wide overhead and for forces and programs that would be assigned only partly to the Persian Gulf (GAO, 1991). As a result, the DoD estimate is relatively low: only $4.7 billion total between 1980 and 1990, or less than $0.5 billion annually (GAO, 1991; our Table 1).[3]

2.3. Other estimates of the cost of defending the Persian Gulf

There are a number of estimates that are based on a literature review or are not fully documented.[4] These estimates range from a low of $15 billion (Hubbard (1991) provides a range of $15–54 billion) to a high of $120 billion by Plesch et al. (2005) who claim (without elaboration) that 25% of the US military and intelligence budget is related to Middle East oil. While there is substantial variation in these estimates, most tend to range between $40 and 60 billion in the late 1990s.

2.4. Our estimates of the peacetime cost of defending the Persian Gulf

The detailed estimates of Ravenal (1991) and Kaufmann and Steinbruner (1991) are likely to be more accurate than the DoDs (GAO, 1991), although we do accept that a small fraction of DoD overhead costs would not be significantly affected if the Persian Gulf mission were eliminated. We believe that in the long run, nearly all defense costs are variable and that Congress would recognize this through base closures, reductions in personnel, scaling back operations, and reduced expenditures on material, equipment, and major weapons systems. This sort of restructuring happens frequently, and hence it is not unreasonable to expect that there would be major cost savings were a major military objective, such as protecting the Persian Gulf, eliminated.

---

[3] This is out of about $300 billion worth of programs that nominally were "dedicated" or "oriented" or generally in some way related to Southwest Asia over the 10-year period.

[4] These include Plesch et al. (2005), Cato Institute (1997, 2005), International Center for Technology Assessment (1998, 2005), Wahl (1996), Romm and Lovins (1992/93), Hubbard (1991), Carpenter and Fiscarelli (1990), Tonelson and Hurd (1990), and Sabonis-Chafee (1987). See Delucchi and Murphy (2008) for a summary.

Table 1
Original estimates of US military expenditures in the Middle East

Author (year)	Estimate (10^9 $)	Year of est. and $	Comments
Copulos (2003)	$52–62	~2003 (2003 $)	Estimated outlays for CENTCOM ($71–$86 bill./yr) multiplied by % of CENTCOM activities directed to Middle East (70%), plus $1.6 bill./yr in other Middle East costs
Ravenal (1991)	$50	FY1992 (1992 $)	Analyzes DoD reports to estimate percent of land forces allocated to Persian Gulf. Uses this ratio to estimate share of general-purpose forces attributable to the region
Kaufmann and Steinbruner (1991)	$64.5	FY1990 (1992 $)	Allocates budget to various "force planning contingencies," including defense of the Middle East
US GAO (1991)	$4.7 for SW Asia-specific missions over 10 years	Total for FY1980-FY1990 (1990 $)	Uses incremental cost approach, which includes only programs that would not exist (in the short run) without the SW Asia mission
Moreland (1985)	$54	?	Uses a CIA methodology to attribute costs; cited in Sabonis-Chafee (1987)

Note: CENTCOM = United States Central Command; DoD = Department of Defense; GAO = Government Accounting Office; CIA = Central Intelligence Agency.

The Ravenal (1991) and Kaufmann and Steinbruner (1991) estimates indicate that in the early 1990s, the United States could have saved $50–$60 billion per year (in peacetime) if it had had no interests in the Persian Gulf. However, to account for the possibility (acknowledged above) that Ravenal (1991) and Kaufmann and Steinbruner (1991) have underestimated "fixed" costs and hence overestimated the "variable" opportunity costs of interest, we assume that the peacetime cost of defending the Persian Gulf was $30–$60 billion per year in 1991. (In a moment we will add the expected cost of occasional conventional wars.)

For two reasons, we expect that the cost is higher today than it was in 1991. First, most of the estimates more recent than 1991 are higher than those of Ravenal (1991) or Kaufmann and Steinbruner (1991) (see Delucchi and Murphy, 2008), although one perhaps should not make too much of this because the estimation methods are different and because the lowest of the recent estimates (Copulos, 2003) may be the most credible because it is the most well documented. Second, a comparison of defense spending with the value of oil imports also suggests that the cost of protecting the Middle East has increased since 1991. Fig. 1 shows defense spending and the value of Persian Gulf oil imports from 1990 to 2004. The two time series clearly move together. This positive correlation is consistent with the hypothesis that defense expenditures are related to the amount and cost of oil imported from the Persian Gulf.[5] With these considerations, we assume that the peacetime cost of defending the Persian Gulf increased by 0.5–1.5% per year since 1991.

2.5. Wartime costs

Expected wartime costs related to the Persian Gulf can be estimated as the annual probability of a war of a given magnitude multiplied by the estimated annual cost of such a war. To estimate the annual cost of wars, we begin by noting that the DoD spent around $61 billion on the 1991 Gulf War (GAO, 1992, p. 51), although contributions from allies offset about $44 billion. From FY 2003 through FY 2006, the US federal government reportedly budgeted about $300 billion specifically for the Iraq War, and almost $100 billion for the war in Afghanistan (in current dollars, above peacetime spending levels), including costs of reconstruction (CBO, 2006a; Belasco, 2006; Wheeler, 2006). The CBO (2006b) projects that a further $200–$400 billion will be spent in Iraq through FY 2017 (in this case excluding reconstruction
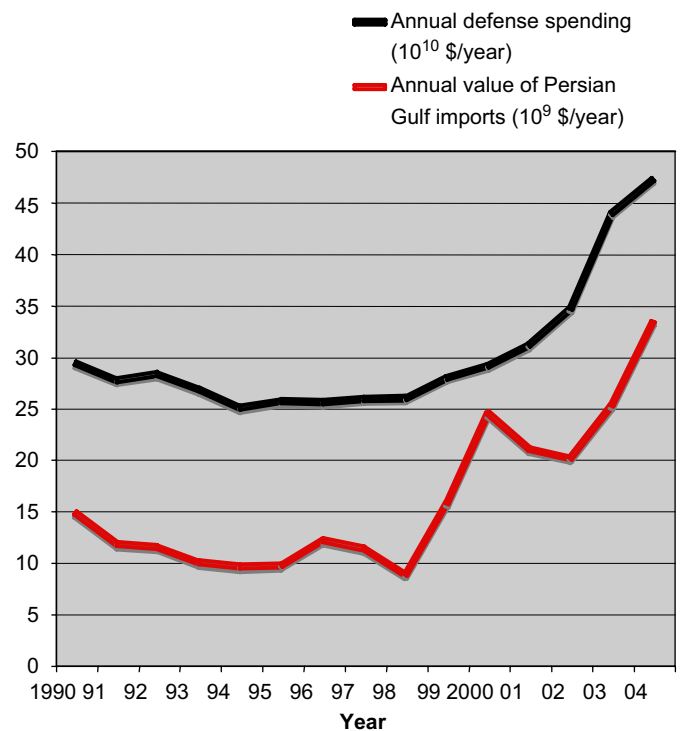

Fig. 1. Defense spending and the value of Persian Gulf oil imports, 1990–2004. *Source*: Defense spending from budget tables in the appendices of the DoD's *Annual Defense Report*, available at www.dod.mil/execsec/adr_intro.html; value of imports based on EIA (2007) and EIA web data at http://tonto.eia.doe.gov/dnav/pet/hist/i040000008a.htm. See Delucchi and Murphy (2008) for details.

costs).[6] However, as Bilmes and Stiglitz (2006) carefully point out, the total economic cost of the Iraq War is much more than the *reported* direct budgetary cost, which in any case underestimates the true total budgetary cost to the federal government. Bilmes and Stiglitz (2006) add overlooked budgetary costs (such as veterans disability payments and increased defense spending not specifically assigned by the government to the Iraq War) and non-budgetary economic costs (such as the economic cost of injuries and deaths), and estimate the economic cost of the Iraq War will be about $800–$1200 billion, or around a *trillion* dollars. They also

---

[5] Hall (1992) reports a similar finding for the period 1968–1989, relating defense spending to the quantity of oil imports.

