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United States cost of military force projection in the Persian Gulf, 1976–2007

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ABSTRACT

This paper presents the first estimate of United States military cost for Persian Gulf force (C_{PGfp}) derived entirely by a quantitative method. An activity-based cost (ABC) model uses geographic distribution of aircraft carriers as a proxy allocator of Department of Defense (DoD) baseline cost to regional operations. Allocation follows simply from DoD data that since 1990 no less than one aircraft carrier has been continuously on-station in the Persian Gulf; that eight are required to keep one on-station there; that the Navy has had eleven–fifteen carriers since 1990; and that Army and Air Force units are virtually never deployed to combat operations without Navy units. For 1976–2007 C_{PGfp} is estimated to be $\$6.8 \times 10^{12}$ and for 2007 $\$0.5 \times 10^{12}$ (2008$). This substantial military investment is not a remedy for the market failure at the heart of regional security problem, which is oil market power. When C_{PGfp} is added to economic losses attributed to market power in another recent study (Greene, 2010), the severity of this market failure becomes more apparent.

1. Introduction

The cost of military force projection in the Persian Gulf (C_{PGfp}) is an important variable in US energy and national security policy. The cost of oil supply protection is widely cited as national security externality, for example (see Koplow and Dernbach, 2001 for a review). Externalities related to energy security, or more properly to energy insecurity, have been described as "the loss of economic welfare that may occur as a result of a change in the price or availability of energy". These welfare losses are of three kinds: those related to (1) energy import volume; (2) energy price variability; and (3) national security and military expenditures for supply protection (Bohi et al., 1996). The present study investigates the third externality as well as other market failures that might result in military cost. The study takes the parochial US rather than a global welfare perspective.

Research on the social cost of oil consumption has also been concerned with the problem of oil market power, which relates to the import volume and price variability externalities described above. Cartel producers exercise some control over production, which results in a higher oil price than would exist in a competitive market. Higher price has an impact on overall economic performance. US wealth transfer losses that result from non-competitive oil price have been counted as a component of the cost oil dependence (Greene and Tishchishyna, 2001). A recent revision of this study estimated the 2008 cost of oil dependence at $\$0.5 \times 10^{12}$ (Greene, 2010). Military costs were not included in this estimate but rather were considered derivative of other costs of oil dependence attributable to market power.

Leiby also excluded military cost in a recent estimate of the oil import premium (Leiby, 2007). This study considered that military costs might be external costs of oil imports, but such costs were excluded from the premium because they cannot be readily disaggregated from other regional mission costs.

> It is difficult to attribute military costs, and specific activities or forces, to oil consumption or imports *per se*. Military activities, even in world regions that represent vital sources of oil imports, undoubtedly serve a broader range of security and foreign policy objectives than simply protecting oil supplies. Furthermore, these military costs may not vary in any measurable way with incremental variations in oil use.

Note, however, that the existence of a broader range of objectives than supply protection does not imply that these objectives must be unrelated to oil markets.

1.1. Oil and the evolution of national security policy

Oil-related policies have evolved since 1980 when the Carter Doctrine (Carter) asserted a US national security interest in Persian Gulf oil. Treatments of military cost in the energy policy literature have not fully recognized this evolution, which is

Abbreviations: ABC, activity-based costing; CENTCOM, Central Command (Persian Gulf & Southwest Asia); CVN, aircraft carrier; EUCOM, European Command (Northeast Atlantic & Mediterranean); fp, force projection; DoD, Department of Defense; DoT, Department of Treasury; PACCOM, Pacific Command; PGfp, Persian Gulf force projection; RCC, regional combatant command

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Nomenclature

a	binary variable for the fraction of annual days when the number of carriers on-station in a region > 0
b	barrel of oil
C	cost
c	cost
d	day
m	regional station-keeping multiplier, the number of ships required to keep one on-station in a region
q	number of carriers required to project force in a region in a given year
y	continuous variable for "CVN years-on-station", meaning the sum of years present by all carriers in the region

important both in estimating C_{PGfp} and evaluating societal benefits of the investment. The most significant post-Carter innovation was the appearance of the Wolfowitz Doctrine (Wolfowitz) in 1992. Wolfowitz asserted that the US must preempt the regional hegemonic power that would emerge if one state were to control the resources of its neighbors (Gellman, 1992). This formulation resolved incongruities that had arisen from questionable applications of Carter during the 1980s.

For example, Reagan Administration officials believed that Iran could not be allowed to win the Iran–Iraq War. So in 1982 oil supply threats formerly ascribed to the Soviet Union were reassigned to Iran in the "Reagan Corollary" to Carter. This elevated Iran from regional nuisance to incipient superpower (Weisman, 1981) and transmogrified Iraq, previously a Cold War adversary, into a US ally against Iran (Alnasrawi, 1994). Paradoxically, what first threatened regional oil supply was not Iran but the new US ally, which attacked Iranian oil navigation (Hiro, 1991). Paradox intensified in 1990 when the G.H.W. Bush Administration invoked Carter to confront Iraq for invading Kuwait. The US then imposed an embargo against exports of Iraqi and Kuwaiti oil (Gordon, 1990). The obvious *non sequitur* was that to protect Persian Gulf oil supply, the US kept a large fraction of it from market (Johnston, 1990).

Wolfowitz reconciled national security policy with what had actually happened in the first Gulf War. Supply threats assumed in Carter might have been ephemeral but the threat of Iraqi hegemony over Arabia was not. The US preempted this hegemony by repulsing Iraq from Kuwait. More broadly, whereas Carter's main concern was preventing US economic losses should a hostile power disrupt supply, Wolfowitz's concern was what that power could achieve with the oil resources that might be seized. Wolfowitz can thus be understood as a response to market power, for if oil price were competitive there would be no monopoly rents or national security concern over their ownership. Adelman had characterized the security problem in precisely this way before the first Gulf War. That is, if Saddam Hussein captured Saudi Arabia he would gain a more effective monopoly that would in turn be capable of funding further wars of resource seizure (Adelman, 1995).

Evolution of national security strategy from Carter to Wolfowitz was relatively straightforward, yet ambiguity over US objectives in the region has persisted. Which rationale is more important? Has one been abandoned for the other? Greene tellingly cites contemporaneous pronouncements from the highest levels of government as to the rationale for recent Iraq operations (Greene, 2010). Chairman Greenspan of the Federal Reserve claimed that oil was the rationale for invading Iraq. Secretary of Defense Rumsfeld claimed it was not. President G.W. Bush, who would seem to have the last word, offered a third interpretation that synthesized Carter and Wolfowitz rationales. He asserted that if terrorists controlled Iraqi oil they could blackmail the US by threatening to withhold supply, driving price to $300–400/barrel.

> You can imagine a world in which these extremists and radicals got control of energy resources…And then you can imagine them saying, 'We're are going to pull a bunch of oil off the market to run your price of oil up unless you do the following'. And the following would be along the lines of, well, 'Retreat and let us continue to expand our dark vision' (Baker, 2006).

