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A Cost Analysis of the U.S. Air Force Overseas Posture

Informing Strategic Choices

Patrick Mills, Adam Grissom, Jennifer Kavanagh, Leila Mahnad, Stephen M. Worman

RAND CORPORATION

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RAND Project AIR FORCE

Prepared for the United States Air Force

The research described in this report was sponsored by the United States Air Force under Contract FA7014-06-C-0001. Further information may be obtained from the Strategic Planning Division, Directorate of Plans, Hq USAF.

Library of Congress Control Number: 2013948441

ISBN: 978-0-8330-8037-0

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Preface

Overseas military presence has been a central concern of American grand strategy for more than a century, dating to the emergence of the United States as a great power in the aftermath of the Spanish-American War. It is equally central to the contemporary debate on the future of American grand strategy in the 21st century.

Three particular policies—the "pivot to Asia," a drawdown of U.S. troops from Europe, and two more possible rounds of Base Realignment and Closure (BRAC)—are presently the topic of much debate by analysts, policymakers, and military officials alike. The RAND Corporation has drilled down on one common element of these policies—overseas U.S. military basing—to answer the following question: What are the potential cost savings associated with altering the U.S. overseas military posture?

The analysis in this report estimates the costs associated with Air Force installations and units to provide further insight into the costs and benefits of overseas basing. Our analysis takes three separable elements of overseas basing (force size, force location, and base location), assesses the costs of altering them individually, and then constructs a cost analysis to frame a range of policy options.

This document summarizes the findings from our cost calculations, offering a comparison of recurring savings resulting from altering the U.S. overseas presence. The analysis should be of interest to planners, programmers, and policymakers involved in the contemporary debate on grand strategy, particularly those that assess overseas military posture.

This research was co-sponsored by the Vice Chief of Staff of the Air Force (AF/CV), the Deputy Chief of Staff for Operations, Plans, and Requirements (AF/A3/5), and the Deputy Chief of Staff for Strategic Plans and Programs (AF/A8). The study was conducted within the Strategy and Doctrine Program of RAND Project AIR FORCE as part of a fiscal year 2012 study titled "A New American Grand Strategy?"

RAND Project AIR FORCE

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Contents

Figures

Tables

Summary

The extent of U.S. military presence overseas is once again the subject of intense debate, as policymakers consider a "pivot to Asia," a drawdown of troops from Europe, and future Base Realignment and Closure (BRAC) decisions. From a strategic perspective, the debate centers on a disagreement over whether the costs associated with overseas presence exceed the benefits in some or all circumstances. Remarkably, however, to date there have been few systematic attempts to estimate either side of the equation.[1]

This report seeks to inform the debate by providing a rigorous estimate of the costs associated with maintaining U.S. Air Force (USAF) installations and units overseas. It describes the various types of expenditures required to maintain bases and military units overseas and estimates current costs using official data and econometric modeling.

Specifically, we used the Air Force Total Ownership Cost database (AFTOC) and other sources to calculate the costs of USAF base support. Cost categories include traditional installation support activities (e.g., facilities operations and sustainment), other installation-related activities (e.g., medical support, air traffic control, and some communications infrastructure), infrastructure recapitalization, regional training cost differences, personnel allowances, permanent change of station move costs, Department of Defense (DoD) Dependents Schools, and Defense Logistics Agency support.

Throughout the analysis, we focus on the *incremental* costs of overseas basing, i.e., the cost of basing forces overseas *rather than* in the United States. We examine three types of presence options that are particularly relevant to the contemporary debate:

- realigning (i.e., moving) forces from an overseas base to a U.S. base without closing the overseas base
- cutting forces currently located at an overseas base but not closing the base
- closing an overseas base.

In estimating costs, we distinguish between the fixed costs that would be saved if a base were closed and the variable costs that would be saved if forces were realigned from overseas to the United States.

The analysis has five significant implications for the ongoing debate on American grand strategy—defined as the alignment of national ends, ways, and means[2]—and overseas presence:

[1] Systematic attempts were made to estimate the costs of overseas forces in Europe around the time of the end of the Cold War. As an example, see Jane M. O. Sharp, *Europe After an American Withdrawal: Economic and Military Issues*, Stockholm International Peace Research Institute, New York, N.Y.: Oxford University Press, 1990.

[2] See Adam Grissom, "What Is Grand Strategy? Reframing the Debate on American Ends, Ways, and Means," Santa Monica, Calif.: RAND Corporation, forthcoming.

1. There are measurable costs associated with overseas presence. For example, our analysis found the following:

- The total potential savings from realigning (i.e., moving) one squadron of 24 F-16s from overseas to the United States (without substituting any rotational presence) would be roughly $17–29 million per year. As a comparison, a single F-16 squadron of the same size operating in the United States has total direct operating and support costs of about $147 million per year.[3]
- The potential annual cost savings from closing a single USAF base with permanently stationed forces would be approximately $230 million in U.S. Air Forces in Europe (USAFE) or $190 million in Pacific Air Forces (PACAF). The savings for closing a comparable base in the United States would be approximately $80 million.
- Cutting an average active duty fighter squadron based in the United States would save roughly $432 million per year (including recapitalization cost avoidance). Cutting a comparable squadron overseas would save an additional $17–29 million (4–7 percent) per year.

2. The costs of overseas presence are small relative to the USAF's overall budget. The costs to maintain the current USAFE and PACAF force structures and installations *overseas rather than in the United States* are roughly $2.2 billion and $1.3 billion per year, respectively.[4] Together, these totals amount to about 2 percent of the USAF total obligation authority. From the perspective of national ends, ways, and means, a forward-deployed USAF costs about the same as a USAF confined to domestic bases. Forward presence is not a major burden on the USAF, DoD, or the nation.

3. The debate about overseas presence should distinguish personnel and force structure costs from basing costs. Many observers conflate a reduction in overseas presence with a reduction in force structure, claiming enormous savings from prospective changes to overseas posture.[5] From the grand strategic perspective, personnel and force structure, not presence or basing, is the biggest cost driver for DoD. The overall size of U.S. non-naval forces, and therefore the vast majority of their cost, is only minimally linked to where DoD has bases.[6] The size of the force is instead driven by force planning requirements. Thus, the important question is

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[3] FY2009–2012 AFTOC, Cost Analysis Improvement Group categories 1–5, all F-16s operated by Air Combat Command.

[4] These estimates include only those bases on foreign soil, and not bases located on American territory outside the continental United States, such as Andersen Air Force Base in Guam.

[5] The Sustainable Defense Task Force, for example, postulated $80 billion in savings from reducing the posture in Europe and Asia, but this estimate included end strength reductions of 50,000 personnel (Sustainable Defense Task Force, *Debt, Deficits, and Defense: A Way Forward*, Washington, D.C., June 11, 2010).

[6] The Navy forward-stations some of its forces and designates them Forward-Deployed Naval Forces (FDNF). FDNF ships and crews operate at a higher operational tempo than those home-ported in the United States. They have a higher availability than U.S.-based forces, but also have higher costs. Thus, the Navy's force structure costs are more tightly coupled with the proportion of its forces that are stationed overseas than are the other Services.

how many operations of what types the United States is planning to conduct rather than where it bases its forces in peacetime.

4. The primary risk in the presence debate is making choices that produce relatively modest savings, but with potentially enormous strategic and fiscal consequences. Proponents of overseas presence claim that such a posture helps deter potential adversaries, contributes to regional stability through capacity building and political influence, and enhances operational performance by fostering regional familiarity among U.S. forces, interoperability with potential partners, and more assured access to en route and in-theater infrastructure.[7] Forward presence is thought to reduce the likelihood of a war against another major power or a major stability operation in an important failed state, and to allow U.S. and coalition forces to conduct operations more effectively and at lower human and financial cost. Cost estimates for Operation Iraqi Freedom range from about $800 billion[8] to several trillion dollars,[9] and estimates for Operation Enduring Freedom range from about $570 billion (through FY2012)[10] to several trillion dollars.[11] If forward presence reduces the likelihood of even one such event, then it will have delivered a substantial return on investment.

5. The burden of proof in the presence debate should shift to *opponents* of presence.[12] It has traditionally fallen to proponents of presence to demonstrate that the benefits are commensurate with costs (which were presumed to be substantial). The cost analysis presented in this report suggests that the more salient question is whether opponents can demonstrate that presence *cannot* offer at least some of the benefits described above.

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[7] See, for example, U.S. Department of Defense, *Sustaining U.S. Global Leadership: Priorities for 21st Century Defense*, Washington, D.C., January 2012b.

[8] Amy Belasco, *The Cost of Iraq, Afghanistan, and Other Global War on Terror Operations Since 9/11*, Washington, D.C.: Congressional Research Service, March 29, 2011.

[9] Linda J. Bilmes and Stiglitz, Joseph, *The Three Trillion Dollar War: The True Cost of the Iraq Conflict*, Location: New York, NY: W. W. Norton & Company, February 17, 2008.

[10] Anthony H. Cordesman, *The U.S. Cost of the Afghan War: FY2002–FY2013: Cost in Military Operating Expenditures and Aid and Prospects for "Transition"*, Washington, D.C.: Center for Strategic and International Studies, May 14, 2012.

[11] Belasco, 2011.

[12] This point would apply somewhat less so to naval forces, for the reason noted above.

Acknowledgments

This work was sponsored by the Vice Chief of Staff of the Air Force, Gen Philip M. Breedlove; the U.S. Air Force Deputy Chief of Staff for Operations and Planning, Lt Gen Herbert J. Carlisle; and by the Director, Air Force Strategic Planning, Deputy Chief of Staff for Strategic Plans and Programs, Maj Gen Darryl Roberson. Without their support, this work would not have been possible. (Ranks and positions are as of the time of our research.)

The support and help from Assistant Secretary of the Air Force for Financial Management and Comptroller was indispensable. In particular, we thank Mr. Larry Klapper and his colleagues for readily providing data and answering countless questions.