[6] The CBO (2004) estimates wartime costs that are *in addition* to those for "routine" military operations, which is precisely what we want because we already estimate "routine" costs here (as "peacetime" costs).

Table 2
Our estimate of the military cost of oil use by motor vehicles: stepwise estimates of the cost (billion dollars per year)

US military costs that Congress might eliminate if	In 1991		In 2004	
	Low	High	Low	High
1. There were no Persian Gulf (peacetime costs plus additional annual-average war-time costs)	45.0	85.0	47.0	97.8
2. There were a Persian Gulf, but it did not have oil	25.5	63.8	26.7	73.4
3. The Persian Gulf had oil, but the US did not produce or consume Persian Gulf oil, while other countries did	17.1	51.0	17.9	58.7
4. The US produced but did not consume Persian Gulf oil	12.8	40.8	13.4	47.0
5. Motor vehicles in the US did not consume any oil	5.1	20.4	5.8	25.4

Source: See text for details. The estimates are not additive or cumulative, but rather step-wise. The estimates *do* include the additional cost of occasional wars in the Gulf, such as the 1991 Gulf War and the 2003 Iraq War, but do *not* include the cost of defending oil interests in other regions or the non-monetary costs of US defense policy.

point out that there are additional macroeconomic costs, such as losses in global income due to increases in the price of oil caused by the war (also see Wallsten and Kosec (2005), for a similar calculation).

Thus, the total cost of the 1991 Gulf War and the 2003 Iraq War is expected to be on the order of a trillion dollars, including rough estimates of the costs of reconstruction in Iraq, but excluding the cost of the war in Afghanistan on the grounds that it is not related to the Persian Gulf or oil. If such a sequence of wars is assumed to occur every 50 years, then the annual expected cost is approximately $20 billion per year. Based on this, we assume a range of $15–$25 billion per year, in current dollars for any year.

By comparison, Ravenal (1991) speculates that over a decade there might be a 10% chance of having a conventional war that costs half as much as did the Vietnam war (which Ravenal estimates cost $1050 billion in 1991 dollars), and an 0.25% chance of having a nuclear war that costs 25% of GNP; together, the two add up to an expected cost of $10 billion per year.

Our total estimate, therefore, is $30 billion–$60 billion in peacetime expenditures in 1991 which we increase at 0.5–1.5% per year ($32–$73 billion in 2004), plus $15–$25 billion annually in expected wartime expenditures, for a total of $47–$98 billion in 2004 as shown in Table 2.

3. Step #2: The cost of defending interests other than oil in the Persian Gulf

3.1. Background

We argue here that the major ongoing US interest in the Persian Gulf is to protect oil supplies, and hence that the cost of defending interests other than oil is a minor fraction of the total cost of defending the Persian Gulf. The reason for this is straightforward: oil is the major source of energy for every industrialized economy in the world, and as a result, the price and quantity of oil in the world market directly affect economic output. Moreover, the rate of change of the price and output of oil also affect economic output. If the world oil market were free and competitive, and if property rights were well defined and adequately enforced by property owners, then output and prices generally would be relatively stable, and the risks of sudden changes in output and prices would be low. If these risks were low, then arguably there would be relatively little need to police oil supplies.

Unfortunately, the world oil market is not always stable and competitive. The Organization of Petroleum Exporting Countries (OPEC) control about 70% of the world's proven oil reserves, and the Persian Gulf nations alone have 56% (EIA, 2006). Even though these nations produce only a small fraction of their reserves, and even though the United States imports only about 12% of its oil

from the Persian Gulf (EIA, 2007), the Persian Gulf can have a considerable influence on the world price of oil and thus on the economic welfare of the United States and other heavy users of oil. This influence can be direct and intentional, as when OPEC countries set prices and abide by output quotas, or unintentional, as the result of a conflict that disrupts production and thereby increases prices. Conflicts in the Middle East have been numerous and deadly: since World War II, over 90 military conflicts in the Middle East have claimed about 2.4 million lives.[7] The more expansive conflicts in the Persian Gulf inevitably threaten oil supplies. For example, during the Iran–Iraq War (1980–1988), the combatants attacked oil tankers and other commercial vessels from neutral nations, and as a result, Kuwaiti tankers were reflagged and escorted through the Gulf by the US military. The Iraqi invasion of Kuwait and the subsequent Gulf War in 1991 caused a brief panic in oil markets: immediately following the invasion, the world price of a barrel of oil more than doubled, from $16.19 in July 1990 to $30.03 in October 1990.[8]

Many economists observe that these oil price shocks hurt Western economies (Jones et al., 2004; Hamilton and Herrera, 2004).[9] Since 1947 there has been a strong correlation between oil price shocks and recessions: 10 of the 11 recessions between 1947 and 2001 were preceded by oil shocks, and 10 of the 11 oil shocks were followed by a recession (Hamilton, 1985; Santini, 1995).[10] Recent research suggests that the price shocks cause the recessions. In a review of the literature from 1996 to 2004 on the macroeconomic effects of oil price shocks, Jones et al. (2004) conclude that recessions that followed oil price shocks were attributable mainly to oil price shocks, and could not have been prevented by alternative monetary policies. Although the United States cannot easily prevent OPEC from agreeing to set prices or restrict output, it does believe that it can help prevent disruptions

---

[7] Most of these regional conflicts have been territorial disputes, religious cleavages, ethnic dissension, or ideological contests (Martin, 1987, p. 10). They have ranged from small-scale border clashes to large-scale, high-technology conflicts, such as the Iran–Iraq War, the 1991 Gulf War, and the 2003 Iraq War. For estimates of casualties through the early 1990s, see Cordesman (1993); for estimates of casualties in the 2003 Iraq War, see www.iraqbodycount.org and Burnham et al. (2006).

[8] Based on data retrieved from the EIA web site, http://tonto.eia.doe.gov/dnav/pet/hist/r0000___3m.htm (composite refiner acquisition cost) and http://tonto.eia.doe.gov/dnav/pet/hist/i000000004m.htm (US average "free-on-board" costs of crude oil).

[9] The past 25 years has seen the emergence of a very large literature on the macroeconomic impacts of oil price shocks. Makinen (1991) provides a clear discussion of the issues in lay terms. Mork (1981), Bohi and Montgomery (1982), Plummer (1982), McNaugher (1985), Hickman et al. (1987), Tsai (1989), Walls and Jones (1990), and Bohi (1991) give more rigorous analyses. Jones et al. (2004) provide an excellent summary of recent research.

[10] Recessionary periods reported by the Census Bureau (www.census.gov/hhes/poverty/histpov/recessn.html), and crude oil price histories are from the EIA (http://tonto.eia.doe.gov/dnav/pet/hist/f000000__3m.htm).

in production and flow due to conflicts in the Persian Gulf. Indeed, as we show next, the main objective of the US military in the Persian Gulf since 1974 has been to protect oil supplies.