The remarks indicate that rationales for Persian Gulf force projection have evolved, accumulated and interacted. Even the newest rationale, combating terrorism, descends from Carter and Wolfowitz. That is, Bush's prospective terrorists seek not to deny supply *per se* but to threaten denial to become more effective monopolists. To prevent this the President asserts a necessity that the US remain in Iraq and the region.

It is not a novel observation that regional reaction to force projection has engendered new rationales for that activity. Yet it bears repeating that terror groups complain specifically against Wolfowitz artifacts such as US military bases and force projection. Osama bin Laden, for example, enjoins followers to kill Americans wherever possible because…

> …the United States has been occupying the lands of Islam in the holiest of places, the Arabian Peninsula, plundering its riches, dictating to its rulers, humiliating its people, terrorizing its neighbors, and turning its bases in the Peninsula into a spearhead through which to fight the neighboring Muslim peoples (Bin Laden and Lawrence, 2005).

Fighting terrorism has in turn become a new rationale for force projection. Yet it appears to be foreign occupation that drives the suicide terrorism against which the US has so strongly reacted, not religious differences as is widely assumed (Pape, 2003; Pape, 2005). Virtually all C_{PGfp} might thus be oil-related.[1]

1.2. Previous estimates of US cost for the Persian Gulf Mission

A variety of supply protection cost estimates have been made since 1991 (see Koplow and Dernbach, 2001 for a review). Some estimate a cost of oil supply protection (Delucchi and Murphy, 2008) others a cost for Iraq–Afghanistan operations (Stiglitz and Bilmes, 2008). Whatever military purpose is assumed in these estimates, they are also estimates of C_{PGfp}. C_{PGfp} has been difficult to estimate on a purely quantitative basis. This is not only because of the disaggregation problem described above (Leiby, 2007) but also because the DoD baseline budget is organized by service[2] rather than by region. In the absence of a geographical operand with which to allocate service budgets, researchers have had to use their best judgment.

An early, influential study determined regional deployments of general-purpose forces from the emphasis given to global regions in DoD budget and planning documents (Ravenal, 1991). Another

[1] While some terrorism may be directed against the US in retaliation for its support for Israel, it is assumed here that US force projection in the Persian Gulf does not protect Israel.

[2] i.e. budgets for the Army, Navy and Air Force.

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study similarly sought to allocate the cost of general-purpose forces on the basis of regional threats (Kaufmann and Steinbruner, 1991). It focused on Congress's intentions, inferring annual regional defense cost from *a priori* DoD planning and budget documents. Implicit assumptions in both studies are that (1) general purpose forces exist such that not all DoD expense can be allocated to regions; (2) DoD spending corresponds with the geography of threats invoked by Congress to justify appropriations; and perhaps (3) that Congress is a rational, cost-minimizing consumer.

A recent study questioned the notion that there are significant fixed costs for general-purpose forces.

> 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 (Delucchi and Murphy, 2008).[3]

These researchers thus reject the notion that C_{PGfp} could be a joint cost allocation problem. Their study also breaks new ground by devising a stepwise approach to separate oil supply protection costs from the cost of defending several other putative US interests in the Persian Gulf. In order to estimate mission cost components, Delucchi and Murphy (2008) ask "What would Congress do?" to a series of increasingly narrow questions about the importance of US interests in the region. In doing so, this study provides the most holistic, detailed estimate of C_{PGfp} to date, $\$47–98 \times 10^6$ (presumably in 2008$).

In a recent estimate of the social cost of war in Iraq and Afghanistan, its monetary cost was one component in a larger welfare economic analysis (Stiglitz and Bilmes, 2008). Among social costs estimated were medical treatment for veterans and effects of debt accrued for war. Stiglitz and Bilmes derive monetary cost by treating the 2001 DoD baseline budget as a pre-war cost basis and assuming that one-quarter of post-2001 increases in DoD baseline expense are attributable to Iraq–Afghanistan operations. If this fraction is added to supplemental appropriations through 2007, the monetary cost of war is $\$0.646 \times 10^{12}$ (2007$) for 2002–2007.

Unlike academic researchers, DoD ignores baseline cost. Iraq–Afghanistan operations costs are considered to be identical to DoD supplemental budgets[4] for those operations since 2001. Congress has apparently acceded to this accounting. For example, a Congressional Research Service report follows DoD Comptroller guidance that Iraq–Afghanistan accounting should "include only incremental [i.e. supplemental] costs directly related to operations" (Belasco, 2008). This is really a self-imposed DoD "supplemental-only" accounting convention that considers Persian Gulf operations to be contingencies. Likewise, the Congressional Budget Office (CBO)

> …also excludes from its Iraq scenarios the costs of maintaining a carrier battle group in the Persian Gulf region—given that the Navy has for many years maintained such a force there and is expected to continue to maintain it irrespective of any long-term US presence in Iraq (Congressional Budget Office, 2007).

Considered closely, however, this rationale for supplemental-only costing contains implicit counterarguments against that method and in favor of a full-cost approach. If the Navy has "for many years maintained" a Gulf force and will in the future irrespective of Iraq deployments (Congressional Budget Office, 2007), the operation is not a contingency. This force must have expended substantial funds that could only have been met from the baseline budget. Looking backwards, it becomes apparent that DoD's contingency logic requires us to accept an absurdity: that since Congress authorized no supplementals to fund Gulf military operations 1992–2001, C_{PGfp} must be zero. This cannot be the case, however, because combat operations there were continuous for the period.

To review briefly, most non-government research on allocating DoD cost to C_{PGfp} estimates that roughly a quarter of DoD baseline budgets should be so allocated (Koplow and Dernbach, 2001). If the estimate of Stigltiz and Bilmes is annualized, it is similar. The most recent and most detailed study considers the fixed cost component of C_{PGfp} to be very low (Delucchi and Murphy, 2008), yet despite a very different methodology finds regional cost to be similar to previous non-government estimates. Lowest costs are reported by government agencies that assume the baseline cost component of C_{PGfp} to be zero (Congressional Budget Office, 2007; Belasco, 2008).

1.3. Opportunity for a novel cost allocation method

A study of US military "responses to situations" (Cobble et al., 2005) creates an opportunity for a more quantitative approach to the regional cost question. The study reviewed over 700 events from 1970–2003 in which a military unit responded to a direction from the President or Secretary of Defense. Among study results is that Army and Air Force units were assigned to combat operations in the absence of a Navy unit on only 0.0026% of over 60,000 "response-days". Knowing that other services are virtually never committed to combat without Navy units, it becomes possible to infer an opportunity cost (with respect to DoD's combat capacity) from geographic data on Navy deployments. Such data have been provided by the CBO for the purpose of the present study.[5]

The study has two objectives. First is to estimate C_{PGfp} by an ABC model that uses Navy deployment data to allocate DoD expense to regions. Following a description of the model and why it was chosen an estimate of C_{PGfp} is presented. This estimate is then compared to the monetary components of previous studies of regional military cost. The second objective of the study is to interpret the C_{PGfp} estimate with respect to the various rationales for the Persian Gulf mission. This objective is pursued in the discussion section, which also considers military cost in the context of other social costs of oil consumption.