At RAND, we thank Mark Totten, Victoria Greenfield, and Daniel Sommerhauser for providing data, analysis, and helpful insights. Formal reviews by Lauri Rohn and Mike Boito significantly strengthened this report.

The authors alone are responsible for any errors or oversights that may remain.

Abbreviations

AETC	Air Education and Training Command
AFTOC	Air Force Total Ownership Cost database
BRAC	Base Realignment and Closure
COCOM	combatant command
CONUS	continental United States
DLA	Defense Logistics Agency
DoD	Department of Defense
DoDDS	DoD Dependents Schools
FY	fiscal year
MAJCOM	major command
MILCON	military construction
O&M	operations and maintenance
O&S	operating and support
OCONUS	outside the continental United States
OOT	over-the-ocean transportation
OSD	Office of the Secretary of Defense
PAA	primary aircraft authorized
PACAF	Pacific Air Forces
PAF	RAND Project AIR FORCE
PCS	permanent change of station
PE	program element
PRV	plant replacement value
USAF	United States Air Force
USAFE	United States Air Forces in Europe

The Costs of Commitment: Cost Analysis of Overseas Air Force Basing

American grand strategy—defined here as "the alignment of national ends, ways, and means"[1]—is once again the subject of intense debate among policymakers, politicians, academics, and analysts. While the debate, like grand strategy itself, spans the range of national priorities and challenges, there are particularly sharp disagreements over the role of the United States in the international system.[2] Most of the discussion focuses on the appropriate scope of American military presence overseas, with opinion ranging from those who call for an expansion of forward military presence (particularly, but not solely, in East Asia) to those who argue that the United States should abrogate its alliance commitments and bring its armed forces home.[3]

From a strategic perspective, the debate on overseas military presence centers on a disagreement over its cost and benefits. Those who call for retrenchment believe that the costs associated with overseas presence exceed the benefits in some or all circumstances. Those who call for greater forward presence believe the opposite, to one degree or another. Remarkably, however, to date there have been few systematic attempts to estimate either side of the equation.[4]

This report seeks to advance the debate by providing a rigorous estimate of the recurring costs associated with maintaining U.S. Air Force (USAF) installations and units overseas. It describes the various types of expenditures required to maintain bases and military units overseas, estimates current costs using official data and econometric modeling, and discusses the significance of these findings for the overall debate on American grand strategy.

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[1] Grand strategy is defined here as "the alignment of national ends, ways, and means." See Adam Grissom, *What Is Grand Strategy? Reframing the Debate on American Ends, Ways, and Means*, Santa Monica, Calif.: RAND Corporation, forthcoming.

[2] For a synopsis, see Peter D. Feaver, "Debating American Grand Strategy After Major War," *Orbis*, Fall 2009, pp. 547–552.

[3] Key examples of the first school include the Obama administration's "pivot to Asia," as enunciated in Barack Obama, "Remarks by President Obama to the Australian Parliament," Washington, D.C.: White House, November 17, 2011; and Robert J. Art, "Selective Engagement in an Era of Austerity," in Richard Fontaine and Kriston Lord, eds., *America's Path: Grand Strategy for the Next Administration*, Washington, D.C.: Center for a New American Security, May 2012. Key examples of the latter school include Christopher Layne, *The Peace of Illusions: American Grand Strategy from 1940 to the Present*, Ithaca, N.Y.: Cornell University Press, 2006; and Christopher A. Preble, *The Power Problem: How American Military Dominance Makes Us Less Safe, Less Prosperous, and Less Free*, Ithaca, N.Y.: Cornell University Press, 2009.

[4] Systematic attempts were made to estimate the costs of overseas forces in Europe around the time of the end of the Cold War. As an example, see Jane M. O. Sharp, *Europe After an American Withdrawal: Economic and Military Issues*, Stockholm International Peace Research Institute, New York, N.Y.: Oxford University Press, 1990.

Components of Overseas Presence

Overseas presence is a complex issue, partly because it is the product of three separate but related sets of strategic choices—how large the armed forces should be, where military bases should be located, and where units should be located among those bases in peacetime. Each of these choices has its own costs, benefits, and risks. Analyzing them as an interrelated whole is inevitably complicated.[5]

Many participants in the debate cope with this complexity by conflating the three sets of decisions.[6] For example, many implicitly assume that reducing the number of units stationed overseas equates to reducing the overall size of the armed forces.[7] As will be seen, such conflation is analytically flawed and contributes to misimpressions about the costs and benefits of overseas military presence.

A comprehensive cost analysis of overseas presence must incorporate three components, diagrammed in Figure 1. The first is *force size*. Decisions about the overall size of the armed forces reflect a number of political, strategic, and operational considerations.[8] The U.S. Department of Defense (DoD) formally supports these decisions through an elaborate process of scenario-based force planning and programming. DoD instructs the services to develop the capabilities and capacity required to handle a given number of scenarios with given characteristics over a given period of time.[9] The services convert these requirements into plans and programs.[10] For the most part, forward presence plays little role in defining the overall size of the armed forces.[11] On the other hand, the overall size of the armed forces (and some of its characteristics) may drive the type and aggregate amount of basing capacity required.

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[5] For more on the costs and benefits of overseas military presence, see Michael J. Lostumbo, Michael J. McNerney, Eric Peltz, Derek Eaton, David R. Frelinger, Victoria A. Greenfield, John Halliday, Patrick Mills, Bruce R. Nardulli, Stacie L. Pettyjohn, Jerry M. Sollinger, and Steven Worman, *Overseas Basing of U.S. Military Forces: An Assessment of Relative Costs and Strategic Benefits*, Santa Monica, Calif.: RAND Corporation, RR-201-OSD, 2013.

[6] Prominent examples include David W. Barno, Nora Bensahel, and Travis Sharp, *Hard Choices: Responsible Defense in an Age of Austerity*, Washington, D.C.: Center for a New American Security, October 2011; Benjamin Friedman, "How Cutting Pentagon Spending Will Fix U.S. Defense Strategy: Austerity Is the Best Possible Auditor," *Foreign Affairs*, November 2011; and Stephen M. Walt, "The End of the American Era," *National Interest*, October 2011.

[7] For a prominent example, see Gordon Adams and Matthew Leatherman, "A Leaner and Meaner Defense," *Foreign Affairs*, Vol. 90, No. 1, January/February 2011, pp. 145–146.

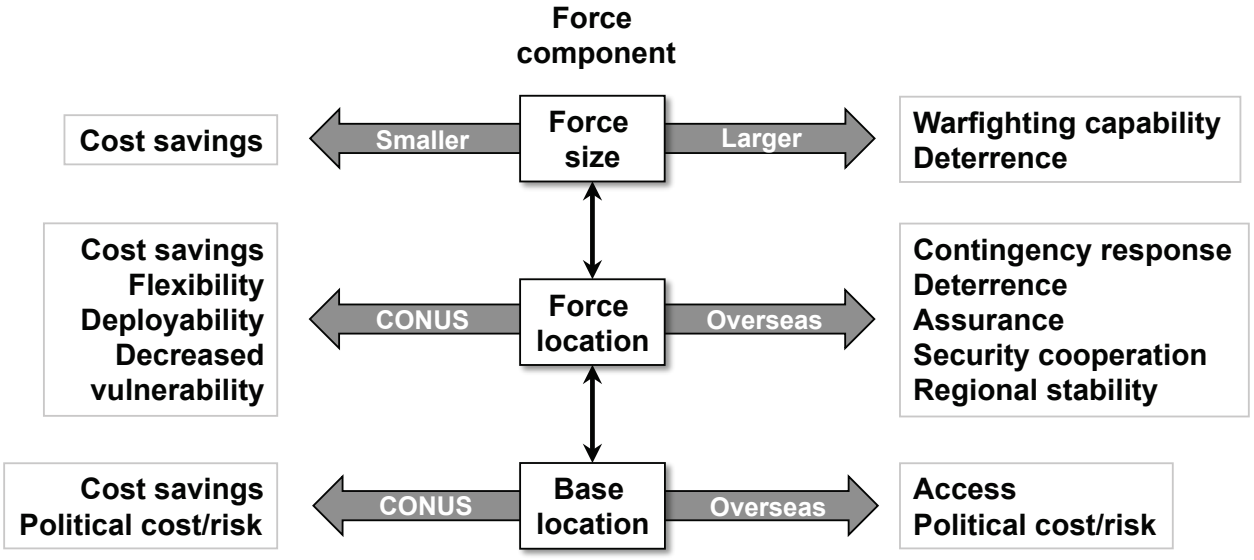
[8] For a classic description, see Ralph Sanders, *The Politics of Defense Analysis*, Cambridge, Mass.: Dunellen, 1973.

[9] The most recent example of such instructions is DoD, *Defense Budget Priorities and Choices*, Washington, D.C., January 2012a.

[10] For an example drawn from the USAF, see Don Snyder, Patrick Mills, Adam C. Resnick, and Brent D. Fulton, *Assessing Capabilities and Risks in Air Force Programming: Framework, Metrics, and Methods*, Santa Monica, Calif.: RAND Corporation, MG-815-AF, 2009.

[11] This point applies somewhat less to the Navy, whose force size is determined in part by how much force it bases overseas.

Figure 1. Force Components of Overseas Military Presence



Likewise, DoD decisions about *force location* (i.e., where units are permanently based in peacetime) generally reflect political, strategic, and operational factors beyond the overall size of the force.[12] For example, DoD may choose to base certain types of units at particular locations overseas in order to enhance deterrence, or to base units in domestic locations where they can be rapidly deployed overseas. Political and financial costs may also play a role (Figure 1).[13] For the most part, these decisions are independent of the size of the overall force, or indeed of the aggregate level of basing capacity required to support the overall force.