3.2. US military objectives and plans for the Persian Gulf, 1974–1990

Throughout the 1970s and 1980s, the US Joint Chiefs of Staff explicitly stated that the US had three key objectives in the Persian Gulf: to contain Soviet influence, to keep the region stable, and to guarantee uninterrupted access to the largest proven oil reserves in the world (Joint Chiefs of Staff, FY1988, p. 16; Joint Chiefs of Staff, FY1989, p. 21). More importantly, the primary reason for the first two objectives was to ensure the third. Even when the Soviet Union was a still possible threat to US security, in every *Military Posture Statement* from fiscal year 1979–1989[11] the Joint Chiefs made clear that protection of oil supplies was a top priority. For example, in 1982 they stated that "of these interests [oil security, regional stability and Soviet containment], continued access to oil on reasonable political and economic terms is the most important to US and allied security" (Joint Chiefs of Staff, FY1982, p. 12; brackets ours).

According to Kaufmann and Steinbruner (1991), the United States military began contingency planning for the Middle East in 1974, right after the 1973 oil embargo, which generated fears of an OPEC attempt to strangle the West by restricting oil supplies. Contingency planning became a more important part of US military planning after 1980 as a result of the Iranian revolution and the Soviet invasion of Afghanistan, which highlighted the instability of the region (Kaufmann, 1992). Those events eventually led to the Carter Doctrine which stated:

> An attempt by any outside force to gain control of the Persian Gulf region will be regarded as an assault on the vital interests of the United States of America and such an assault will be repelled by any means necessary, including military force (Carter, 1980, p. 197).

Also in 1980, the US established the Rapid Deployment Joint Task Force, which in 1983 became the US Central Command (CENTCOM). CENTCOM's primary responsibility was to protect US interests in Southwest Asia, including the Persian Gulf (Joint Chiefs of Staff, 1992, 4-3).

3.3. US military objectives in the Persian Gulf after the fall of the Soviet Union

The end of the Cold War essentially eliminated any Soviet threats to US interests, including those in the Middle East. As a result, the US reformulated its military strategy to focus on regional, rather than global conflicts (Joint Chiefs of Staff, 1992). Without a Soviet threat to contain, protecting access to oil supplies became the paramount if not the sole concern of the US military in the Persian Gulf. In March 1992, the New York Times published a story regarding the draft of a classified Pentagon document that stated the US military objective in the Persian Gulf unequivocally:

> In the Middle East and Southwest Asia, our overall objective is to remain the predominant outside power in the region and preserve US and Western access to the region's oil (US Department of Defense, 1992; cited in Tyler, 1992).

Three years later, the Assistant Secretary for Defense for Economic Security, Joshua Gotbaum, reiterated the Defense Department's position to a Senate hearing on US dependence on foreign oil when he testified that "…protecting against military threats to global oil supplies is an important factor for which we must be prepared" (cited in Koplow and Martin, 1998, 4-2). Finally, in a discussion of US policy towards the Persian Gulf, Fuller and Lesser (1997, p. 42), state that "Gulf policy is founded on the principal that access to the region's oil is critical to Western—indeed global—prosperity."

3.4. Counter arguments

We have made the case that the US spends money on defense of the Persian Gulf mainly because of its oil supplies. However, some analysts disagree with this. In an analysis of the external costs of oil use in transportation, the Congressional Research Service (CRS, 1992) argues that concern about oil has been but one of many reasons that the US military has cared about the Persian Gulf, and even implies that oil security is a minor concern. In this section we review and rebut the CRS' arguments, which in some form have been made by others.

First, the CRS (1992) claims that throughout the Cold War, the US military was concerned more with the Soviet threat (per se) in the Persian Gulf than with US oil interests. However, the CRS does not offer any evidence in support of this claim, which as noted above is directly refuted by statements in every *Military Posture* document by the Joint Chiefs of Staff from 1979 to 1989.

Next, the CRS (1992) claims that the US military also is concerned with the security of Israel. However, we see no evidence of a major military policy concern for Israel per se, independent of general concerns about oil supply security for the region, and apart from the economic and military grants that the US makes directly to Israel (and which we discuss more later). The Joint Chiefs of Staff were clear on this when they stated that:

> The United States is determined to preclude disruption or hostile control of the vital resources and to limit the spread of Soviet influence in the area. Other US interests, important in their own right *but bearing heavily on the security of energy resources*, include peaceful resolution of the Arab–Israeli conflict and increased stability throughout the region (Joint Chiefs of Staff, FY1983, p. 6, emphasis added).

On account of its oil interests in the Gulf, the US certainly does want the region to be stable, and to forestall and resolve Arab–Israeli conflicts. Thus, US military policy is not concerned significantly with the security of Israel per se, but rather with regional stability because of the region's oil. We contend that if the Middle East had neither oil nor strategic importance, the US would *not* make a significant military commitment in the region solely to help protect Israel. Fuller and Lesser (1997) agree, stating that "at this point, Israel's security, however important, does not represent an extra dimension of US Gulf Policy" (p. 45).[12]

Third, the CRS argues that the failure of the US to go to war after the 1973–1974 oil embargo (which was a trade policy of sovereign nations) and the 1979 Iranian oil disruptions (due initially to a strike by oil workers in Iran) suggests that the US military really was not concerned with protecting oil supplies then. However, this argument is off point in two ways. First, we

---

[11] FY1989 is the last year for which this document is available.

[12] Note that we are *not* arguing that the US does not have any interest in the security Israel; rather, we are arguing that the US military policy towards the Middle East is not predicated ultimately on the security of Israel. Indeed, as we discuss later, the US does give Israel military and economic grant aid (the cost of which is separate from the US DoD costs estimated here). Thus, whatever interest the US has in the security of Israel it expresses mainly by giving Israel military and economic aid rather than by devoting more resources to the US military presence and operation in the Middle East.

are arguing here that the US is prepared to respond to major military threats to oil supplies, not that the US plans to attack sovereign nations that merely have trade policies or internal economic problems that it does not like. Second, while it may be true that the US military was not much concerned with risks to oil supplies before the 1973–1974 oil embargo, this hardly means that the US military never became concerned afterwards. To the contrary, it seems clear that the 1973–1974 embargo demonstrated the severe economic consequences of major oil price shocks and hence the need consider defending against military threats to oil supplies.

Finally, the CRS suggests that another "major" interest is the protection of US citizens, but given the small number of tourists in the Middle East—maybe 10,000 in the oil-rich nations, out of a total of nearly 7 *million* US tourists abroad in the early 1990s (Bureau of the Census, 1992), this seems highly unlikely. (In addition, about 50 thousand US citizens were residents in the oil-rich countries of the Middle East, but it is likely that most of them worked for oil companies or related ventures, and hence would not be there if the region were not oil-rich.)

3.5. Our estimate of the cost of defending Persian Gulf interests other than oil

If, as we have argued, the main concern of the US military in the Persian Gulf is to protect oil supplies, and if, as we also have argued, most military resources vary as a function of the number and extent of threats, then it follows that if there were no oil in the Persian Gulf, Congress eventually would eliminate most of the defense spending related to the Persian Gulf. (It would not eliminate *all* Persian Gulf defense spending because of non-oil interests in the Gulf and because of the fixed costs that are incurred if there is any regional defense at all, regardless of its size, scope, and purpose.) We assume that if there were no oil in the Persian Gulf, Congress would reduce peacetime Persian Gulf military expenditures by 60–75%, and leave 25–40% to protect non-oil interests and cover fixed costs (which are likely to be relatively small).

By contrast, Koplow and Martin (1998) assume that non-oil interests—promoting regional stability, and preventing the emergence of a hegemonic power—are responsible for 67% of the cost of defending the Persian Gulf. However, we think that this is too high, because if the area did not have so much oil, it is unlikely that the world would care much about it is political make-up and stability.[13] Moreover, Koplow and Martin (1998) note that Earl Ravenal, an expert on military spending, believes that virtually all defense spending on the Middle East should be attributed to oil.