1.4. Choice of the ABC accounting model

A variety of full-cost accounting methods could be used to allocate baseline DoD costs to combatant regions. DoD is analogous to a large firm that produces a variety of products. Such firms often allocate joint costs to different products at some unvarying rate for each product. A problem with applying this model to the regional cost problem is that the use of unvarying

[3] However, the federal budget process is by nature political. Delucchi and Murphy assume Congress to be a rational actor that would respond to threat reductions by, among other things, closing bases. However, as a practical matter Congress often resists base closings and endeavors to retain or upgrade weapons systems that the DoD does not want. For a discussion of this problem see Higgs (2006). All defense costs is probably variable as these researchers suggest, but perhaps only in the long run.

[4] A "supplemental" is a budget request made in addition to and after Congress approves the DoD baseline budget.

[5] These data are probably available elsewhere in DoD publications.

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rates will disguise changes in the geography of military activity over time.

A solution to this problem, which is common in commerce, lies in a geographical approach to cost allocation. To try to account for geographical dynamism within the firm, large firms like DoD that have multi-national operations sometimes use transfer pricing.[6] However, the notional identity assumed here between force projection and national security production obviates the need for a transfer-pricing approach, which would be complex even if DoD accounts were transparent. ABC offers the capacity to translate changes in regional deployments over time into an allocation of $c_{PGfp\ baseline}$. ABC is a full-cost method that traces flows of goods and services within the firm. ABC asks where cost is incurred and why, linking activities that generate overhead to the goods and services they require (Bruns and Kaplan, 1987). This reveals internal flows of goods and services that are obscured by traditional accounting models that assign overhead at unvarying rates.

ABC is no longer considered the radical innovation it was when invented in the 1980s. ABC has become widely adopted, although firms using it are still a minority among large firms to which DoD is comparable. For example, ABC adoption in a sample of large UK firms rose to just 21% during the 1990s, though this was from a base of zero in the early 1980s. The same study also found ABC users in large firms generally believe that ABC benefits outweigh costs (Innes et al., 2000). DoD itself has begun to use ABC in some situations, apparently for its capacities in the highly mobile joint service setting (Melese and Savage, 2008). Mobility is the most important reason for choosing ABC for the present study because this quality is so important for war-fighting.

The central task of ABC is the assignment of costs to activities and of activities to products. In this study it is assumed that distribution of force projection activity among its three regional combatant commands (RCCs)[7] reveals DoD preferences for where its services are most needed and hence where its appropriations have been expended. This assumption differentiates the present study from previous C_{PGfp} estimates that allocate based on assessments of Congress' *a priori* intention about where funds will be spent. That is, Congress may have intended that roughly 22% of the 1991 DoD budget be applied to oil supply protection as one study inferred (Kaufmann and Steinbruner, 1991) yet DoD might not have expended its appropriation in precisely this way. ABC can resolve this problem by revealing where expense is incurred how the geography of expense changes over time.

2. Methods

This study seeks to solve the equation

$$C_{PGfp} = c_{PGfp\ baseline} + c_{PGfp\ supplemental} \quad (1)$$

in which C_{PGfp} is composed of contributions from DoD baseline and supplemental budgets. National security costs are incurred to:

> Provide for the common defense—the primary DoD task is to deter conflict—but should deterrence fail, to fight and win the nation's wars. The department will provide a joint force, persuasive in peace, decisive in war, preeminent in any conflict.[8]

From an economic perspective, the common defense is the public good of national security. This good is really a government service provided by a "joint force" comprised of mobile combat units from the Army, Navy and Air Force. Forward deployment of these units to combatant regions constitutes force projection, an activity whose increasing "jointness" is clearly attested by US forces response records in named combat operations (Cobble et al., 2005). Whether national security is actually produced by a DoD combat deployment or might have been produced more efficiently by some other government action are important questions, but not germane to allocating cost. This study also ignores non-combat deployments because they fall outside the primary DoD task of providing common defense.

In the present study baseline costs are assumed to be attributable to any RCC in proportion to its ratio of total DoD combat units. This metric clearly traces the fate of DoD investments in its production units. This model can be further simplified following the logic of DoD's joint force doctrine that Army, Navy and Air Force combat units train and deploy as one force.[9] However, only Navy combat units, i.e. aircraft carrier battle groups can be readily deployed alone in response to threat. Since Army or Air Force units are virtually never deployed to combat operations without a Navy unit (Cobble et al., 2005), it can be inferred that whether Army or Air Force units are at home bases or deployed to RCCs, their baseline costs can be allocated to RCCs in proportion to the fraction of total Navy combat units in an RCC. This fraction constitutes a proxy multiplier with which to allocate baseline cost to regions. In other words, when a Navy combat unit is committed to a region an opportunity cost is incurred not only from the loss of that Navy unit to any other RCC, a proportional opportunity cost for the other armed services is incurred as well. Thus if the Navy's fraction of total combat units committed to CENTCOM can be determined, this fraction can be applied as a proxy multiplier of $c_{DoD\ baseline}$ in order to allocate that cost to c_{PGfp}.

Let fp_{total} represent the sum of all force projection activity and let $fp_{Persian\ Gulf}/fp_{total}$ be the fraction expended in the Gulf. Thus to determine the unknown in Eq. (1), i.e. $c_{PGfp\ baseline}$, assume that

$$fp_{Persian\ Gulf}/fp_{total}(c_{DoD\ baseline}) = c_{PGfpbaseline.} \quad (2)$$

$c_{DoD\ baseline}$ and $fp_{Persian\ Gulf}/fp_{total}$ are determined independently. First, total DoD cost (C_{DoD}) must be composed of $c_{DoD\ \text{baseline}}$ plus the supplemental cost of *PGfp* as given in supplementals, i.e.:

$$C_{DoD} = c_{DoD\ baseline} + c_{PGfp\ supplemental} \quad (3)$$

Cost data that come close to meeting auditing standards are available from 2001–2007 from the Department of the Treasury (DoT) for both C_{DoD} (2007)[10] and $c_{PGfp\ supplemental}$ (2007)[11] C_{DoD} data of a lower accounting standard are available from DoD for 1976–2000 (2007). With values for C_{DoD} from these

[6] Transfer pricing is an accounting system in which divisions of a firm that do not earn revenue charge internal prices for the labor, intermediate products, assets, services or capital they provide to other divisions.

[7] These are European Command (EUCOM), Pacific Command (PACCOM) and Central Command (CENTCOM, which includes the Persian Gulf and Southwest Asia).

[8] From Joint Vision 2020: http://www.defenselink.mil/prhome/stratplan.html

[9] http://www.dtic.mil/jv2010/jv2010.pdf.

[10] Net cost is taken from the Treasury Department Financial Statement United States Department of Treasury, Financial Management Service, 2007. Financial Statements of the United States Government for the years ended in September 30, 2007, and September 30, 2006. Washington, DC. rather than any of the various "defense spending" budgets reported by Congress, DoD or other agencies. Following a memorandum from the President in May 1998, heads of departments were directed to produce financial statements that could obtain an unqualified audit opinion. This was a serious challenge that DoD apparently did not begin to achieve until 2001. In that year DoT reported incongruously high DoD expense, suggesting that previously unrecognized liabilities were being realized. Differences between DoT and DoD reporting of DoD expense can be very substantial, exceeding $\$100 \times 10^9$ in 2007, for example. This study assumes DoT reporting is more reliable. Hence DoT financial statements, which began to include DoD expense after 2001, are used for 2001–2007.