Base location, our third component, has the most obvious connection to force location. Certainly, for units to be located overseas, the United States needs access to physical facilities at those locations. But decisions about base location are informed by many factors beyond those that cause DoD to wish to base a unit in a region during peacetime. For example, the United States may wish to consolidate installations to save money or reduce political friction with a host nation.[14] Likewise, maintaining base locations, irrespective of how few forces are permanently stationed there, may also serve U.S. objectives. For example, some bases serve as logistical hubs for peacetime and wartime activities. Having access to a given base may ensure the uninterrupted supply of cargo and personnel to ongoing operations.

Because these three elements can have their own cost-benefit trade-offs, any valid cost analysis must assess each separately. The analysis must also express costs in commensurable

[12] For an excellent overview, see Stacie L. Pettyjohn, *U.S. Global Defense Posture, 1783–2011,* Santa Monica, Calif.: RAND Corporation, MG-1244-AF, 2012.

[13] Pettyjohn, 2012.

[14] Adjustments being made at the time of this writing (early 2013) in Japan (politics) and Germany (cost) reflect these considerations.

terms to allow the different types of costs to be compared across permutations of options. One must be able to compare, for example, the cost of moving a unit from a base in Europe to a base in the United States with the cost of removing the unit from its European base but then deactivating it.

This analysis estimates the cost of *force size* in terms of the cost of typical units on which most strategic and operational analyses focus, e.g., flying wings or squadrons, brigade combat teams, marine expeditionary units, etc. This captures the cost of having a unit in the force structure irrespective of its peacetime station.

The cost of *force location* corresponds to the relative difference in cost to maintain units and personnel overseas rather than in the United States. This captures such cost differences as manning and training a unit in its overseas location compared with manning and training the unit at a domestic base. If, for example, personnel receive additional housing allowances for being stationed overseas, this is included in the relative force location cost.

The cost of *base location* corresponds to the relative difference in cost to maintain installations themselves (i.e., direct base support) in overseas locations rather than in the United States. This captures any activities associated with running the installation, irrespective of the number of units or base population located there. It is, in essence, the cost to "open the doors" for an installation. It includes the general overhead needed to run an installation of a given type (e.g., a base with deployable operational forces could be expected to have a different overhead burden than a base with primarily depot-maintenance or acquisition-related activities). If, for example, environmental compliance costs tend to be higher in an overseas location than in the United States, this would be part of the base location cost.

In our analysis, we quantify the costs associated with these three elements of overseas presence, assess the costs of altering them individually, then combine them to examine five types of presence options that are particularly relevant to the contemporary debate:

- realigning (i.e., moving) forces from an overseas base to a domestic base without closing the overseas base[15]
- cutting forces currently located at an overseas base but not closing the base
- closing an overseas base.

In the analysis, we erred on the side of overestimating overseas costs. For that reason, we take these estimates to be an upper bound on the recurring costs of overseas bases and forces. Further, we analyze neither the investment costs necessary to implement the above changes to overseas posture, nor the costs to substitute rotational for permanent presence, should that be

[15] By "domestic," we mean bases located in the continental United States (CONUS). By "overseas," we mean bases located on foreign soil outside the continental United States (OCONUS). Bases located on American territory OCONUS, such as Andersen Air Force Base in Guam, are not included in this analysis.

desired. Rotational costs could mitigate any anticipated cost savings from reducing permanent overseas presence, and investment costs would delay such savings.[16]

An Overview of Air Force Spending

To provide some context to our cost analysis, we provide a brief overview of Air Force spending. Not all costs relevant to our analysis are contained within the USAF budget, but most are. This discussion is intended to give a broad overview of USAF obligations, not to parse the costs in detail for analysis, as we do later.

In this report, we focus on the incremental costs of overseas basing, i.e., the cost of basing forces overseas *rather than* in the United States. To do that, we first must narrow down the scope of costs in the Air Force's Total Obligation Authority (TOA) to the costs that are relevant to overseas basing. Figure 2 shows the USAF TOA broken down in several ways. From left to right, the figure shows various slices, or perspectives, on USAF spending. The height of each column shows the portion of TOA in various categories. The x-axis labels show the data source.

The left column in Figure 2 shows the total "base budget" budget authority by appropriation type.[17] Operations and maintenance (O&M) and military personnel (MILPERS) costs drive more than half of the $167 billion total. The three slivers at the top are military construction (MILCON), family housing, and revolving and management funds. For our purposes, the most relevant appropriation types are O&M (which funds the day to day operations of installation support, including civilian pay), MILPERS (some of which provides installation support), and MILCON (some of which supports the recapitalization of the existing infrastructure).[18]

The second column shows the same categories but restricts the data to the Air Force Total Ownership Cost database (AFTOC), the Air Force's operating and support (O&S) data tracking system.[19] In this chart, we only show O&M and MILPERS from AFTOC, though it has a small amount of RDT&E and Procurement funding (about $2 billion and $3 billion, respectively). While MILCON is excluded from AFTOC, we explain later how we use other data sources to estimate MILCON costs.

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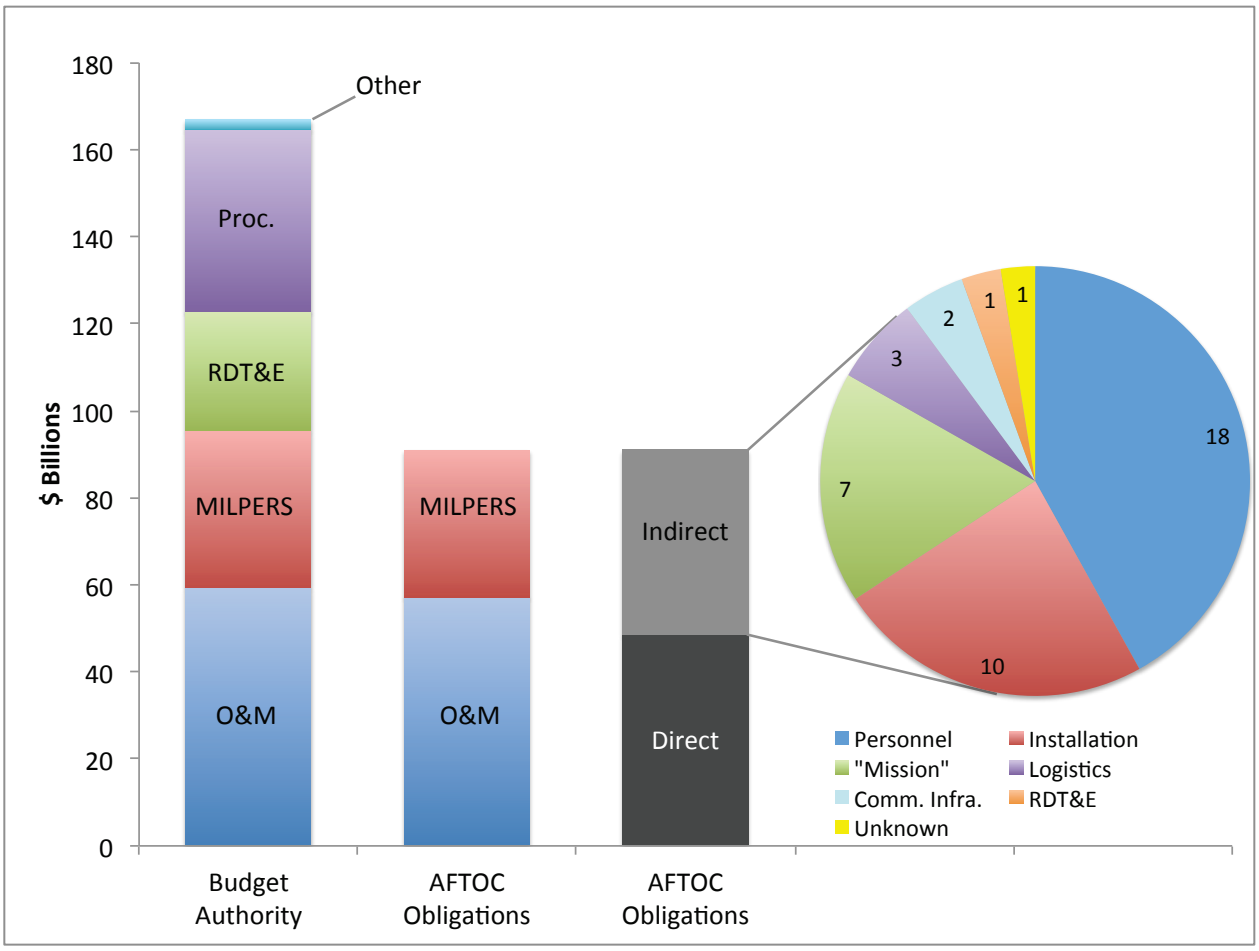
[16] For more on the costs of overseas USAF rotational costs, see Jennifer D. P. Moroney, Patrick Mills, David T. Orletsky, and David E. Thaler, *Working with Allies and Partners: A Cost-Based Analysis for the U.S. Air Forces in Europe*, Santa Monica, Calif.: RAND Corporation, TR-1241-AF, 2012.

[17] U.S. Department of Defense, *National Defense Budget Estimates for FY 2012*, Washington, D.C., March 2011a.

[18] Since 1981, the annual USAF MILCON budget has ranged from about $1 billion to $3.5 billion. Recent cuts put it at about $1.7 billion in FY2011, and it is expected to stay in that range for at least the near future (DoD, 2011a).

[19] FY2007–FY2011 AFTOC data (Agile Combat Support [ACS] cost model) provided by the Air Force Financial Management and Comptroller, Deputy Assistance Secretary of Cost and Economics, Directorate of Cost Analysis (SAF/FMCC), in February 2012.

Figure 2. Air Force FY2011 Spending



SOURCE: Author's analysis of FY2011 Air Force Budget Authority Data and FY2011 AFTOC data.
NOTES: "Other" includes MILCON, Family Housing, and Revolving and Management Funds. RDT&E = Research, Development, Testing, and Evaluation; Proc. = Procurement; Comm. Infra = Communications Infrastructure.