We also assume that the percentage by which Congress would reduce in wartime expenditures where there is no oil in the Middle East is similar to the percentage it would reduce in peacetime expenditures. In support of this, we note that there is ample evidence that the desire to protect access to Middle East oil is a major factor in US wars in the Middle East. For example, Plesch et al. (2005) claim that "oil played a strong if not determining factor" (p. 8) in the Iraq–Iran War, the 1991 Gulf War, and the 2003 US invasion of Iraq. Similarly, Copulos (2003) notes that "while there are a variety of concerns associated with the Baghdad regime, the security of energy resources in the region is unquestionably a major consideration—especially given Saddam Hussein's repeated attempts to gain control over neighboring

oil-rich territory" (p. 30). Copulos (2003) ends up assuming that 50% of the wartime costs are attributable to oil. With these considerations, we assume that if there were no oil in the Middle East, the expected annual cost of wars in the area would be 50–75% less.

4. Step #3: The cost of defending against a worldwide recession resulting from an oil price shock

Rapid changes in the price of oil could occur and would affect the US even if the US did not import any oil from the Middle East. A Congressional Research Service (CRS) analysis conducted after the 1991 Gulf war concluded that "so long as domestic suppliers of energy can participate in these [world oil] markets, disruptions to the world supplies of energy will be felt even in a self-sufficient United States as domestic suppliers of the affected energy source divert their supplies to foreign markets and as suppliers of substitute energy sources do the same" (Makinen, 1991, p. CRS-7). Moreover, even if the US did not produce or consume any oil at all, it still would be hurt by a worldwide recession triggered by a rapid increase in oil prices, at a minimum because foreign demand for US goods and services would decrease. Unfortunately, we have no way of estimating how important it is for the US to protect itself against this effect alone, as distinct from effects related to US production and consumption of Persian Gulf oil. We simply assume that this general interest in preventing any price shock, regardless of US oil imports, is significantly less important than are the interests related specifically to US production and consumption of Persian Gulf oil. Quantitatively, we assume that in the eyes of Congress, the value of defending against worldwide price shocks is 20–33% of the total value of defending Persian Gulf oil, and hence that the direct interests of US producers and consumers of Persian Gulf oil are 67–80% of the total value of defending Persian Gulf oil.[14]

5. Step #4: The cost of defending the investments of US oil producers in the Persian Gulf, apart from the interests of US oil consumers

Even if the US did not consume any oil at all and somehow was completely insulated from the worldwide economic impacts of sudden increases in the price of oil, Congress probably would still allocate resources to defend Persian Gulf oil because US corporations have invested billions of dollars in the petroleum industry in the Persian Gulf and sell billions of dollars worth of Persian Gulf oil worldwide. We can gain a sense of Congress' assessment of the need to defend the interests of producers per se by comparing the value of US oil producer assets, sales or investment in the Middle East with the value of US consumption of oil from the Persian Gulf.

Our analysis of data from the Bureau of Economic Analysis (BEA) indicate that the assets of Middle East affiliates of US petroleum companies have ranged from $15 billion in 1997 to perhaps as much as $30 billion today.[15] Sales of Middle East affiliates have ranged from $7 billion (1997) to about $15 billion today, and direct investment by the US petroleum industry in

---

[13] Koplow and Martin (1998) base their allocation on the discussion in Fuller and Lesser (1997) of US goals in the Persian Gulf. However, we believe that Fuller and Lesser (1997) clearly indicate that the goals of preserving regional stability and preventing the emergence of a regional power ultimately derive from the overall all goal of preserving access to oil at reasonable prices.

[14] It is possible that this portion of the marginal defense cost per gallon increases with increasing oil consumption. This will be the case if the higher prices that result from greater consumption cause an increase in the potential macroeconomic cost of a disruption, and if this higher potential cost elicits higher defense expenditures.

[15] http://www.bea.gov/bea/di/home/directinv.htm, Financial and operating data tables, accessed September 2006. We have extrapolated the trends in the data. See Delucchi and Murphy (2008) for details.

foreign affiliates in the Middle East has ranged from $3 billion in 1997 to perhaps $5 or $6 billion today (Delucchi and Murphy, 2008). Delucchi and Murphy (2008) also assume that direct-plus-indirect investment, where indirect investment is Middle East investment by US petroleum companies via non-Middle East holding companies, ranged from $4 billion in 1997 to about $9 billion today.[16]

Which of these measures best represents (in the eyes of Congress) the value of the "interest" of US petroleum companies in the Middle East? Using the assets of Middle East affiliates of US petroleum companies probably overstates the Middle East interest of US producers because US parent companies do not own all of the assets of their foreign affiliates (Mataloni, 1995). Similarly, although the sales of Middle East affiliates of US petroleum companies may be a ready indicator to Congress of the magnitude of the Middle East interest of US producers, if US parent companies do not own all of the assets of their foreign affiliates, then they probably do not have stake in all of their sales. On the other hand, direct investment in Middle East affiliates probably understates the Middle East interest of US oil companies because US companies have indirect as well as direct investment in their Middle East affiliates. Direct-plus-indirect investment may be the best indicator of the value of the interest of US producers in the Middle East, but unfortunately it also is the most uncertain.

The discussion to this point suggests that value of the interest of US oil producers in the Persian Gulf has ranged from $4 billion in 1997 to perhaps $10 to $20 billion per year today. However, one also has to consider that if the US did not consume Persian Gulf oil, US producers might have less of a stake in the production of Persian Gulf oil. Allowing for this, we assume that the interests of US producers in the Persian Gulf, apart from the interest of US consumers of Persian Gulf oil, have ranged from $3 billion per year in the mid 1990s to about $10 billion per year in 2005.

This range of $3–$10 billion as the value of US oil producer interest in the Middle East can be compared with the value of US oil consumer interest in the Middle East, represented by the value of petroleum imports from the Persian Gulf. The value of petroleum imports has ranged from around $10 billion between 1993 and 1998 to over $40 billion in 2005.[17] Therefore, on the basis of these illustrative estimates, we assume that in the eyes of Congress, the interests of US producers in the Persian Gulf are 25–33% of those of US consumers of Persian Gulf oil, and that Congress budgets defense spending accordingly.[18]

6. Step #5: The cost of defending the use of oil in sectors other than highway transportation

The deductions to this point (see Tables 2 and 3) leave us with the cost of protecting US consumption of Persian Gulf oil in all sectors of the US economy (motor vehicles, other ground transportation, air and water transportation, heating, power plants, etc.). We now wish to estimate the cost of protecting US consumption of Persian Gulf oil by motor vehicles specifically, both in total dollars (for the whole motor vehicle sector) and per gallon of all motor fuel used by motor vehicles. If petroleum from the Persian Gulf was distributed randomly throughout the US

economy—i.e., if it was thoroughly mixed with all other petroleum used in the US before being refined and distributed—then the fraction of Persian Gulf petroleum that ended up being used by motor vehicles would be the ratio of total petroleum consumption in the motor vehicle sector to total petroleum consumption in all sectors in the US. This ratio has been increasing gradually, from about 48% in 1991 to 52% in 2005.[19]

However, for two reasons, the fraction of Persian Gulf oil that ends up in the motor vehicle sector may not be equal to this ratio. First, although it is difficult to trace the flow of crude oil from the Persian Gulf to any particular end-use sector, it is not difficult to trace the flow of other petroleum products: for example, all motor gasoline but no residual fuel is used in the motor vehicle sector. Data in Delucchi (1996) indicate that in 1991, slightly more Persian Gulf petroleum products went to non-motor vehicle sectors than to motor vehicle sectors, with the result that in 1991, 46.4% of Persian Gulf petroleum went to the motor vehicle sector, assuming still that Persian Gulf crude oil was randomly mixed with other sources of crude oil.