[11] Only supplemental appropriations to DoD are included. Those for the War on Terrorism or the departments of State and of Homeland Security are excluded.

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budgets and for $c_{PGfp\ supplemental}$ from DoD supplemental budgets, Eq. (3) can be solved for $c_{DoD\ baseline}$. Annual values for $c_{DoD\ baseline}$ can then be substituted into Eq. (2), leaving $fp_{Persian\ Gulf}/fp_{total}$ as the remaining term to be determined in that equation.

PGfp is the task of CENTCOM.[12] If CENTCOM's ratio of total Navy combat units can be determined, the all-service opportunity cost can be inferred from $fp_{Persian\ Gulf}/fp_{total}$ as just discussed. The US Navy is organized into combat units called aircraft carrier battle groups, each a flotilla organized around one aircraft carrier (CVN). These units train, transit and deploy together. Total CVN ($n_{CVN\ total}$) were 13 from FY1976–1981, 14 from 1982–1986, 15 from 1987–1991, 14 in 1992, 13 in 1993, 12 from 1994–2006, and 11 from 2006 to the present (O'Rourke, 2006).

Extending the identity between force projection and the effort to produce national security, the ratio $n_{CVN\ region}/n_{CVN\ total}$ is also fp_{region}/fp_{total}. Letting q be the number of carriers required to project force in a region in any year:

$$fp_{region}/fp_{total} = q_{region}/n_{CVN\ total} = c_{region\ baseline}/c_{DoD\ baseline} \quad (4)$$

Since $n_{CVN\ total}$ and $c_{DoD\ baseline}$ are known from public data, the problem of allocating $c_{DoD\ baseline}$ reduces to the problem of determining a value for q_{region} in Eq. (4). This can be determined from a simple function of the time a CVN spends in a region multiplied by the US Navy station-keeping multiplier (m) for that region (m_{region}). In the example of the Persian Gulf this function is either:

$$q_{PGfp\ 1976-2000} = m_{PG}(a_{PGfp}) \quad (5a)$$

or

$$q_{PGfp2001-2007} = m_{PG}(y_{PGfp}). \quad (5b)$$

where a_{PGfp} is a binary variable for the fraction of annual days when the number of carriers on-station in the Persian Gulf >0 during the years 1976–2000,[13] and where y_{PGfp} is a continuous variable for "CVN years-on-station", meaning the sum of years presented by all carriers in the region from 2001–2007.[14] A Navy Department communication[15] defines m_{region}.

> The station-keeping multiplier [m_{region}] is how many of that particular type of ship, from that particular homeport is required to maintain 100% presence at that particular location inside the Commander-in Chief's Area of Responsibility [RCC], independent of other presence or crisis requirements. Transit distance was computed to a location inside each [RCC] where crises have historically occurred. Current maintenance scheduling information and operating parameters were used in the calculations.

[12] CENTCOM's broadest assignment is Southwest Asia. The command descends from the Rapid Deployment Force developed by the Carter Administration in response to perceived Soviet threats to Persian Gulf oil supply and the disappearance of Iran as one of the "Twin Pillars" of US security in the region. CENTCOM forces operated mainly in the Persian Gulf until 2001 when limited operations in Afghanistan began. This study does not try to separate Afghanistan costs from Persian Gulf costs as will be treated in the discussion. US interests in Afghanistan date from Carter Doctrine concerns about a Soviet thrust through there to the Persian Gulf.

[13] A 1976–2002 Navy Department time series provided by CBO expresses CVN presence-on-station in binary fashion. The series gives the fraction of annual days when one or more carriers are present in a region. This reveals whether a carrier is present in a region but not how many. This time series is analyzed through 2000, after which the continuous data represented by y in Eq. 5b are used.

[14] 2001–2006 CVN regional presence data from CBO express CVN daily presence as 0, 1…4 CVN.

[15] The unclassified communication is from the Navy to CBO, released by CBO for purposes of this study. The communication also includes the data presented for m_{region} in Table 1. These data probably exist elsewhere in the public record.

Table 1
Station-keeping multipliers (m_{region}) for US aircraft carriers (CVN) by region and homeport.

CVN Homeport	Regional Combatant Command (RCC)		
	EUCOM m_{Eur}	PACCOM m_{Pac}	CENTCOM m_{PG}
Norfolk	5.9		7.1
San Diego		6.7	10
Yokosuka, Japan		1	
Average, Norfolk+San Diego			8.55

Reproduced from CBO data provided to this study. Derivation of average value for m_{PG} assumes that CVN from Norfolk deploy only to EUCOM, from San Diego only to PACCOM, and to CENTCOM equally from Norfolk and San Diego.

Values for m_{region} are shown in Table 1. Keating augments the definition of m_{region} and gives independent confirmation of the average value derived for m_{PG} in Table 1.

> Carrier rotation [i.e. m_{region}] is set by variables such as transit distance, maintenance and guidelines that set deployments lengths and time between deployments. Eight to one is the carrier rotation factor for CENTCOM. The ratio is 6:1 in the Med [EUCOM] and 1:1 in the Western Pacific [PACCOM] due to the home porting of a carrier in Japan (Keating, 2001).

For conservatism, Keating's value for m_{PG} is used to derive Table 2, which presents DoD presence data along with solutions to q for Eq. (5a), the period for which only binary data are available. Results for y_{PGfp} and q_{PGfp} for 2001–2006 when continuous data are available are shown in Table 3. Lacking Navy presence data for 2007, an estimate based on $y=1$ is included in Table 4.

3. Results

Having derived q_{PGfp}, Eqs. (4)b, (2) and (1) can be solved in turn. Table 4 summarizes these calculations. Fig. 1 shows C_{PGfp} (col. k) and its contribution to C_{DoD} (col. e).

4. Discussion

The present study's result that $C_{PGfp\ 1976-2007} \approx \$6.8 \times 10^{12}$ is the first estimate of this quantity to be derived by a purely quantitative method. The result suggests that C_{PGfp} is considerably greater than previously recognized for Iraq–Afghanistan operations and the long era of Persian Gulf force projection that preceded them. However, the disparity between the present and past estimates raises questions that should be addressed before implications of the study are discussed. First, could the past–present disparity arise from the present study's collation of cost data from different sources? Second, could the disparity arise from differences in assumptions or methods? Third, can the present result be compared to previous studies or do differences in methods or assumptions preclude comparison?

4.1. Does disparity arise from use of cost and presence data from different sources in the present study?

DoT reports of DoD expense data are used for the 2001–2007 period whereas DoD data are used for the earlier period of this study. DoT reports show considerably higher DoD expense than do DoD documents in the two years after 2000 when both are

Table 2
Binary CVN presence (a) and corresponding CVN required (q_{region}) for station-keeping, 1976–2002 (solution to Eq. (5a) in right hand columns).