The rightmost column shows the same data for O&M and MILPERS only, now divided into direct costs, which can be attributed directly to weapon systems, and indirect costs, which cannot.[20] Some portion of indirect costs should be attributable to installation support activities. The pie chart at the far right then breaks out the indirect costs further, into categories provided in AFTOC that roughly mirror the support panel structure. In this context, "Mission" simply indicates program elements that do not apply to specific weapon systems, but for one reason or another are aligned to mission panels (e.g., some Agile Combat Support [ACS] personnel who support expeditionary operations during war but support installations while at home station). About $10 billion goes to what is defined here as installations, and about $1.8 billion of that goes to PACAF and USAFE, split about evenly between them.

[20] We used AFTOC's data fields to distinguish these two categories.

This raises several questions. How much of that "indirect" spending goes to installation support? How much of it would be saved if forces were realigned from overseas to the United States? If an overseas base were closed? That is what we seek to determine. As we move through our analysis, we will often compare the costs of overseas basing against the direct USAF operating costs and against the total USAF TOA, as a way to put them into perspective. It is not our intent to weigh the benefits of this overseas posture, but such relative comparisons can help contextualize the costs.

Cost Categories for Overseas Basing

In the previous section we focused on USAF TOA, and primarily on O&S as a subset of that. We now broaden the aperture to explain the range of activities pertinent to our analysis of the costs of overseas basing.

The activities required to support military personnel and installations are many, and current DoD and USAF data systems do not capture them all in one place. The following list shows the various categories of costs related to overseas basing that we used to inform our analysis:

- traditional installation support
- other installation-related activities
- infrastructure recapitalization
- personnel allowances
- permanent change of station (PCS) move costs
- DoD Dependents Schools (DoDDS)
- Defense Logistics Agency (DLA) support.

Traditional installation support costs are captured within a set of program elements (PEs); the Office of the Secretary of Defense (OSD) provides the services with which to track the PEs' installation support costs. These categories of spending (though not the dollar values) are generally comparable across services. Examples of these PE categories are facilities operations, facilities sustainment, and child and family services—these activities at present at virtually every permanent military location, irrespective of service or region.

In addition to traditional installation support categories, we include in our analysis a range of other cost categories that we believe help to better reflect the costs associated with permanent installation activities. Good examples of this are air traffic control and communications infrastructure. For bureaucratic reasons, these costs are often allocated to the operational units on an installation, but are ultimately part of running the installation itself. "Other" installation support also includes the cost of medical care. For both traditional and these "other" categories of installation support, we use data from the AFTOC database.[21]

[21] While DoD medical support is provided under the umbrella of the Defense Health Program (DHP), the Services bear most of the direct cost burden, and thus service-specific cost data capture most these costs. Costs borne by the

In addition to the costs of operating and maintaining installation support, the myriad infrastructure assets on base must be periodically recapitalized. Most of this spending occurs under the MILCON appropriation, but MILCON also includes capability upgrades and construction to support new missions, so using historical MILCON spending as a guide for future spending can be problematic. We use an approach that combines the plant replacement value of facilities with a periodic recapitalization rate, in an approach we explain below.

Personnel stationed overseas also receive several special allowances that compensate them for different living costs overseas. In reality, the DoD compensation system applies a series of allowances and special pay categories to adjust each person's salary to reflect the conditions under which they live and serve. AFTOC, however, uses a single average per-person cost for personnel irrespective of location, and thus does not reflect these regional pay differences. Thus, if one were to take the military pay costs in AFTOC as stated (for example, within unit training costs), one would see no regional pay differences. Instead, we estimate these special allowances as a separate category and supplement the AFTOC data with other sources.

PCS move costs are also not reflected directly in military personnel pay categories, so we must account for that separately, too. We used publicly available USAF budget data to do so.

Finally, USAF data do not capture the activities of most other defense agencies, some of which support overseas personnel and installation activities. Two important ones are DoDDS and DLA. Education costs per military person are higher overseas, if for no other reason than all dependents utilize it, whereas in the United States only a fraction of dependents do. We used publicly available data from OSD to estimate the additional costs of dependents education for overseas personnel.

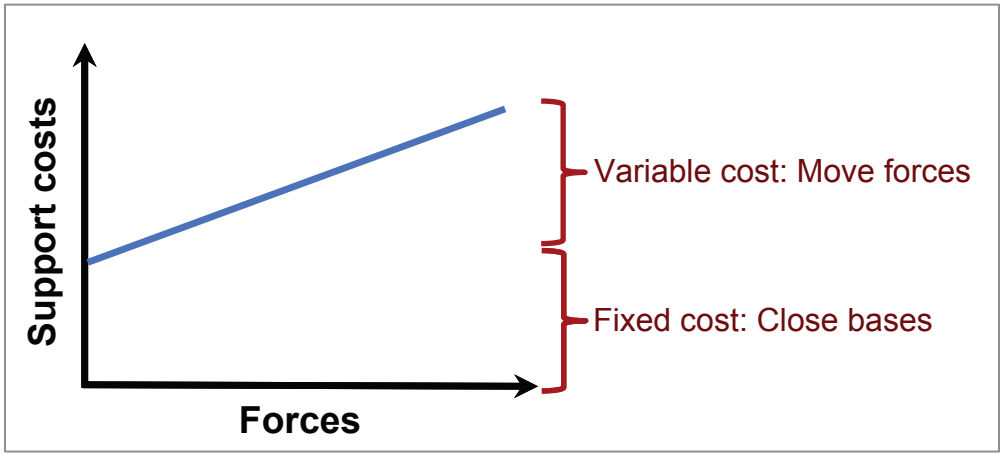
DLA provides two kinds of support that are relevant here. In addition to the network of CONUS defense distribution centers, DLA operates several overseas Forward Distribution Depots (FDDs) that support inventory and distribution to overseas locations, the cost of which is not borne by U.S. installations. Also, transportation costs from CONUS to overseas locations is not reflected in DLA surcharges (and thus installation-level spending), but instead are paid from centralized Service-wide accounts. These transportation costs are referred to as over-the-ocean transportation (OOT) costs.

Modeling Installation Support Costs

We now present a model of installation support costs that will inform our detailed cost analysis. This analysis covers the first two categories we described above: traditional installation support and other installation-related activities. Figure 3 shows a notional mathematical model of installation support costs as they relate to the size of the military presence on that installation.

DHP itself are management or overhead costs that would not vary greatly whether forces are located in the United States or overseas.

Figure 3. Notional Model of Installation Support Costs



In Figure 3, forces (who drive support costs) are on the x-axis, while support costs are shown on the y-axis. As personnel requiring support increase, so do support costs. However, we know from direct analysis of USAF manpower planning documents[22] that installation support activities as a whole have fixed and variable components. The variable cost component (the slope of the line) corresponds to the per-person cost of having forces located at a particular base. In particular, "Variable cost: Move forces" represents the costs that would be saved if an installation were to stay open but forces were moved from it. The variable cost at that installation would decrease, but the variable cost would increase at the installation receiving the moved forces, and the fixed costs would remain unchanged at both installations. Thus, there is only a variable cost savings if there is a difference between the two installations, i.e., an *incremental* cost.

The fixed cost component (the y-intercept of the line) corresponds to the cost of base location. In particular, "Fixed cost: Close bases" represents the annual fixed-cost portion of the installation—again not all of the costs associated with the installation—that would be saved if the installation were closed and the forces inactivated or moved to an existing installation. Since some posture questions may involve partial realignment of forces from an installation, it is important to have a model that can disentangle the fixed versus variable costs and show how the latter vary with changes in base population.

Simply dividing the total support costs at an installation by the total personnel, without taking into account the above dynamic, would skew per-person costs; this simple approach would overestimate variable costs and understate (or even eliminate) fixed costs. Thus, to

[22] USAF sizes much of its installation-related manpower support using a tool called a manpower standard. These standards usually provide mathematical formulae for calculating manpower requirements. For more, see Air Force Instruction 38-201, *Management of Manpower Requirements and Authorizations*, Washington, D.C., September 26, 2011.

accurately estimate support costs, it is necessary to use a method that will capture the variable- versus fixed-costs dynamic effectively.

The nature of these costs leaves us with two basic alternatives. The first is to work out from first principles the costs of each of the many components of support at a base. This could start from some kernel of demand, e.g., a flying wing or other operational unit with personnel. Those units and personnel drive demand for personnel, facilities, and other support. Most of these can be estimated from manpower and other planning documents. Each successive category of support (e.g., facilities to house the personnel, engineers to maintain the facilities, security forces to guard the engineers, doctors and other medical personnel to care for the security forces, and so on) would be chained to the last, and the whole sequence could be iterated to capture the interdependencies of each of the categories. The logic could be assembled into a model that would, given a set of basic inputs, estimate the total burden for base support activities and costs.[23]

Unfortunately, that approach is extremely time- and manpower-intensive. It requires gathering and analyzing a wide range of rule sets (i.e., the planning factors and equations) to account for the diverse activities conducted at military installations, and assembling them all in a way that is ultimately rather complex. For example, the USAF maintains hundreds of manpower standards, most of which have multiple equations or rule sets. Not all manpower standards are for installation support, but many are. Assembling the necessary set of these would still not capture the requirement for facilities space, vehicles, logistical support, and other activities and physical assets.

An alternative approach—the one we take in this report—is to approach the problem from the other direction. By performing a regression analysis, we essentially infer the relationships between support demanders and providers. This approach is approximate: Because of the variation in how different USAF rule sets are applied and how installations and their tenant units change over time, a regression model developed in this way will not perfectly predict most cost outcomes. But for the precision we sacrifice, we gain speed and flexibility. Ultimately, the fidelity of the models we develop can be assessed by their accompanying statistics and by simply testing their predictive power using actual data.