Second, Persian Gulf crude oil might not be randomly distributed to all end uses; by chance or by market forces, it might be disproportionately used more in one sector than another. For example, it might be that in the long run reductions in oil use reduce domestic production rather than Persian Gulf imports, because domestic oil tends to be more costly than Persian Gulf imports.

Given these considerations, and without doing a formal analysis, we assume that in 1991, 40–50% of Persian Gulf petroluem ended up as motor fuel. We then assume that these percentages increased at 0.6% per year, consistent with the data cited above that indicate that the motor fuel share of total petroleum consumption has been increasing slightly over time.

7. Results and discussion

Tables 2 and 3 show the results of the analysis. Table 2 shows the results of the five-step analysis presented above. Table 3 shows the cost of defending each individual "interest" in the Persian Gulf, including interests unrelated to oil use. The bottom line of our analysis is that if all motor vehicles in the US (light-duty and heavy-duty) did not use oil, Congress might reduce defense spending by $6–$25 billion annually in the long run. This amounts to about $0.03–$0.15 per gallon ($0.01–$0.04 per liter) of all gasoline and diesel motor fuel in 2004 (based on fuel use data from the Federal Highway Administration, 2008). The lower end of this range is trivial, but the upper end is not.

We emphasize that ours is not an estimate of the total social or external cost of importing oil from the Persian Gulf. The total social cost of importing oil in transportation also includes other energy security costs, such as the macroeconomic costs of oil market disruptions and sustained high oil prices. Leiby (2007) estimates that these other energy security costs amount to $7–$23 per barrel of imported oil, or approximately $0.07–$0.30 per gallon ($0.02–$0.08 per liter) of all highway fuel (assuming that about 44–55% of imported oil currently goes to highway fuel)—approximately twice as large as the military costs we have estimated.

---

[16] The use of holding companies increased dramatically from 9% of the direct investment abroad position in 1982 to 35% in 2004 (Koncz and Yorgason, 2006).

[17] Our estimates based on data from the EIA (EIA, 2006a; http://tonto.eia.doe.gov/dnav/pet/hist/i040000008a.htm).

[18] Again, it is possible that this portion of the marginal defense cost per gallon increases with increasing oil consumption. This will be the case if the higher prices that result from greater consumption cause an increase in the "value" of the corporations, and if this higher value elicits higher defense expenditures.

[19] Calculated by dividing the total volume of highway fuel consumed (Federal Highway Administration (2008)) by the total volume of petroleum products supplied (EIA, 2007), and then adjusting the resultant ratio to account for differences in density between motor fuel and other petroleum products and for the use of non-petroleum products in motor fuel (adjustments based on data in Delucchi, 1996).

Table 3
Our estimate of the military cost of oil use by motor vehicles: the cost of defending each US interest in the Persian Gulf (billion dollars per year)

The cost of defending:	In 1991		In 2004	
	Low	High	Low	High
The use of oil by motor vehicles in the US[a]	5.1	20.4	5.8	25.4
The use of oil by other sectors in the US[b]	7.7	20.4	7.6	21.6
The interests of US oil producers in the Persian Gulf[c]	4.3	10.2	4.5	11.7
The world economy from the effects of disruptions in the supply of oil from the Persian Gulf[d]	8.4	12.8	8.8	14.7
US non-oil interests in the Perisan Gulf[e]	19.5	21.3	20.3	24.5
All US interests in the Persian Gulf (sum of above)	45.0	85.0	**47.0**	**97.8**

[a] From line 5 of Table 2.
[b] The difference between line 4 and line 5 of Table 2.
[c] The difference between line 3 and line 4 of Table 2.
[d] The difference between line 2 and line 3 of Table 2.
[e] The difference between line 1 and line 2 of Table 2.

In principle, the uncertainty in our estimate could be narrowed through a carefully specified model in which some measure of US oil interests in the Persian Gulf, along with measures of other determinants of the US military budget, explain the military budget over time. The challenge, of course, is to find an adequate measure of US oil interests, and to identify and quantify other determinants of the military budget. Hall (1992) made an attempt in this direction by estimating an autoregressive moving average model in which total defense spending in year t depended on imports of crude oil and petroleum products in year $t-2$ (the 2-year lag accounts for lags in the political, legislative, and budgetary processes). Hall (1992) found that for every million barrels of daily oil imports, defense spending increased by \$2.67 billion (in 1982 dollars). (At current levels of imports [about 5 billion barrels per year] and in 2005 dollars, the defense cost would be on the order of \$60 billion per year). Of course, given that his is a single variable regression, one reasonably can argue that the results are spurious, or that the oil import variable captures the effects of omitted correlated variables, or even that if there is any causality, it goes the other way (i.e., that something that is associated with an increase in military spending causes an increase in oil imports). We encourage further analytical work in this area, to help narrow the range of reasonable estimates.

7.1. Other issues bearing on the analysis

7.1.1. Free riders on US defense
Should some of the US military cost be allocated to oil consumption and production by other nations, on the grounds that these other nations benefit from US military expenditures? The answer is an unambiguous "no". These other nations are free riders, and whenever there are free riders the incidence of benefits does not correspond to the incidence of costs. In an economic cost or cost-benefit analysis, the relevant question always focuses on opportunity cost, on the counterfactual: if the US did not have oil interests in the Persian Gulf, and in fact was completely insulated from any worldwide recessions traceable to any country's use of Persian Gulf oil, it certainly would not spend money (without reimbursement or reciprocation) to protect oil in the Persian Gulf. US expenditures are motivated entirely by US interests, broadly defined, and the presence of free riders does not change this.

7.1.2. Military spending and economic growth
One might ask whether military spending affects economic growth, and hence has social benefits or costs in addition to the direct expenditures. One could argue, for example, that technological spin-offs of military research and development become a positive externality in the private sector and contribute to economic growth. On the other hand, one could argue that defense spending takes money from more productive uses. As it turns out, most studies have found either no link between defense spending and economic growth, or else weak and ambiguous links.

There are some suggestions that reductions in defense spending boost the economy (Mintz and Huang, 1990; Congressional Budget Office, 1992; Findlay and Parker, 1992; Heo, 1998; Boyd and Chermak, 2002). However, others have found that reductions in defense spending might hurt the economy (Atesoglu and Mueller, 1990; Thomas et al., 1991; Mehay and Solnick, 1990), and many analysts have found no links between defense spending and economic growth (Kinsella, 1990; Gold and Adams, 1990; Dunne, 1990; Payne and Ross, 1992; Huang and Mintz, 1990, 1991; Gerace, 2002). Gerace (2002) sums up prevailing views well, observing that "the net effect of military expenditures on economic growth is theoretically ambiguous" (p. 2), and that "there is no general consensus on whether military spending positively or negatively affects economic growth" (p. 1). Payne and Sahu (1993) offer a similar assessment. On the basis of this brief literature review, we conclude that defense spending does not have any offsetting economic benefits or additional external costs.

7.1.3. The shape of the total cost function
As mentioned above, if the total cost vs. quantity function is nonlinear, then the marginal \$/gallon cost today could be higher than our estimate of the average \$/gallon cost. We think this is likely to be the case. For example, if the oil defense cost per gallon is proportional to the price of oil per gallon, then given that the price of oil increases with quantity, the defense cost per gallon will increase with quantity, the total-cost function will be nonlinear, and the marginal defense cost at today's quantity of oil will be greater than the average cost. The defense cost per gallon will be proportional to price if (for example) the total defense cost is proportional to total revenues received by oil exporting countries, which in turn will be the case to the extent that the general instability in the Middle East that the US is defending against is positively related to oil revenues.[20] Although we cannot formally evaluate these possibilities, we think they are plausible examples of mechanisms that can lead to a nonlinear total cost function.