FY	a			q_{region}		
	EUCOM	CENTCOM	PACCOM	EUCOM	CENTCOM q_{PGfp}	PACCOM
1976	1.00	0.00	1.00	5.90	0.00	1.00
1977	1.00	0.01	1.00	5.90	0.07	1.00
1978	1.00	0.01	1.00	5.88	0.07	1.00
1979	1.00	0.05	0.98	5.90	0.40	0.98
1980	0.96	0.00	0.99	5.67	0.00	0.99
1981	1.00	0.02	0.95	5.90	0.21	0.95
1982	1.00	0.32	1.00	5.90	2.72	1.00
1983	1.00	0.52	0.99	5.90	4.47	0.99
1984	1.00	0.90	0.93	5.90	7.69	0.93
1985	1.00	0.79	0.84	5.90	6.77	0.84
1986	1.00	0.13	1.00	5.90	1.15	1.00
1987	1.00	0.39	1.00	5.90	3.30	1.00
1988	1.00	0.78	0.89	5.90	6.63	0.89
1989	1.00	0.46	0.91	5.90	3.91	0.91
1990	0.95	0.34	1.00	5.59	2.90	1.00
1991	0.73	0.99	0.73	4.32	8.46	0.73
1992	0.83	1.00	0.68	4.87	8.55	0.68
1993	0.93	0.67	0.97	5.50	5.74	0.97
1994	0.77	0.50	0.73	4.56	4.24	0.73
1995	0.89	0.69	0.91	5.24	5.88	0.91
1996	0.67	0.74	0.93	3.95	6.31	0.93
1997	0.74	0.76	0.98	4.38	6.54	0.98
1998	0.51	0.98	0.64	3.01	8.34	0.64
1999	0.62	0.95	0.83	3.67	8.15	0.83
2000	0.35	0.98	1.00	2.06	8.41	1.00
2001	0.62	0.90	1.00	3.64	7.73	1.00
2002	0.24	0.99	0.81	1.44	8.46	0.81

q_{PGfp} values for 2001 and 2002 are included here but are not used to estimate C_{PGfp} for those years as continuous presence data (shown in Table 3).

Table 3
CVN presence and corresponding CVN required for station-keeping, 2001–2006. In the time series analyzed here, what had been PACCOM for 1976–2002 is divided into two regions, EASTPAC and WESTPAC (subdivisions of PACCOM). WESTPAC is shown here because (i) WESTPAC is clearly the combatant command for Korea, (ii) the US naval base in Japan is in WESTPAC, and (iii) from a calendar of regional carrier presence it is clear that transits into WESTPAC from EASTPAC occur more or less concurrently with a corresponding transit from WESTPAC to CENTCOM, and vice versa. Values for m thus appear to be unaffected, the CENTCOM value from San Diego obviously so. The PACCOM m multiplier is used for WESTPAC because Admiral Keating's comment (cited above) makes explicit that this is the case.

	% annual days n_{CVN} present in region					y_{region}	q_{region}
	0	**1**	**2**	**3**	**4**		
EUCOM							
2001	72	2	26	0	0	0.54	3.20
2002	58	41	1	0	0	0.43	2.55
2003	58	15	27	0	0	0.70	4.11
2004	71	17	8	4	0	0.45	2.63
2005	84	16	0	0	0	0.16	0.92
2006	80	20	0	0	0	0.20	1.18
CENTCOM							
2001	0	65	18	13	4	1.56	12.48
2002	0	65	33	1	0	1.34	10.88
2003	10	68	6	13	3	1.31	10.40
2004	3	91	6	0	0	1.03	8.24
2005	1	96	3	0	0	1.02	8.16
2006	18	82	1	0	0	0.83	6.64
WESTPAC							
2001	32	46	22	0	0	0.91	0.91
2002	47	32	21	0	0	0.75	0.75
2003	0	80	12	7	1	1.29	1.29
2004	12	75	14	0	0	1.02	1.02
2005	0	64	35	2	0	1.38	1.38
2006	9	64	18	8	0	1.25	1.25

Note also that CENTCOM y values for 2001 and 2002 exceed those for a in Table 2, hence q_{PGfp} values are also higher. Data for a, which are binary, do not reveal how many carriers might be present but only the fraction of annual days where at least one is present. By contrast, the continuous variable y for 2001–2006 represents a complete record of regional activity. In subsequent analysis of C_{PGfp}, y values are used to generate q_{PGfp} for 2001–2002.

available.[16] The impact of DoD under-reporting of expense can be seen in the large year-on-year increase in 2001 C_{DoD} in Fig. 1, followed by a steep decline in 2002. The 2001 increase represents a one-time charge for a "non-recurring effect of the extension of $293.0 billion in medical benefits to retired personnel and another $91.3 billion in other actuarial assumption changes in 2001" (US Department of Treasury, 2003). In other words at least $386 billion in expense had been omitted from DoD's own accounts for an undetermined number of years before 2001. Thus if the present estimate is biased downwards due to its use of DoD cost data 1976–2000, that bias is shared by all previous estimates as all relied on DoD expense reporting. Use of DoT accounting after 2000 does contribute to past–present disparity, but this contribution poses no barrier to comparison because accounting accuracy is improved.

An additional conservative bias for 1976–2000 arises from the use of binary Navy presence data, which do not reveal how many more than one carrier might have been present on any day. An indication of this conservatism is apparent from a 1982 report on the development of the Rapid Deployment Force, the precursor to CENTCOM. The report cites an increase in regional naval presence from "minimal" to "the presence in the Indian Ocean of two carrier battle groups" (Davis, 1982). However, binary presence data cannot account for those days when two carriers were present in 1982. Binary data, therefore, result in cost underestimation by the present study. This would tend to decrease rather than increase disparity between present and past results.

[16] A partial explanation for higher Treasury accounts of DoD expense is that Department of Treasury faithfully reports all pension and retirement liabilities.

4.2. Does past–present disparity arise from differences in assumptions or methods

A greater contribution to past–present disparity may arise from variation in treatments of fixed cost. Important early studies assumed that they were allocating only variable costs and that substantial fixed costs existed for general-purpose forces that DoD would retain irrespective of the Persian Gulf mission (Kaufmann and Steinbruner, 1991; Ravenal, 1991). Delucchi and Murphy (2008) by contrast, assume that almost all DoD expense is variable. The present study takes a third path by allocating both fixed and variable costs, which is the purpose of ABC. The ABC method would thus add to past–present disparity, yet if almost all DoD cost is variable as Delucchi and Murphy suggest the effect may be unimportant.

However, there are reasons to suspect that the fixed component of C_{DoD} might be less trivial than Delucchi and Murphy assume, particularly from a short run perspective. These include explicit US treaty obligations (e.g. to NATO and Japan); implicit treaty obligations (e.g. to Taiwan and Saudi Arabia); the state of war with North Korea; and, from a force-preparedness perspective, the necessity to maintain training at a high level should rapid force expansion become necessary. This necessity would imply a corollary need for some significant air, land and sea forces and continuous innovation in their technology. More generally, DoD resembles firms with high fixed cost in that it has much capital tied up in assets, is financed mainly by debt and needs a large labor force in order to operate its production facilities. Truly fixed

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Table 4
US Cost of Persian Gulf force projection, (C_{PGfp}) 1976–2007 in $ 10^6 2008.