Using regression analysis does require an additional task to process the cost data we have assembled. To inform our regression analysis, we must classify costs and personnel (one of the primary drivers of cost) as either being independent or dependent variables (i.e., support demanders or providers). For the purposes of our regression analysis, we classified all military activities (i.e., units or organizations) into one of three broad categories based on whether they

[23] Past RAND Project AIR FORCE research used this approach to analyze Air Force deployment requirements. This research developed a decision support tool that does essentially what is described here for personnel and equipment required at expeditionary operating locations. See Don Snyder, Patrick Mills, *A Methodology for Determining Air Force Deployment Requirements*, Santa Monica, Calif.: RAND Corporation, MG-176-AF, August 2004.

drive installation support or provide them. These categories are mutually exclusive and completely exhaustive.

Referring back to Figure 2, we classified two types of activities as drivers of installation support costs, i.e., as independent variables.

Operational forces, the first set of cost drivers, form the core of the military. Within operational forces, we include both deployable forces—e.g., fighter wings, brigade combat teams, marine expeditionary units, and carrier groups—and nondeployable operational forces—such as space, missile, and cyber forces—that have ongoing operational missions but employ from home station. One way to encapsulate operational forces is to ask whether these units or activities directly support a combatant command (COCOM), whether from the U.S. or foreign soil. Thus, the size and shape of operational activities is driven by operational missions as enumerated in law, guidance documents, and relevant operational plans or scenarios.

The second subclass of installation support drivers we call "institutional." Institutional activities are those that sustain the organization as a whole (including the needs of the operational forces) but do not themselves directly support COCOMs. Good examples of institutional forces are such support activities as recruitment, training, and supply chain management. In the USAF, these activities are performed primarily at Air Education and Training Command (AETC) and Air Force Materiel Command. The size and shape of institutional forces is more or less directly tied to the size and shape of the operational forces, For example, the size of AETC's pilot training operations (its aircraft and instructors) ought to correlate to the number of pilots in the force and therefore the number of aircraft the USAF operates. If the number of aircraft declines, the number of pilots should, too, reducing the number of AETC training aircraft and trainers.

We would also include in the institutional category wing-level headquarters activities, major command (MAJCOM) headquarters, regional headquarters, and the like. Generally speaking, squadrons (whether aircraft, missile, or space squadrons) are doing the operational "work" of the organization, and the headquarters units are often the result of decisions about desired span of control, geography, and internal and external constraints (e.g., how many MAJCOMs the USAF will have, how many four-star billets the services are allowed). At an enterprise level, institutional activities on the whole are driven by operational forces on the whole.

These operational and institutional activities must be performed somewhere, and they incur costs wherever they are located. Thus, these two activities drive installation support costs, our dependent variable. Installation support includes all the facilities, equipment, and personnel needed to run the installations where operational and institutional units are located: to feed, house, protect, provide medical support to, and otherwise support the installations' populations in the performance of their day-to-day tasks. What we are calling "installation support" is usually referred to as base operating support. However, we include in our definition of installation support some activities that would not fall in the normal range of base operating support, such as some air traffic control and communications activities.

At an enterprise level, operational activities drive institutional activities, and both drive installation support. However, at an installation level, the calculus is different. Operational units are placed at particular locations for a range of reasons—operational, environmental, historical, and political. In general, though, the location of institutional forces is not determined by the size and shape of operational forces *on that base*.

So, at base level, operational and institutional forces are independently located, and they do not, on the whole, affect one another on a given base. We treat operational and institutional activities separately, even though they are both drivers, or demanders, of base support, because they place different types of demands on installation support with different cost implications.

Regression Analysis of Installation Support Costs

We applied this framework to USAF cost data to derive cost relationships for base support. We assigned all USAF program elements to one of those three categories. Operational and institutional activities are demanders of base support, and therefore independent variables. Support activities are providers of base support, and therefore dependent variables.

We performed several least squares regression analyses of cost data to isolate the fixed and variable costs of base support. We used FY2009–2011 AFTOC data (averaging the three years, to mitigate outliers) as our primary source for data on operating cost. For 89 active duty bases, we collected data on total operating costs, total mission costs, and total support costs.[24] (See the appendix for more detail on how we scoped our data set.) We looked to USAF personnel data to derive numbers of civilian and military personnel.[25]

We coded several dummy variables to differentiate among types of bases. We coded bases with permanently stationed aircraft to test whether the fixed cost of running and maintaining aircraft operations (runway, air traffic control, additional security, etc.) changes the cost profile of a base. We coded both PACAF and USAFE bases as dummies to test whether there is a significant difference in fixed cost between CONUS and overseas bases, and between the two regions.

Our focus in this analysis is to quantify the support costs associated with military bases and personnel in order to create a cost model that can inform a range of high-level posture options. Therefore, our primary dependent variable is total support cost. However, because AFTOC uses a single per-person cost for personnel irrespective of location, a straightforward assessment of

[24] We excluded MAJCOM headquarters and other very large bases (e.g., air logistics centers) from our regression analysis, because they have additional cost burdens not captured by the factors we are modeling. These bases skewed our cost models by including expenditures not present at most bases. Our aim is to produce a reliable cost model that works for the kinds of bases in which we are interested. When we do return to the question of including MAJCOM headquarters in our calculations, we explain how we account for their costs.

[25] Manpower data from Authorized Manpower Master File. Personnel data from Active Enlisted End of Month Master Personnel Extract File and Active Officer End of Month Master Personnel Extract File. All data were obtained from the Air Force Personnel Center and were current as of September 30, 2011.

AFTOC's installation support costs would miss some of the unique overseas pay categories accrued by the military personnel supporting installations. One of those costs is the pay for military personnel providing installation support. In peacetime, these support personnel provide installation support, and in wartime, they generally deploy to support expeditionary operations. For our purposes, these personnel, and their pay, are part of installation support. This military pay is generally found in program elements entitled "Combat Support," so we refer to them as Combat Support personnel.[26] Because AFTOC uses average pay figures, irrespective of region, it does not directly reflect the special allowances that these Combat Support personnel accrue. To estimate those allowances, we must estimate the number of support personnel driven by operational activities, as we do for support costs. We therefore assess separate regression models to estimate the impact of independent variables on support personnel and support costs.

We iteratively tested a range of models that specified different independent and control variables to identify the primary drivers and best predictors of support costs. We used the overall fit of the model as measured by the F-statistic and total R-squared (which quantifies the percentage of variation in the dependent variable captured in the independent variable) to determine which combination of independent variables best explain variation in support costs across the bases in the dataset. To determine the statistical significance of each effect, we used a p-value of < 0.1.

Our regression analysis revealed statistically significant terms for both fixed and variable components (lending support to our notional mathematical model in Figure 1). We focused on two of our regression models to understand what drove our dependent variables. These models produced parameter estimates and statistical estimates of error bounds, giving us lower and upper bounds. We show the parameter estimates here, for brevity's sake. The appendix has further details on this regression analysis.

For the variable cost component (i.e., the per-person support costs), we found the following:

- One additional operational military person is associated with approximately $29,000 in additional total support costs (this is apart from the individual's direct pay).
- One additional institutional military person is associated with roughly $102,000 in additional total support costs.[27]

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[26] The Air Force generally refers to this category as Agile Combat Support (ACS). We use the term Combat Support in this report.

[27] This result—that institutional personnel, often in jobs one would consider clerical, would drive higher support costs than operational personnel, who operate and maintain large, expensive weapon systems—is counterintuitive. The explanation is simple. Institutional organizations tend to include a significant number of civilians working alongside the military, yet, for simplicity's sake, we included only military personnel in the regression model. Because the institutional military personnel correlate with the civilians, that variable is, in effect, a proxy for all the personnel in those organizations. Institutional military personnel correlate with their own support costs, but also with civilians in their organizations, who also drive support costs. Thus, the institutional military personnel correlate with what appear to be very high support costs. We also tested a model that included institutional civilian personnel, but that model's fit was significantly worse. Since our main focus in this paper is on the impact of moving operational forces, we chose to use the simpler model.

These figures directly reflect AFTOC data and have not been adjusted for factors that AFTOC does not include. We discuss those adjustments in a subsequent section.

We also looked at the effect of operational and institutional personnel on Combat Support personnel and found the following:

- One additional operational person is associated with roughly 0.4 additional Combat Support personnel.
- One additional institutional person is associated with roughly 0.4 additional Combat Support personnel.

Our analysis found that operational and institutional personnel drove essentially the same number of Combat Support personnel, even though they drove different total dollar amounts of base support cost, as explained above. There are few institutional personnel at overseas locations, since most of them are at headquarters units. The costs of institutional personnel do not directly figure into our analysis very prominently.[28]

Our regression analysis yielded a fixed cost component (i.e., y-intercept), which approximates the potential savings from closing a base. The fact that we found a fixed component indicates that savings could be realized by consolidating presence at fewer locations. We found the following regarding active duty bases with permanently stationed aircraft (including AFTOC costs only):

- CONUS bases have a fixed cost of about $66 million per year and have about 315 Combat Support personnel.
- USAFE bases have a fixed cost of about $165 million per year and have about 634 military Combat Support personnel.[29]
- PACAF bases have a fixed cost of about $141 million per year and have about 689 military Combat Support personnel.

These significant differences between U.S. and overseas bases raise the question of why the fixed cost and number Combat Support personnel would be so much higher overseas than in the United States. One factor that may drive both is that these overseas USAF bases generally have significantly more facilities and facility space than their U.S. counterparts. This would certainly drive higher support costs, because the majority of installation support costs go to facility maintenance. This would drive higher Combat Support personnel numbers, because more facilities require more engineers to maintain them, more security to guard them, etc. This could also have a ripple effect on other support personnel requirements not directly affected by facilities, because the total base populations would be somewhat higher.[30] There could also be

[28] We also tested to see whether the variable costs were higher for OCONUS than for CONUS, using an interaction term. We found that the interaction term did not reach statistical significance. If it had, we could attribute a difference in variable cost to overseas bases.

[29] Incirlik Air Base is excluded from these figures, because it does not have permanently stationed aircraft.