---

[20] An anonymous reviewer suggested this possibility.

7.1.4. Military-related costs other than peacetime and wartime military expenditures for the Persian Gulf

Expenditures on the military are only a portion of the entire relevant military or "security" cost of using oil. Just as the total social cost of pollution due to cars is equal to the value of the resources devoted to controlling pollution (the control cost) plus the value of the resources damaged by whatever pollution still is emitted (the residual damages), the total military or security cost of using oil is equal to the military "control" cost plus the dollar cost of whatever military or security problems remain in spite of, or even due to, the military expenditures. These "residual" costs include reduced flexibility in the conduct of US foreign policy, strains on international relations due to the activities of the US military and even due to competition for oil (US Department of Energy, 1987), anti-American sentiments due to the presence of the US military in the Middle East (Cato Institute, 2005, p. 563), political destabilization of the Middle East, and the nonfinancial human-suffering costs of war and political instability related to US demand for oil. Although to our knowledge nobody has ever quantified these costs, they are important.[21] Indeed, one could argue that a primary motivation of many programs and policies aimed at reducing US dependence on foreign oil is not to reduce military expenditures related to defending the Persian Gulf, but rather to mitigate some of the political and human costs associated with US demand for Persian Gulf oil. If this is right, then the "costs" that we have *not* estimated may be large relative to the military costs we have estimated.[22]

7.1.5. Will Congress reduce defense expenditures in the future, given the same set of interests to protect?

Kaufmann and Steinbruner (1991) and Carpenter and Fiscarelli (1990) have argued that defense expenditures in the Middle East can be substantially reduced without compromising US objectives in the region. If Congress recognizes this and decides that it can provide for what it perceives to be necessary missions in the region at less cost, then present expenditures overestimate future costs, and we have overestimated the future military costs of oil use in transportation.

Ravenal (1991) suggests that US military stop policing the Gulf altogether and instead let the private sector protect against supply disruptions by developing domestic petroleum and non-petroleum fuels and using petroleum more efficiently. It is tempting to assume that if the private sector were entirely responsible for policing and protecting its oil supplies that it would spend less than what the US military is estimated to be spending today, but we do not have an empirical basis for such an assumption.

7.1.6. Is economic and military assistance to the Middle East related to oil use, and hence an additional "hidden" cost of oil use?

The United States maintains an influence in the Middle East not only through its military presence and operations, but also through foreign military sales (which are separate from peacetime and wartime defense spending) and various types of foreign aid to countries throughout the region. Countries of the Middle East and North Africa receive 80–90% of all US military assistance and

30–40% of total US assistance—generally between $5 and $6 billion in total assistance per year (US Agency for International Development, 1993, 2006). Is any of this assistance—which is not part of the US Defense budget, and is distinct from the US military costs estimated above—attributable to countries in the Middle East and North Africa motivated by US oil interests in the region?

Most of the US assistance in the Middle East and North Africa goes to Israel and Egypt. It is likely that none of the grants to these countries are *directly* related to US oil interests, primarily because these countries do not produce much oil. However, to the extent that grants to these countries are meant to promote regional stability (as opposed to, say, the security or economic development of an individual country), they arguably are related to US oil interests because, as discussed above, the US' main reason for wanting to keep the region stable is to keep the oil accessible.

Israel receives more outright grant money from the US than does any other country in the Middle East. The relevant counterfactual question, again, is how much (if at all) the US would reduce this grant aid to Israel were there no oil in the Middle East and hence no general regional stability concerns related to oil. The US would probably continue to give Israel grant aid even if there were no oil in the Persian Gulf because this assistance is meant to benefit Israel specifically.[23] Indeed, as we argued above, the most plausible interpretation of US policy is that it satisfies security concerns for Israel directly through military and economic grants to Israel rather than indirectly via general US military planning and operations in the Persian Gulf.

Egypt is the second largest aid recipient in the region. To some extent, aid to Egypt is motivated by a desire to promote regional stability, which in turn is motivated by the desire to protect the oil there. A strong relationship with Egypt also provides the United States with an alliance with an important Arab nation and helps the US maintain an influence in the region. Thus, an argument could be made that at least some and perhaps most of the $2 billion in annual assistance to Egypt (US Agency for International Development, 2006) could be linked indirectly to US oil interests in the region.

In summary, we conclude that if there were no oil in the Middle East, the US would scale back its annual military and economic assistance to Middle East countries by less than $2 billion. Moreover, even if the US did give less grant aid to the Middle East, it very well might give more to other regions. (Although, if this were the case, one would have to consider that there might be a cost to the US of *not* giving to these other regions now.) It is not clear, then, whether US oil interests in the Middle East cost the US more than a trivial amount in grant aid.

7.1.7. Summary of other issues

The cost of economic and military assistance related to oil, and the cost of defending oil supplies outside of the Persian Gulf—neither of which we have included—are likely to be relatively small compared to the costs we have included. However, the unquantified non-monetary costs of the US' Persian Gulf military policy and operations may be significant. Moreover, if the total defense cost vs. oil consumed function is nonlinear, the marginal defense cost today may be higher than we have estimated. On the other hand, if Congress decides that it can protect US interests in the Persian Gulf for much less than it is spending today, then we have significantly overestimated future costs.

---

[21] If one accepts the estimate of Burnham et al. (2006) that over 600,000 people have died in Iraq as a result of the US war, and if one believes that there would not have been a war and hence that those people would not have died if the region did not have oil, then the oil/war-related cost of those deaths could be on the order of $10 billion per year, depending on how many more people die, the statistical value of life, and the frequency of such conflicts.

[22] Also, we have not included the military cost of protecting oil interests in any other regions. For example, the US might be spending money to defend oil pipelines and ports in Alaska, oil refineries in the Caribbean, and oil fields in South America, Africa, and Indonesia. We suspect, though, that these defense expenditures are small compared to those for the Persian Gulf.

[23] Actually, given that US assistance to Israel antagonizes the oil-owning Arab states that are hostile to Israel, and hence undermines US "oil security" in the region, it is possible that US assistance to Israel would increase were there no oil-related issues to constrain US policy towards Israel.

8. Summary and conclusion

Analyses of the full social cost of motor vehicle use often include the military cost of defending oil supplies from the Persian Gulf. We have tried to provide a credible estimate of this cost, by carefully answering the question: "If the US highway transportation sector did not use oil, how much would the US federal government reduce its military commitment in the Persian Gulf?" Our analysis accounts for the fact that, in regards to the Persian Gulf, the US cares not only about the use of Persian Gulf oil in transportation, but also about the use of the region's oil in non-transportation sectors, the interests of US oil producers in the Persian Gulf, the stability of the world price of oil, and even matters unrelated to oil. We recognize that other analysts might disagree with us at every step. Certainly, we cannot deny the possibility that the military cost of using Persian Gulf oil in transportation is less than our lower bound and essentially zero. (We doubt, however, that a case can be made that it is much larger than our upper bound, unless one expands the analysis to include the value of the non-monetary impacts of military policy). The key question—how much would Congress reduce defense spending if the US becomes less dependent on oil from the Persian Gulf?—cannot be answered easily by a formal model, and it is always possible that Congress would do nothing. However, we have presented arguments and evidence in support of the proposition that spending on defense of the Persian Gulf is in fact related to US interests in the region, which are mainly but not entirely oil interests. Our best estimate of this relationship translates to $0.03–$0.15 per gallon ($0.005–$0.05 per liter) of all gasoline and diesel fuel used by motor vehicles. We recommend that this range be used in analyses of the social cost of motor vehicle use in the US.