Year	a DoD deflator	b C_{DoD} nominal $	c $c_{PGfp\ supplemantal}$ nominal $	d $c_{PGfp\ supplemental}$ 2008 $	e C_{DoD} 2008 $	f $c_{DoD\ baseline}$ 2008 $	g a or y	h q Eq. (5a or 5b)	i q/n_{cvn} Eq. (4)	j $c_{PGfp\ basedline}$ 2008 $ Eq. (2)	k C_{PGfp} 2008 $ Eq. (1)
1976	26.11	87,891			336,575	336,575	0.00	0.00	0.00	0.00	0.00
1977	28.19	95,557			338,940	338,940	0.01	0.08	0.01	2086	2086
1978	30.33	103,042			339,696	339,696	0.01	0.08	0.01	2090	2090
1979	32.71	115,013			351,575	351,575	0.05	0.40	0.03	10,818	10,818
1980	36.82	132,840			360,755	360,755	0.00	0.00	0.00	0.00	0.00
1981	41.30	156,153			378,095	378,095	0.02	0.16	0.01	4653	4653
1982	45.54	184,520			405,184	405,184	0.32	2.56	0.18	74,091	74,091
1983	47.88	205,040			428,196	428,196	0.52	4.16	0.30	127,235	127,235
1984	49.90	220,806			442,534	442,534	0.90	7.20	0.51	227,589	227,589
1985	52.16	245,370			470,399	470,399	0.79	6.32	0.45	212,352	212,352
1986	53.77	265,636			494,029	494,029	0.13	1.04	0.07	36,699	36,699
1987	55.27	274,007			495,734	495,734	0.39	3.12	0.21	103,113	103,113
1988	57.13	281,935			493,457	493,457	0.78	6.24	0.42	205,278	205,278
1989	59.55	294,880			495,166	495,166	0.46	3.68	0.25	121,481	121,481
1990	61.19	289,755			473,507	473,507	0.34	2.72	0.18	85,863	85,863
1991	63.53	262,389			413,015	413,015	0.99	7.92	0.53	218,072	218,072
1992	65.99	286,962			434,843	434,843	1.00	8.00	0.57	248,482	248,482
1993	67.60	278,588			412,090	412,090	0.67	5.36	0.41	169,908	169,908
1994	69.16	268,635			388,430	388,430	0.50	4.00	0.33	129,477	129,477
1995	70.29	260,608			370,749	370,749	0.69	5.52	0.46	170,545	170,545
1996	71.70	253,258			353,204	353,204	0.74	5.92	0.49	174,247	174,247
1997	73.65	258,330			350,749	350,749	0.76	6.08	0.51	177,713	177,713
1998	75.36	256,136			339,885	339,885	0.98	7.84	0.65	222,058	222,058
1999	76.79	261,379			340,360	340,360	0.95	7.60	0.63	215,561	215,561
2000	79.02	281,234			355,910	355,910	0.98	7.84	0.65	232,528	232,528
2001	81.48	731,235	14,000	17,182	897,441	880,259	1.56	11.00	0.92	806,904	824,086
2002	83.61	380,207	18,000	21,529	454,739	433,210	1.34	10.72	0.89	387,001	408,530
2003	85.45	512,291	80,000	93,622	599,521	505,899	1.31	10.48	0.87	441,819	535,441
2004	88.16	605,365	88,000	99,819	686,666	586,848	1.03	8.24	0.69	402,969	502,787
2005	91.19	634,879	70,000	76,763	696,216	619,453	1.02	8.16	0.68	421,228	497,991
2006	94.84	586,048	111,000	117,039	617,933	500,894	0.83	6.64	0.60	302,358	419,397
2007	97.44	622,452	152,000	155,993	638,805	482,812	1.00	8.00	0.73	351,136	507,129
Total				581,947	14,654,399	14,072,452				6285,352	6867,299

a. DoD deflators are from (United States Department of Defense, 2007).
b. Values from 1976–2000 are from (United States Department of Defense, 2007), Tables 6–11. Values from 2001–2007 are taken from Statements of United States Government Net Cost in (United States Department of Treasury, Financial Management Service, 2001–2007) Statement of Nest Cost.
c. Supplemental values are those for Iraq–Afghanistan DoD expense only. From the estimated costs of US operations in Iraq and Afghanistan and of other activities related to the War on Terrorism, Committee on the Budget. Congressional Budget Office, Washington, DC, pp. 4, Table 2. Supplemental appropriations to other departments are ignored.
d. Supplemental values in 2008 $ derived from deflator in col. a.
e. DoD expense in 2008 $ derived from deflator in col. a.
f. col. e − col. d.
g. Presence-on-station expressed as a (from Table 1) for 1976–2000 or y (Table 2) for 2001–2007 as described in methods section.
h. Number, q, of CVN required to keep a or y CVN present in the Persian Gulf. Values for a for years 1976–2000 are derived from Eq. (5a). Values for y for 2001–2007 are derived from Eq. (5b).
i. q/n_{CVN}, i.e. proxy multiplier for allocation of $c_{DoD\ baseline}$, subject to the constraint that its value cannot exceed $n_{CVN}-1/n_{CVN}$, where n_{CVN} is the total number of CVN in operation in a given year because one CVN is always present in PACCOM. As it happens, this constraint binds only in 2001.
j. Baseline cost of Persian Gulf force projection ($c_{PGfp\ baseline}$) derived from Eq. (2), i.e. col. f times col. i.
k. Total cost of Persian Gulf force projection, C_{PGfp} derived from Eq. (1), i.e. col. k plus col. d including period when Navy units operated in the Indian Ocean but flew sorties into the Gulf.

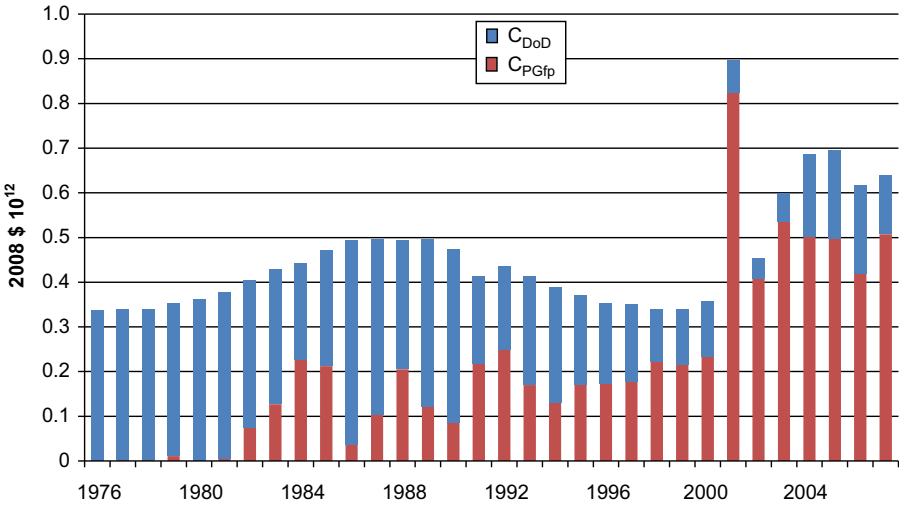

Fig. 1. C_{PGfp} and C_{DoD} 1976–2007.

cost might represent as much as 20% of DoD expense, but this is a guess. From a longer run perspective, however, most DoD cost is probably variable as Delucchi and Murphy assert. Contemporary finance theory also asserts that truly fixed costs are very few (Harrington, 2004).