[30] Upon closer examination of USAF personnel data, we found that when overseas bases had higher numbers of Combat Support personnel than comparably sized U.S. bases, most of the difference was usually in civil engineers.

specific operational requirements for the greater facilities and support personnel at overseas bases, but it is beyond the scope of this report to pursue them.

The fixed costs quoted above capture traditional installation support and other installation-related activities, but they do not include the other cost elements we considered (infrastructure recapitalization, personnel allowances, PCS move costs, DoDDS, and DLA support). Below, we add those additional cost elements when we do our final calculations.

The above regression analysis helped us separate total installation support costs into their fixed and variable components. This is, in essence, the ideal case, where we can analytically separate these two components. In some cases, the data available to us do not enable us to be so precise, such as when only the total costs for an activity are available. The best one can do is calculate a simple per-person cost for the activity, even though we know that doing so typically overstates variable costs and understates the fixed costs associated with installations. We seek to adjust these simple per-person costs with some factor to attribute some of the total to fixed effects and reduce this error. In our analysis of installation support costs, we found that, on the whole, fixed costs comprised about 25 percent of the total. Thus, in some cases where we lack the data to directly separate the fixed and variable components, we use a value of 25 percent for the fixed component, and attribute the remainder to variable, or per-person costs. We highlight the cases in which we apply this factor.

Other Cost Categories

In this section, we explain how we analyzed the costs of the other categories in our analysis, then summarize the results of these calculations in a table. For personnel allowances, we utilized the Active Duty Military Pay files from the Defense Manpower Data Center (DMDC).[31] These files include the following categories of allowances:

- basic allowance for housing (BAH)/Overseas Housing Allowance (OHA)
- cost of living allowance (COLA), U.S. and overseas
- family separation allowance.

We first determined which personnel were in each region, including separating Japan and South Korea because of substantial differences in allowances between the two countries. We

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Source: Active Enlisted End of Month Master Personnel Extract File and Active Officer End of Month Master Personnel Extract File. All data were obtained from the Air Force Personnel Center and were current as of September 30, 2011.

[31] RAND possessed FY2009–2011 Active Duty Military Pay files prior to this analysis. Permission granted for re-use by DMDC in January 2013 via email.

aggregated allowances for all personnel stationed in the selected areas to develop region-, country-, state-, territory-, and base-specific estimates on a per-person basis.[32]

We based PCS costs on recent USAF budget estimates combined with personnel and demographics data.[33]

Estimating infrastructure recapitalization costs from MILCON spending is challenging, because spending fluctuates greatly from year to year, and MILCON includes construction projects to increase, not simply recapitalize, capabilities. To produce a more stable estimate of future MILCON costs, we used the total plant replacement value (PRV) of facilities at individual installation in each region, using the Real Property Database, or RPAD.[34] We performed a regression analysis of these data (combined with USAF personnel data) similar to the one described above for installation support (details of this regression analysis are found in the appendix).[35] We assumed a 67-year recapitalization cycle for facilities, based on DoD documentation.[36]

We then made one adjustment to these cost estimates. Given that this method calculates a requirement (i.e., the USAF *should* spend this much to recapitalize its infrastructure), not a prediction based on *actual* historical spending, we sought to adjust our estimate based on historical MILCON spending, so we compared actual MILCON spending with our PRV-derived estimates for each region. (Details can be found in the appendix.) We found that for all regions, actual MILCON spending was lower than a simple PRV-derived requirement. Thus, we adjust our PRV-derived recapitalization requirements to better capture what *actual DoD spending* would be for installations in these regions. Therefore, for our cost models, we make the following adjustments to the estimates:

- U.S. and Europe: 80 percent of calculated value
- Japan and South Korea: 40 percent of calculated value.

Based on these calculations, the recurring variable costs per person for infrastructure recapitalization were as follows:

- CONUS and USAFE = $2,150 per person

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[32] To determine per-person rates for a location and service combination, we only included personnel that were in the location for the full year. We excluded records where personnel were in more than one region during the year, as they received allowances for more than one region.

[33] Department of the Air Force, *Fiscal Year (FY) 2012 Budget Estimates: Military Personnel Appropriation,* February 2011.

[34] RPAD is maintained by the Office of the Under Secretary of Defense, Acquisition, Technology, and Logistics. As defined in the RPAD data dictionary (Version 4.0, 2010, p. 169), the PRV is "The cost to replace a facility using current DoD facility construction standards." RPAD data provided in February 2013 by the Air Force Civil Engineer (AF/A7C).

[35] We excluded from our calculations all closed or disposed facilities, all land-only infrastructure, and all Guard- or Reserve-only installations.

[36] DoD, *Facilities Recapitalization Front-End Assessment,* Washington, D.C., August 2002.

- PACAF = $1,080 per person.

In addition, our regression analysis revealed a fixed cost component. Including adjustments for actual DoD MILCON spending, the recurring fixed cost components are as follows:

- CONUS = $14.4 million
- USAFE = $28.4 million
- PACAF = $14.2 million.

These fixed cost components are then added to the installation support fixed cost components to arrive at a total fixed cost component for each region.

For dependents' education, we looked to recent OSD O&M estimates.[37] We tallied the monies spent on dependents education overseas (i.e., DoDDS) versus those in CONUS and divided the totals by the total military personnel in each category. This accounts for direct spending on DoD Domestic Dependent Elementary and Secondary Schools, but it does not include Impact Aid.[38] Dividing the total spending by the total military personnel, this produces a per-person (not per-student) cost of $4,870.[39] Military dependents moving from overseas to the United States would, however, incur costs for Impact Aid. We estimate the cost per CONUS-based service member to be about $450.[40] Thus, the net savings is about $4,420 per military person.

To estimate the costs of DLA FDDs, we obtained data from DLA on the annual operating costs of its distribution centers.[41] We divided the distribution center costs in each region (e.g., Germany for all of Europe, Japan, Korea) by the total U.S. military personnel (not just USAF) in that region.

To estimate annual transportation costs to OCONUS for the delivery of supplies, we extracted data on OOT costs from the Strategic Distribution Database at RAND and used the

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[37] Office of the Secretary of Defense, *Fiscal Year (FY) 2013 Budget Estimates*, Volume 1, Part 1 of 2, *Justification for FY 2013 Operation and Maintenance, Defense-Wide*, February 2012.

[38] Federal Impact Aid provided through the U.S. Department of Education "provides assistance to local school districts with concentrations of children residing on Indian lands, military bases, low-rent housing properties, or other Federal properties and, to a lesser extent, concentrations of children who have parents in the uniformed services or employed on eligible Federal properties who do not live on Federal property" (U.S. Department of Education, Office of Elementary and Secondary Education, "About Impact Aid: Impact Aid Programs," August 27, 2008). The purpose of Impact Aid is to compensate local education agencies where the schools bear a burden of educating such children but the property tax pool is reduced as a result of where their parents live.

[39] This method slightly overstates the per-person costs and understates the fixed costs, but because these numbers are small relative to the total fixed and variable component costs, this should not greatly affect our results.

[40] The total Impact Aid budget in FY2011 and FY2012 was just under $1.3 billion per year (U.S. Department of Education, *Fiscal Year 2013 Budget)*. Based upon 40 percent of this aid going to school districts serving children of service members, this works out to about $450 per CONUS-based service member (Military Impacted Schools Association, "DoD Impact aid Funding for Military Children," no date; and Richard J. Buddin, Brian P. Gill, and Ron W. Zimmer, *Impact Aid and the Education of Military Children*, Santa Monica, Calif.: RAND, MR-1272-OSD, 2001).

[41] RAND Strategic Distribution Database, 2012, FY2008–2011 DLA distribution depot cost data, August 2012.

data to directly compute the cost of transportation by region.[42] We calculated the total cost of OOT for supplies by service and region, and then we scaled the difference to a per-person cost.

One other potentially significant cost not included so far is procurement of equipment and vehicles. The AFTOC data include only O&M support for equipment and vehicles. We analyzed recent Air Force spending data and found that (a) the amount of money that could be allocated to individual MAJCOMs (and therefore to different regions) rather than centralized accounts is very small, about $50 million per year for USAFE and PACAF combined (out of total budgets of about $5 billion each); and (b) the potential per-person cost difference is miniscule, and therefore does not justify inclusion in these calculations.

Table 1 summarizes the results of the calculations described above. Table 1 shows the annual cost per military person for each category by region or country. The left section (labeled "Total") of the table shows the total cost per person; the right section (labeled "Incremental (net)") shows the costs for overseas regions *above and beyond* installation support costs for CONUS bases, i.e., each region's cost minus the CONUS cost.

Table 1. Cost Summary of Other Support Categories

	Total				Incremental (net)		
Category	**CONUS**	**Europe**	**Japan**	**Korea**	**Europe**	**Japan**	**Korea**
Personnel allowances	17,800	32,500	29,500	22,500	14,700	11,700	4,700
PCS moves	2,400	9,700	9,700	9,700	7,400	7,400	7,400
Infrastructure recapitalization costs	2,150	2,150	1,075	1,075	0	–1,075	–1,075
DoDDS[a]	450	4,870	4,870	4,870	4,420	4,420	4,420
DLA FDD		240	300	660	240	300	660
DLA OOT		490	860	860	490	860	860
Total	22,800	49,950	46,300	39,670	27,250	23,600	16,970

SOURCES: Author's analysis of DoD Active Duty Military Pay files, FY2013 Air Force budget documents, FY2013 RPAD, FY2013 DoD O&M budget documents, FY2008–2011 DLA distribution center cost data, and RAND Strategic Distribution Database.
NOTE: Totals may not sum due to rounding.
[a]DoD Schools cost for CONUS includes Impact Aid estimate on per-military-person basis.