Acknowledgements

References

Atesoglu, H.S., Mueller, M.J., 1990. Defence spending and economic growth. Defence Economics 2, 19–27.

Belasco, A., 2006. The cost of Iraq, Afghanistan, and other global war on terror operations since 9/11. Order Code RL331210, Congressional Research Service, Washington, DC, June 16. ⟨www.fas.org/sgp/crs/natsec/RL33110.pdf⟩.

Bilmes, L., Stiglitz, J.E., 2006. The economic costs of the Iraq War: an appraisal three years after the beginning of the conflict. NBER Working Paper Series, Working Paper 12054. National Bureau of Economic Research, Cambridge, MA, February. ⟨http://www2.gsb.columbia.edu/faculty/jstiglitz/cost_of_war_in_iraq.pdf⟩.

Bohi, D.R., 1991. On the macroeconomic effects of energy price shocks. Resources and Energy 13, 145–162.

Bohi, D.R., Montgomery, W.D., 1982. Oil Prices, Energy Security, and Import Policy. Resources for the Future, Washington, DC.

Boyd, R., Chermak, J.M., 2002. The Impacts of Current US Oil Policy: A Dynamic CGE Model, draft manuscript. University of New Mexico ⟨www.unm.edu/~econ/faculty/chermak_files/oilprice.pdf⟩.

Bureau of the Census, 1992. Statistical Abstract of the United States 1992. US Department of Commerce, Washington, DC.

Bureau of the Census, 2007. Statistical Abstract of the United States 2007, 126th ed. US Department of Commerce, Washington, DC ⟨http://www.census.gov/compendia/statab⟩.

Burnham, G., Lafta, R., Doocy, S., Roberts, L., 2006. Mortality after the 2003 Invasion of Iraq: a Cross-Sectional Cluster Sample Survey. The Lancet October 11 ⟨www.thelancet.com/webfiles/images/journals/lancet/s0140673606694919.pdf⟩.

Carpenter, T.G., Fiscarelli, R., 1990. Defending America in the 1990s: a budget for strategic independence. In: America's Peace Dividend: Income Tax Reductions from the New Strategic Realities. Cato Institute, Washington, DC August 7.

Carter, P.J., 1980. The State of the Union, January 23, 1980. Weekly Compilation of Presidential Documents, 16, January 28.

Cato Institute, 1997. The 1998 Defense Budget. Chapter 7 in the Cato Handbook for Congress: Policy Recommendations for the 105th Congress, Washington, DC. ⟨www.cato.org/pubs/handbook/hb105/hb105-7.html⟩.

Cato Institute, 2005. Towards a Sensible Policy in the Middle East. Chapter 56 in the Cato Handbook on Policy, sixth ed., Washington, DC. ⟨www.cato.org/pubs/handbook/hb109/hb_109-56.pdf⟩.

Clayton, M., 2007. US house takes on big oil. Christian Science Monitor January 18 ⟨www.csmonitor.com/2007/0118/p01s01-usec.html⟩.

Congressional Budget Office, 1992. The Economic Effects of Reduced Defense Spending, Washington, DC, February.

Congressional Budget Office, 2004. Estimating Continuing Operations in Iraq and Other Operations of the Global War on Terrorism, Washington, DC, June 25. ⟨www.cbo.gov/ftpdocs/55xx/doc5587/Cost_of_Iraq.pdf⟩.

Congressional Budget Office, 2006a. Estimated Funding for Operations in Iraq and the War on Terrorism, Washington, DC, August 25. ⟨www.cbo.gov/ftpdocs/75xx/doc7506/GWOT_Tables_2006_08.pdf⟩.

Congressional Budget Office, 2006b. Estimated Costs of US Operations in Iraq Under Two Specified Scenarios, Washington, DC, July 13. ⟨www.cbo.gov/ftpdocs/73xx/doc7393/07-13-IraqCost_Letter.pdf⟩.

Congressional Research Service, 1992. The external costs of oil used in transportation. CRS Report for Congress 915-874 ENR, The Library of Congress, US Congress, Environmental and Natural Resources Policy Division, Washington, DC, June 17.

Copulos, M.R., 2003. America's Achilles Heel, The Hidden Costs of Imported Oil. The National Defense Council Foundation, Washington, DC October ⟨http://ndcf.homeip.net/ndcf/energy/NDCF_Hidden_Costs_of_Imported_Oil.pdf⟩.

Cordesman, A.H., 1993. After the Storm: the Changing Military Balance in the Middle East. Westview Press, Boulder, CO.

Delucchi, M.A., 1996. The Allocation of the Social Costs of Motor vehicle Use to Six Classes of Motor Vehicles, UCD-ITS-RR-96-3 (10). Institute of Transportation Studies, University of California, Davis December ⟨www.its.ucdavis.edu/people/faculty/delucchi⟩.

Delucchi, M.A., Murphy, J., 2008. US military expenditures to protect the use of Persian Gulf oil for motor vehicles. UCD-ITS-RR-96-3 (15) rev. 3. Institute of Transportation Studies, University of California, Davis March ⟨www.its.ucdavis.edu/people/faculty/delucchi/⟩.

Dunne, P., 1990. Military expenditures and unemployment in the OECD. Defence Economics 1, 57–73.

Energy Information Administration, 2006. International Energy Outlook 2006, DOE/EIA-0484(2006). US Department of Energy, Washington, DC June ⟨www.eia.doe.gov/oiaf/ieo/index.html⟩.

Energy Information Administration, 2007. Annual Energy Review 2006. DOE-EIA/0384(2006), Washington, DC, June 27. ⟨www.eia.doe.gov/emeu/aer/petro.html⟩.

Federal Highway Administration, 2008. Highway statistics. Annual Report, data on motor fuel use available online at ⟨www.fhwa.dot.gov/policy/ohpi/qffuel.htm⟩, accessed January 2008.

Findlay, D.W., Parker, D., 1992. Military spending and interest rates. Defence Economics 3, 195–210.

Fuller, G.E., Lesser, I.O., 1997. Persian Gulf myths. Foreign Affairs 76 (3), 42–52.

General Accounting Office, 1991. Southwest Asia: cost of protecting US interests. GAO/NSIAD-915-250. US Government Printing Office, Washington, DC August.

General Accounting Office, 1992. Budget issues, 1991 budget estimates: what went wrong. GAO/OCG-915-4. US Government Printing Office, Washington, DC January.

Gerace, M.P., 2002. US military expenditures and economic growth: some evidence from spectral methods. Defence and Peace Economics 13, 1–11.

Gold, D., Adams, G., 1990. Defence spending and the American economy. Defence Economics 1, 275–293.

Hall, D.C., 1992. Oil and national security. Energy Policy 20, 1089–1096.

Hamilton, J.D., 1985. Historical causes of post-war oil shocks and recessions. The Energy Journal 6, 97–116.

Hamilton, J.D., Herrera, A.M., 2004. Oil shocks and aggregate macroeconomic behavior: the role of monetary policy. Journal of Money, Credit, and Banking 36, 265–286.

Heo, U., 1998. Modeling the defense–growth relationship around the globe. Journal of Conflict Resolution 42, 637–657.

Hickman, B.G., Huntington, H.G., Sweeney, J.L. (Eds.), 1987. The Macroeconomic Impacts of Energy Shocks. North-Holland, Amsterdam, Netherlands.

Huang, C., Mintz, A., 1990. Ridge regression analysis of the defence–growth tradeoff in the United States. Defence Economics 2, 29–37.

Huang, C., Mintz, A., 1991. Defence expenditures and economic growth: the externality effect. Defence Economics 3, 35–40.

Hubbard, H.M., 1991. The real cost of energy. Scientific American 264, 36–42.