Also, Air Force Missile Command is not a field force that can be deployed to a combatant region, so allocating its cost by a geographic multiplier seems counter-indicated. On the other hand, to exclude these forces would seem to require an assumption that they exert deterrence randomly across the globe. For this reason their cost is allocated geographically along with all other forces. Recognizing that this is a matter of opinion, those who disagree could reduce the $c_{DoD\ baseline}$ estimate by subtracting from it the Missile Command line item in DoD budgets, which would result in 9–11% reduction in most years.

4.3. Comparisons to previous studies

Because the present study and Stiglitz and Bilmes (2008) make estimates of the monetary cost of 2002–2007 Iraq–Afghanistan operations cost, these can be compared even though methods vary.[17] The upper bound for their monetary cost component is $\$0.64 \times 10^{12}$ (2007$). The present study's estimate for the same period is $C_{PGfp\ baseline\ 2002–2007} \approx \$2.30 \times 10^{12}$ (2008$) (Table 4, $\sum C_{PGfp\ baseline\ 2002–2007}$ from col. k). Most of the disparity is due to different treatments of baseline cost. Perhaps for conservatism, Stiglitz and Bilmes include only 25% of post-2001 baseline budget increases in their estimate of war cost. Stiglitz and Bilmes speculate, however, that other monetary costs of war might be hidden in the baseline budget. The present study reveals how great these hidden costs are, i.e. $C_{PGfp\ baseline\ 2002–2007} \approx \$2.30 \times 10^{12}$ (2008$), even before addition of supplemental costs counted in both studies. Whatever additional social costs one accepts from Stiglitz and Bilmes could be added to $C_{PGfp\ 2002–2007}$ for a more holistic accounting of recent regional cost.

Differences in assumptions and methods between the present study and Delucchi and Murphy (2008) are greater. While their study does not accrue cost over time, it does estimate a 2004 range of $\$47–97 \times 10^9$ for the cost to defend all US interests in the Persian Gulf. The researchers express doubt that cost could be "much larger than our upper bound, unless one expands the analysis to include the value of the non-monetary impacts of military policy". Nonetheless, the present study's estimate for 2004 is greater by an order of magnitude, i.e. $C_{PGfp\ 2004} = \$494 \times 10^9$, with no non-monetary impacts included.

Delucchi and Murphy's (2008) $\$47–97 \times 10^9$ estimate includes an annualization of $\$15–25 \times 10^9$ for expected war cost, this based on an assumption that the US will fight a major regional war once every 50 years. By contrast, the present study counts baseline and supplemental C_{PGfp} for 2004 when an actual war was taking place. An assumption of more frequent war, which would be reasonable, could steeply increase the Delucchi and Murphy estimate and reduce disparity with the present study.

However, the peacetime component of the Delucchi and Murphy estimate (i.e. $\$30–60 \times 10^9$ for 1991 increasing to $\$32–72 \times 10^9$ in 2004) can be directly compared to the present study's estimate of baseline contribution to C_{PGfp} for the same years. Applying q_{PGfp}/n_{CVN} for 1991 (0.53) to nominal $C_{DoD\ 1991}$ (i.e. $\$262 \times 10^9$) gives $C_{PGfp\ 1991} = \$142 \times 10^9$. Even if this estimate is reduced by 30% to remove putative fixed and Missile Command cost the result is $C_{PGfp\ 1991} = \$99.4 \times 10^9$, which exceeds the $\$60 \times 10^9$ upper bound of Delucchi and Murphy. By 2004 the disparity is much greater, $C_{PGfp\ 2004} = \$402 \times 10^9$ versus their upper bound of $\$72 \times 10^9$.

The large difference highlights the consequences of variation in methods and assumptions between the two studies. Delucchi and Murphy adapted the most detailed early estimates of oil supply protection cost (Kaufmann and Steinbruner, 1991; Ravenal, 1991), which were based on judgments of Congress' intentions in 1991 as discussed above. Use of a geographic operand to allocate regional cost in the present study suggests that earlier estimates were probably too low. A further contribution to disparity comes from the Delucchi and Murphy assumption that their $\$30–60 \times 10^9$ range of 1991 peacetime expense should increase at rates of 0.5–1.5%/year. This yields a $\$32–72 \times 10^9$ Persian Gulf military expense for 2004 before addition of annualized war cost. The assumption that 1991 regional cost should grow at what appear to be discount rates implies a further assumption that defense effort in the region remained constant over the period. The present study's determination of q_{PGfp} from geographic data indicates that regional defense effort has been dynamic.

The present estimate is also much higher than comparable federal government estimates. Taking the 2004 example above, DoD would count only its Supplemental Budget, $\$99 \times 10^9$

[17] However, their headline estimate of a "Three Trillion Dollar War" is a social not a monetary cost estimate hence is not comparable. The discussion here concerns only the monetary cost component of the Stiglitz and Bilmes estimate.

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(2008$). Exclusion of baseline cost from DoD Iraq–Afghanistan accounting explains most disparity between their estimate and the present study. DoD's assumption that no baseline expense is attributable to Persian Gulf operations seems fanciful given that deployments there have been continuous since 1982 (Fig. 1). However, it cannot be said that DoD accounting must be wrong. Accounting is an information management system that reflects judgments about what information a firm believes is most important. Whatever the logic of DoD accounting, its result is to obscure regional cost information that seems critical to energy and national security policy.

To summarize with respect to the disparity between past and present estimates of C_{PGfp}, DoT cost data used for the post-2000 period increase disparity but are more accurate than DoD cost data, hence problems of comparison do not arise. While differences in methods and assumptions between this study and the most important previous ones (Delucchi and Murphy, 2008; Kaufmann and Steinbruner, 1991; Ravenal, 1991) preclude comparisons of headline conclusions, other comparisons are possible. Incorporation of a geographic operand to allocate cost to regions in the present study overcomes a limitation of earlier studies and shows that C_{PGfp} is considerably greater than previously understood. Present results also show that C_{PGfp} is much greater than acknowledged by any US agency. This is so whether or not the $C_{PGfp\ 1976–2007} \approx \$6.8 \times 10^{12}$ estimate is reduced by 20% to account for putative fixed costs and a further 10% to exclude Missile Command cost.

4.4. Implications for US energy and national security policy

This discussion assumes that $C_{PGfp\ 1976–2007} \approx \$6.8 \times 10^{12}$ is the most accurate estimate of this quantity consistent with the contention that most DoD expense is variable in the long run (Delucchi and Murphy, 2008). Putting aside the question of C_{PGfp}'s relation to oil for the moment, a number of trends and comparisons are of interest. First, on an annual basis the Persian Gulf mission now costs about as much as did the Cold War. Evident from Fig. 1 is that C_{PGfp} after 2001 is roughly equivalent to C_{DoD} at the height of the Cold War. Persian Gulf force projection is also costly with respect to oil trade valuations since 1988. C_{PGfp} exceeds the value of Gulf petroleum exports in all years except 1990[18] and the value of US petroleum imports from the region by roughly an order of magnitude over most of the study period (Fig. 2).