In Table 1, the difference in variable cost per military person between USAFE and CONUS is about $27,000, the difference between Japan and CONUS is about $24,000, and the difference between Korea and CONUS is about $17,000. That is, in essence, the premium that DoD pays to have each military person stationed overseas, aside from any differences in training costs

[42] RAND Strategic Distribution Database, 2012.

themselves (discussed below). Fully burdened costs for Air Force military personnel in CONUS are about $96,000 per year,[43] so for these cost categories, overseas billets are about 18–28 percent higher, or 11–23 percent higher if only including costs borne by the Air Force.

For the remainder of this report, we refer to this relative difference between variable cost components in two regions as the *incremental cost* to keep forces stationed overseas. When we perform calculations involving the relative costs of stationing personnel overseas, these are the figures we use.

Summary of Results

We now summarize the results of the above cost analyses. Table 2 is intended to serve as a guide for the succeeding sections, which will draw on these results to inform further calculations.

Table 2. Summary of Cost Elements, by Region

Fixed/Variable	Cost Category	United States	Europe	Japan	Korea
Fixed ($ millions)	Installation support	66.5	164.7	141.2	141.2
	Recapitalization	14.2	28.3	14.2	14.2
	Combat Support[a]		14.4	11.3	11.3
	Total fixed	80.2	207.4	166.7	166.7
Variable ($ thousands)	Total variable[b]	22.8	50.0	46.3	39.7
	Net above U.S.		27.3	23.6	17.0

SOURCE: Author's analysis.
NOTES: Totals and net costs may not sum due to rounding.
[a]Combat Support includes the additional overseas costs of military personnel providing installations support and does not apply to U.S. bases.
[b]Total variable cost includes only cost categories described in this report, not basic pay.

Cost-Sharing Arrangements

Before we move on, we highlight an important point about any calculation of the costs of overseas military installations. Foreign partners bear a significant cost-sharing burden to support U.S. forces and installations overseas. Comprehensive data were not currently available, but DoD data from a 2004 report provide a partial picture.[44] Those data show that for countries with significant permanent USAF presence, foreign partners offset between 27 and 75 percent of base support costs, in the form of direct or indirect payments.[45]

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[43] Adapted from Air Force Instruction (AFI) 65-503, *U.S. Air Force Cost and Planning Factors*, Washington, D.C., February 4, 1994, Table A19-1, "Standard Composite Rates by Grade."

[44] DoD, *2004 Statistical Compendium on Allied Contributions to the Common Defense,* Washington, D.C., 2004.

[45] Direct payments are on-budget for the host nation; indirect payments are off-budget (e.g., forgone rent or lease payments; waivers of customs duties and other taxes).

However, we argue that, for the policy options under consideration in this analysis, those cost-sharing arrangements are mostly irrelevant. The baseline we assess is the current overseas posture and spending, and the net cost differentials we calculate should have all of those payments built-in (like an instant rebate on a purchase).

Any changes we consider to overseas presence are reductions and should not incur any penalties. There are two potential exceptions to this. The first is the possibility that by reducing our presence in a country, we lose goodwill with the partner due to a perceived reduction in commitment on our part. It is possible such a partner could retaliate by reducing its burden-sharing.

Perhaps more relevant is a scenario in which a European country currently embroiled in the continent's financial crisis could find itself essentially unable to bear the costs it has in the past. The possibility of either case does expose the United States to some risk, but it is beyond the scope of this paper to incorporate such risks into our analysis.[46]

Applying Cost Factors to Policy Options

In our detailed cost analysis, we explore three policy actions with regard to overseas presence: realigning forces, closing bases, and cutting force structure.

Realigning Forces

To assess the savings possible from realigning forces, we analyzed the costs associated with an example flying unit and its personnel, including the incremental costs described in Table 1, plus regional training cost differences, which are attributed to the operating unit. As an illustrative example, we estimated these costs for a 24 primary aircraft authorized (PAA) squadron of F-16s to show the relative cost to maintain a single squadron overseas.

Figure 4 shows the total relative cost to sustain a squadron of F-16s overseas rather than in the United States. (Note that not all overseas F-16 squadrons have 24 aircraft. In cases where the squadron size is different, we scaled the personnel to a 24-aircraft squadron to make the cost estimates more commensurable.)[47] Along the x-axis, we show five different OCONUS bases—three in PACAF and two in USAFE. These are the five bases that currently have permanently stationed F-16 units. The y-axis shows the total marginal cost to sustain a squadron of F-16s at each base (i.e., the total recurring savings possible by realigning that unit to CONUS). We walk through each cost element using the first base, Misawa, as an example.

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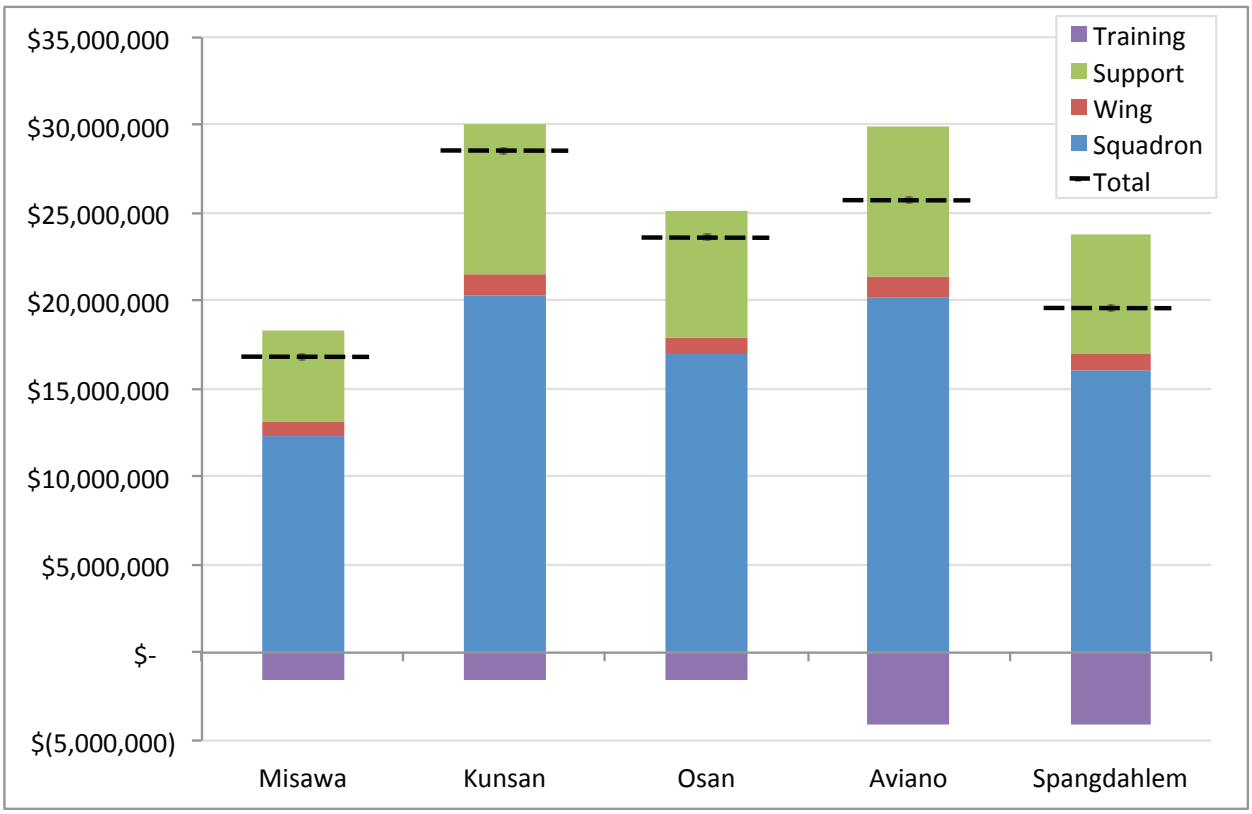
[46] From the annual reports collected by OSD, these host-nation contributions were fairly stable during the late 1990s and early 2000s.

[47] Squadron sizes vary for several potential reasons. The specific mission design series could drive different numbers of maintenance personnel, depending on engine or avionics types and demands. Local peacetime and wartime mission requirements could also drive differences.

The blue part of the column shows about $12 million per year. This includes the incremental per-person cost calculated above for Korea, applied to the F-16 Operations and Maintenance Group personnel for a single squadron (scaled to a 24-aircraft squadron). The next section of the column, in red, shows the cost represented by the wing personnel moved, using the same incremental per-person costs, about $0.75 million.

Figure 4. Recurring Savings from Realigning One F-16 Squadron from Overseas to CONUS



SOURCE: Author's analysis.

Next, we tally the incremental cost of the Combat Support personnel (i.e., USAF military personnel providing installation support) that would relocate from Misawa to a CONUS destination. From our regression model, we estimated that for every operational person moved, a corresponding 0.4 base support personnel would be moved. Thus, a fraction of Misawa's base support personnel would relocate with the operational squadron, saving additional incremental costs of over $5 million. Those personnel-related costs alone total about $18 million per year in recurring savings if the entire squadron were moved to CONUS (the total height of the column).

The final cost element is the relative training cost differences among regions. Because each region, on average, has somewhat different training costs, we chose to add those to the overall potential savings. We found in the cost data that PACAF and USAFE's F-16 operating costs were slightly less than their Air Combat Command counterparts (about 1 percent and 3 percent

less, respectively).[48] Thus, including a per-aircraft cost differential, the total relative cost of a squadron of F-16s overseas decreases by about $1.5 million. We show this training cost differential by the purple column. We show the total cost (i.e., savings if realigned) with a black dotted line. For Misawa, the total cost is about $17 million per year for one 24 PAA squadron of F-16s, or roughly $700,000 per aircraft per year.

We did these same calculations for each of the five bases to show the variation across squadrons. The main source of variation for incremental personnel costs is the differences in allowances for each country. Regional training cost differences between USAFE and PACAF are an additional driver of total cost differences. On the whole, basing in PACAF costs about $17–29 million per squadron more than in the United States, while basing USAFE costs about $20–26 million per squadron more.