International Center for Technology Assessment, 1998. The Real Price of Gasoline, Washington, DC, November. ⟨www.icta.org/doc/Real_Price_of_Gasoline.pdf⟩.

International Center for Technology Assessment, 2005. Gasoline Cost Externalities: Security and Protection Services. An update to CTAs The Real Price of Gasoline, Washington, DC, January 25. ⟨www.icta.org/doc/RPG_security_update.pdf⟩.

Joint Chiefs of Staff, United States Military Posture for FY19xx, various years. US Government Printing Office, Washington, DC. Published annually for FY1979–FY1989.

Joint Chiefs of Staff, 1992. 1992 Joint Military Net Assessment. US Department of Defense, Washington, DC.

Jones, D.W., Leiby, P.N., Paik, I.K., 2004. Oil price shocks and the macroeconomy: what has been learned since 1996. The Energy Journal 25 (2), 1–32.

Kaufmann, W.W., 1992. Personal Communication. The Brookings Institution, Washington, DC.

Kaufmann, W.W., Steinbruner, J.D., 1991. Decisions for Defense: Prospects for a New Order. The Brookings Institution, Washington, DC April 27.

Kinsella, D., 1990. Defence spending and economic performance in the United States: a causal analysis. Defence Economics 1, 295–309.

Koncz, J.L., Yorgason, D.R., 2006. Direct investment position for 2005, country and industry detail. Survey of Current Business 86 (7), 20–35 July.

Koplow, D., Martin, A., 1998. Fueling Global Warming, Federal Subsidies to Oil in the United States. Greenpeace, Washington, DC, June. ⟨www.greenpeace.org/raw/content/usa/press/reports4/fueling-global-warming.pdf⟩.

Leiby, P.N., 2007. Estimating the Energy Security Benefits of Reduced US Oil Imports, ORNL/TM-2007/028. Oak Ridge National Laboratory, Oak Ridge, TN February 28 ⟨www.epa.gov/otaq/renewablefuels/ornl-tm-2007-028.pdf⟩.

MacKenzie, J.J., Dower, R.C., Chen, D.D.T., 1992. The Going Rate: What it Really Costs to Drive. World Resources Institute, Washington, DC June.

Makinen, G., 1991. Energy Independence: Would It Isolate the United States from Oil Price Shocks? CRS 91-438E. Congressional Research Service, Washington, DC May 15.

Martin, L.G., 1987. Patterns of Regional Conflict and US Gulf Policy. In: Olson, W. (Ed.), US Strategic Interests in the Gulf Region. Westview Press, Boulder, CO.

Mataloni, R.J., 1995. A guide to BEA statistics on US multinational companies. Survey of Current Business 75 (3), 38–55 March.

McNaugher, T.L., 1985. Arms and Oil: US Military Strategy and the Persian Gulf. The Brookings Institution, Washington, DC.

Mehay, S.L., Solnick, L.M., 1990. Defense spending and state economic growth. Journal of Regional Science 30, 477–487 November.

Mintz, A., Huang, C., 1990. Defence expenditures, economic growth, and the peace dividend. The American Political Science Review 84, 1283–1293.

Moreland, H., 1985. A few billion for defense: plus $250 billion for overseas military intervention. New Policy Papers No. 1, Coalition for a New Foreign and Military Policy, Washington, DC.

Mork, A.K. (Ed.), 1981. Energy Prices, Inflation, and Economic Activity. Ballinger Publishing Company, Cambridge, MA.

Ogden, J.M., Williams, R.H., Larson, E.D., 2004. Societal lifecycle costs of cars with alternative fuels/engines. Energy Policy 32, 7–27.

Parry, I.W.H., Darmstadter, J., 2003. The costs of US oil dependency. Discussion Paper 03-59, Resources for the Future, Washington, DC, December. Available at ⟨www.rff.org⟩.

Payne, J.E., Ross, K.L., 1992. Defense spending and the macroeconomy. Defense Economics 3, 1168–1615.

Payne, J.E., Sahu, A.P., 1993. Defense spending and economic growth. In: Payne, J.E., Sahu, A.P. (Eds.), Defense Spending and Economic Growth. Westview Press, San Francisco.

Plesch, D., Austin, G., Grant, F., 2005. Britain's Energy Future: Securing the "Home Front". The Foreign Policy Centre, London, UK September ⟨http://fpc.org.uk/fsblob/575.pdf⟩.

Plummer, J.L. (Ed.), 1982. Energy Vulnerability. Ballinger Publishing Company, Cambridge, MA.

Ravenal, E.C., 1991. Designing Defense for a New World Order: The Military Budget in 1992 and Beyond. Cato Institute, Washington, DC.

Romm, J.J., Lovins, A.B., 1992/93. Fueling a competitive economy. Foreign Affairs 71, 46–62.

Sabonis-Chafee, T., 1987. Projecting US Military Power: Extent, Cost and Alternatives in the Gulf, RMI Publication No. 87–23. Rocky Mountain Institute, Old Snowmass, CO.

Santini, D.J., 1995. Considerations in making projections to assess best transportation technologies to meet Asilomar sustainability goals. Presented at Is Technology Enough? Sustainable Transportation Energy Strategies, Asilomar Conference Center, Pacific Grove, CA, July 31–August 3.

Taylor, J., 2007. How large are federal oil subsidies? Cato@Liberty, January 18. ⟨www.cato-at-liberty.org/2007/01/18/how-large-are-federal-oil-subsidies/⟩.

Thomas, R.W., Stekler, H.D., Glass, G.W., 1991. The economic effects of reducing US defence spending. Defence Economics 2, 183–197.

Tonelson, A., Hurd, A.K., 1990. The real cost of Mideast oil. New York Times, A-17 September 4.

Tsai, H.L., 1989. Energy Shocks and the World Economy. Praeger Publishers, New York.

Tyler, P.E., 1992. US strategy plan calls for insuring no rivals develop. New York Times 1, 14 March 8.

US Agency for International Development, 1993. US Overseas Loans and Grants and Assistance from International Organizations, CONG-R-0105. US Government Printing Office, Washington, DC.

US Agency for International Development, 2006. US overseas loans and grants and assistance from international organizations, on-line data tables, available at "The Greenbook" at ⟨www.usaid.gov/policy/budget/⟩, accessed September.

US Department of Defense, 1992. Defense planning guidance for the fiscal years 1994–1999. Classified Draft Report, February 18. Cited in Tyler (1992).

US Department of Energy, 1987. Energy security. DOE/S-0057, Washington, DC, March.

US Government Accountability Office, 2006. Strategic petroleum reserve: available oil can provide significant benefits, but many factors should influence future decisions about fill, use, and expansion. GAO-06-872, Washington, DC, August. ⟨www.gao.gov/new.items/d06872.pdf⟩.

Wahl, J.B., 1996. Oil Slickers: How Petroleum Benefits at the Taxpayers Expense. Institute for Local Self-Reliance, Washington, DC ⟨www.ilsr.org/carbo/costs/truecost0.html⟩.

Walls, M.A., Jones, A.S., 1990. From bad to worse: impacts of the 1986 oil price collapse. ENR90-08, Resources for the Future, Washington, DC, February.

Wallsten, S., Kosec, K., 2005. The economic costs of the war in Iraq. Working Paper 05-19, AEI-Brookings Joint Center for Regulatory Studies, September. ⟨www.aei-brookings.org/admin/authorpdfs/page.php?id=1188⟩.

Wheeler, W., 2006. Defense Budget Tutorial: So, You Think You Know the Cost of the Wars? Center for Defense Information, Washington, DC August 1 ⟨www.cdi.org/program/document.cfm?DocumentID = 3601⟩.