Interestingly, C_{PGfp} is relatively strongly correlated to Gulf petroleum export value and volume (r^2=0.54 and 0.42, respectively,) and somewhat less strongly to Dubai spot price (r^2=0.27).[19] Comparisons of C_{PGfp} to metrics such as the oil import premium and the cost of oil dependence are also of interest. The most detailed oil import premium estimate is the most recent, its wide range ($6.71–23.25/b) reflecting the wide variation in supply and demand behaviors that were simulated to derive it (Leiby, 2007). Huntington clarifies an important distinction between the oil import premium and military costs of supply protection.

> Empirical premium estimates correctly exclude military expenditures to maintain peace and property rights in oil-producing countries. The premium measures what governments *should* spend to reduce a set of damages. Actual military expenditures indicate what the government *does* spend (Huntington, 2009).

Nonetheless, Huntington suggests that expressing military cost in terms of oil consumption is still useful for "judging military expenditures that can be clearly identified with the US oil interests". He thus compares an annual DoD cost of Iraq operations against Leiby's mid-range estimate of the oil import premium.

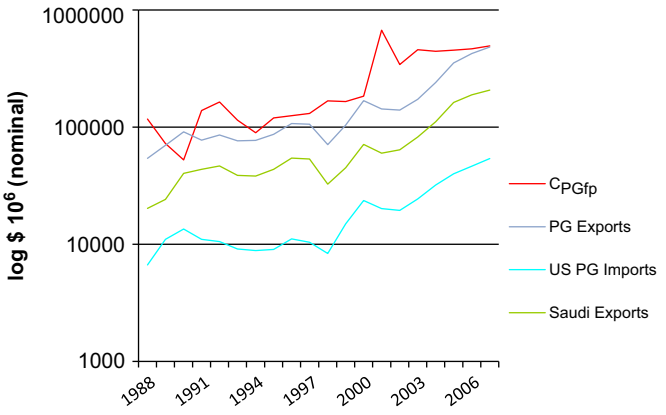

Fig. 2. C_{PGfp} and Persian Gulf petroleum trade values, 1988–2007. Trade values from OPEC Statistical Bulletin, 2008. OPEC. Vienna Austria. US PG import value from United States DoE Annual Energy Review 2008, table 5.4 (http://www.eia.doe.gov/emeu/aer/pdf/ pages/sec5_11.pdf).

> According to the director of the US Congressional Budget Office, annual US military expenditures in Iraq are now about $113 billion. Spreading those costs over the 5 billion barrels currently imported [annually] by the United States results in approximately $23 per barrel. This simple calculation suggests that the United States is spending too much if its military commitment was due solely to reaping societal oil benefits" [of $13/barrel (Leiby, 2007)].[20]

If this same metric is applied using $C_{PGfp\ 2006}$ the result is $C_{PGfp\ 2006}$=$84/barrel, or roughly $2/gal of gasoline. A further perspective on the unexpected magnitude of C_{PGfp} is that its 2007 value, $0.5 × 10^{12}$, is almost identical to the estimated 2008 cost of dependence, which is a market power effect (Greene, 2010).

4.5. The relation of oil to C_{PGfp}

As discussed in the Introduction, oil-related rationales for Persian Gulf force projection have evolved, accumulated and interacted in the three decades since Carter assumed a threat to regional supply. This process suggests whatever proportions of C_{PGfp} are incurred under the various Carter, Wolfowitz and anti-terror rationales, a very large fraction of C_{PGfp} is oil-related. As Fig. 1 shows, most C_{PGfp} has accrued since the first Gulf War in 1991, in which the US objective was to preempt a hegemonic monopolist as per Wolfowitz. The more recent war also has a Wolfowitz rationale, as is clear from President Bush's remarks cited above.

The newest rationale for regional force projection, combating terrorism, seems less obviously oil-related. Yet without the extensive long-term US military presence in the Persian Gulf it seems an open question whether anti-US suicide terrorism such as the *USS Cole* and 9/11 attacks would have taken place. Foreign occupation is well-correlated with suicide terrorism, which rarely occurs in the presence of religious differences alone (Pape, 2005). This is not to say that there are no rationales for Persian Gulf force projection besides those that have evolved directly or indirectly

[18] US imports value will again exceed C_{PGfp} in 2008.

[19] Dubai Spot Price taken from BP Statistical Review of World Energy 2009.

[20] The year appears to be 2006, as the Supplemental Budget for that year is $113 (col. c), i.e. nearly the value Huntington cites.

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from oil markets. It is rather that evidence is not decisive as to what those other rationales might be.

5. Conclusion

While C_{PGfp} is derivative of oil market power as are other social and monetary costs of oil dependence (Greene, 2010) it is very substantial. Before 1990 C_{PGfp} was clearly an external cost of supply protection, since the Carter Doctrine had rationalized force projection. Supply may not have been seriously threatened, but costs were incurred all the same. With adoption of the Wolfowitz Doctrine, the US committed itself to preempt emergence of a regional hegemonic power that might control oil resources. Policymakers seem not to have realized it but these policies were responses to market power, without which the contested resources would have had far less value. C_{PGfp} thus seems to derive mainly from market power since 1990.

The estimate presented here provides a new perspective on the magnitude of oil market power as a societal problem for the US. When $C_{PGfp\ 2007} \approx \$0.5 \times 10^{12}$ is considered alongside Greene's nearly identical estimate of the cost of oil dependence, market power emerges as a substantial source of social and monetary losses. If most C_{PGfp} is now incurred under Wolfowitz, combined market power effects are approximately $\$1.0 \times 10^{12}$ per year, 7% of US GDP.

Unfortunately, force projection is not a remedy for market power but a strategy to contend with its consequences. Since market power has never been challenged by any sustained US or importer monopsony policy, the strategy of force projection was bound to fail as Iran's emergence as a regional hegemon seems to demonstrate. Treating symptoms with force has thus led to the substantial investment of $C_{PGfp\ 1976–2007} \approx \$6.8 \times 10^{12}$ perhaps too little purpose. The path not taken, monopsonist energy policies, to improve fuel efficiency, would address the core problem.

Greenhouse gas emissions reductions policies are sometimes considered with respect to the ancillary benefits such policies would achieve, such as public health benefits from air pollution reduction (Burtraw et al., 2003). Such policies would also reduce market power effects by reducing oil demand and possibly price. However, the magnitude of market power's putative $\$1.0 \times 10^{12}$/yr of economic and military effects suggests another way to conceive of ancillary benefits. Adoption of monopsonist policies to reduce energy demand would achieve ancillary climate and public health benefits, so long as coal were not substituted for oil consumption. Given the recent failure to obtain global agreement on greenhouse emissions, the potential of stand-alone US or importer state oil monopsonist policies as a partial substitute for carbon constraints should not be overlooked. Conversely, even if the US adopted emissions reductions policies additional monopsonist policies might still be appropriate to reduce oil demand. The goal should not be to eliminate imports but to reduce oil market power.

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