To put this in perspective, we make a very macro-level comparison. Aviano Air Base, in Italy, is currently home to two F-16 squadrons. The total annual O&S costs are roughly $600 million per year (excludes MILCON and non-USAF costs).[49] Moving the two F-16 squadrons could generate a savings of about $52 million per year. This means that, in one sense, the premium being paid to keep those F-16 units at Aviano rather than CONUS is about 9 percent of the base's annual recurring costs.

Cutting Force Structure

One of the points we argued at the beginning of this report, one that we believe is key to properly assessing the costs of basing forces overseas, is that the size of a military force is determined essentially separately from where it is based (with the possible exception of the Navy, given its overseas policies). The USAF makes force-sizing decisions over time for both strategic and fiscal reasons. The 2012 Defense Strategic Guidance[50] drove the USAF to pursue a strategy in which it cut some operational forces to live within newly set fiscal constraints.[51] The USAF announced its intention to cut units from both the active and reserve components, and from U.S. and overseas bases.[52] While those decisions no doubt incorporated strategic and political concerns, one question is this: How might the savings differ if some of those units are cut from overseas versus U.S. bases?

Any cut in force structure will have cascading effects. The operational unit itself brings with it operating costs, including pay, fuel, spare parts, etc. That unit requires a pipeline of personnel

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[48] For more on relative overseas training costs, see Moroney, 2012.

[49] FY2011 AFTOC database.

[50] U.S. Department of Defense, *Sustaining U.S. Global Leadership: Priorities for 21st Century Defense*, Washington, D.C., January 2012b.

[51] U.S. Air Force, *Air Force Priorities for a New Strategy with Constrained Budgets*, Washington D.C., February 2012.

[52] Jill Laster, "Spangdahlem A-10 Squadron to Shut Down," *Air Force Times*, February 16, 2012.

training from AETC and materiel support from Air Force Materiel Command. With a big enough reduction, arguably many of the USAF's institutional organizations would be affected. If the unit is a flying unit, and the fleet is permanently reduced, the modernization dollars that would eventually be spent to replace that fleet would also be saved. Depending on the type of aircraft, there might be support aircraft in the inventory that would be reduced proportionally (e.g., tankers to support the deployment of fighters). Finally, all of those reductions in operational and institutional personnel (and activities) would drive a reduction in base support personnel (wherever they are located), according to the proportions described above. We estimate the savings from a reduction in force structure to assess what relative difference the location (i.e., overseas versus the U.S.) of the forces would make.

Table 3, drawing from a range of sources, shows each component in such a force structure reduction, again using a 24 PAA squadron of F-16s as an example. In this example, we show costs for CONUS-based units, then quantify the incremental difference if the cut were made to OCONUS forces. In Table 3, we first show the annual O&S costs saved if 24 F-16s were cut from the force. This estimate of the operating costs saved from a U.S. unit can be compared against the incremental cost of having that unit overseas. At the bottom of the table, we also show the annual procurement cost of the F-35, the F-16's replacement.

Table 3. Recurring Cost Savings Associated with Cutting 24 F-16s

Category	Annual Cost (2011 $, millions)
F-16 direct O&S (CONUS)	147
F-35 additional O&S	31
Institutional	135
Installation support	46
O&S subtotal	359
F-35 procurement[a]	73
Total with F-35 procurement	432

SOURCE: Author's analysis of various data sources.
[a]Procurement costs spread out over 30 years.

In Table 3, direct O&S costs for one active duty CONUS F-16 squadron (including fuel, spare parts, unit personnel, etc.), total about $147 million.[53] In addition, the flying hour costs of the F-35, the F-16's replacement, are projected to be about 42 percent higher than current F-16 flying hour costs.[54] Given that flying hour costs represent about 50 percent of total support

[53] Reserve F-16 operating costs are about $3 million per year. We use active duty costs, as those seem the best comparison when making comparisons with overseas forces.

[54] DoD, *Selected Acquisition Report (SAR): F-35*, Washington, D.C., RCS: DD-A&T(Q&A)823-198, December 31, 2011b.

costs,[55] we estimate the F-35 total support costs to be 21 percent higher than total F-16 O&S costs, which translates to an additional $31 million per year for 24 aircraft.

Given the reduction in the fighter forces, we anticipate a concomitant reduction in the institutional force. Fewer aircraft means fewer pilots to train, less burden on the supply chain, etc. Given the current size of the USAF fleet, we estimate the above reduction to correspond to the flying forces being reduced overall by 0.7 percent.[56] Returning to our three categories of activities (operational, institutional, and support), the institutional force made up about $27 billion of 2011 USAF obligations. If we assume that all institutional costs are variable, and that there are no fixed costs for these activities, such as force structure reduction would reduce institutional costs by $162 million per year. For argument's sake, we assume that 25 percent of the USAF's institutional force is fixed cost. As discussed earlier, this aligns with the finding that about 25 percent of installation support costs are fixed. The net result, then, is that USAF institutional costs would be reduced by only $135 million per year. If a greater proportion of USAF institutional costs were fixed, the corresponding reduction would be less.

Installation support is the last component of O&S shown here. The results of our regression analysis showed that for each operational or institutional person reduced, installation support costs would reduce by about $29,000 and $102,000, respectively. Given the reduction in operational and institutional forces described above, that would translate to an additional $46 million per year savings for reduced installation support needs.

The total recurring O&S cost saved by cutting a single 24-ship F-16 squadron, then, is approximately $359 million for a squadron located in CONUS. If the F-16s and supporting personnel (operations and base support) were in OCONUS, how much *more* would the USAF save? To answer this, we draw on the analysis shown in Figure 4. If the fighters were cut from USAFE, the net additional savings, on top of the $359 million, would be about $20–26 million (5–7 percent) higher. If they were cut from PACAF, the savings would be $17–29 million (5–8 percent) higher.

If one includes in the estimate of savings the modernization cost avoided to recapitalize the F-16s, which must eventually be done, the savings increase. Using the average procurement unit cost, with procurements spread out over 30 years, we estimate the savings to be about $73 million per year[57] over that time horizon (next-to-last row in Table 3). This brings the total savings to about $432 million. If the fighters were cut from overseas, the additional savings would be 4–7 percent more, depending on the theater. In either case, the additional savings from

[55] Derived from AFTOC 2011 F-16 cost data.

[56] Excludes trainer, Operational Support Airlift, and VIP aircraft.

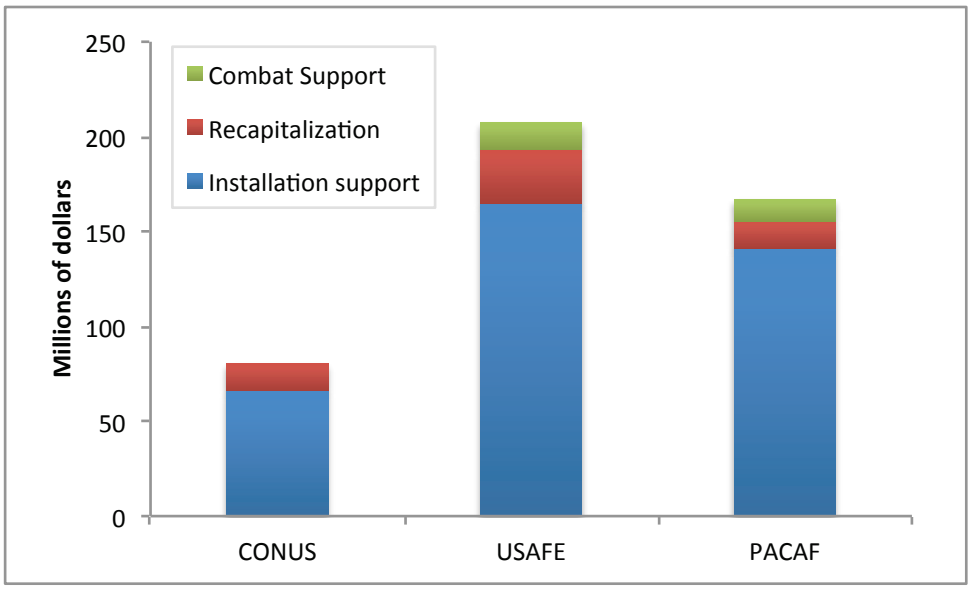
[57] DoD, 2011b.

cutting the squadron from overseas is small relative to the baseline savings accrued by the USAF.[58]

Closing Bases

This option includes only the annual operating costs/savings associated with completely closing and/or vacating an installation. In our regression analysis, we analyzed the fixed and variable cost components of USAF installations. The results we discussed earlier were directly from our regression analysis, and did not adjust for the incremental costs of Combat Support personnel we showed in Table 2. We now include the full range of fixed costs in these calculations.
Figure 5 shows the fixed cost components associated with active duty bases with permanently stationed aircraft in CONUS, USAFE, and PACAF, adjusted for the other personnel costs.

Figure 5. Fixed Component of Recurring Costs for USAF Bases



SOURCE: Author's analysis.

We drew the results from our first regression model, and added the overseas dummy variables to the CONUS value to estimate the total fixed cost in each region. We also include the fixed component from our infrastructure recapitalization estimate ("Recapitalization" in Figure 5). In this figure, we separate out the incremental cost of military installation support personnel ("Combat Support"). This helps show which costs are driven by general installation support activities, and which are attributable to the use of military personnel for installation support. The

[58] One could argue that a reduction in the fighter fleet would bring reductions in other aircraft fleets. The most obvious example is tankers, the size of whose fleet is primarily driven by the size of the fighter force. This raises questions of what associated aircraft should be included, which is beyond the scope of this analysis.

height of each column shows the fixed cost associated with these bases in each region: $80 million for CONUS, $207 million for USAFE, and $167 million for PACAF.

It is these fixed costs that could potentially be saved by closing an installation (notwithstanding any investments necessary to close the base or to relocate personnel to a domestic base). So, in relative terms, the USAF spends on OCONUS bases roughly two to two-and-a-half times what it does on CONUS bases when considering the *fixed cost component*.

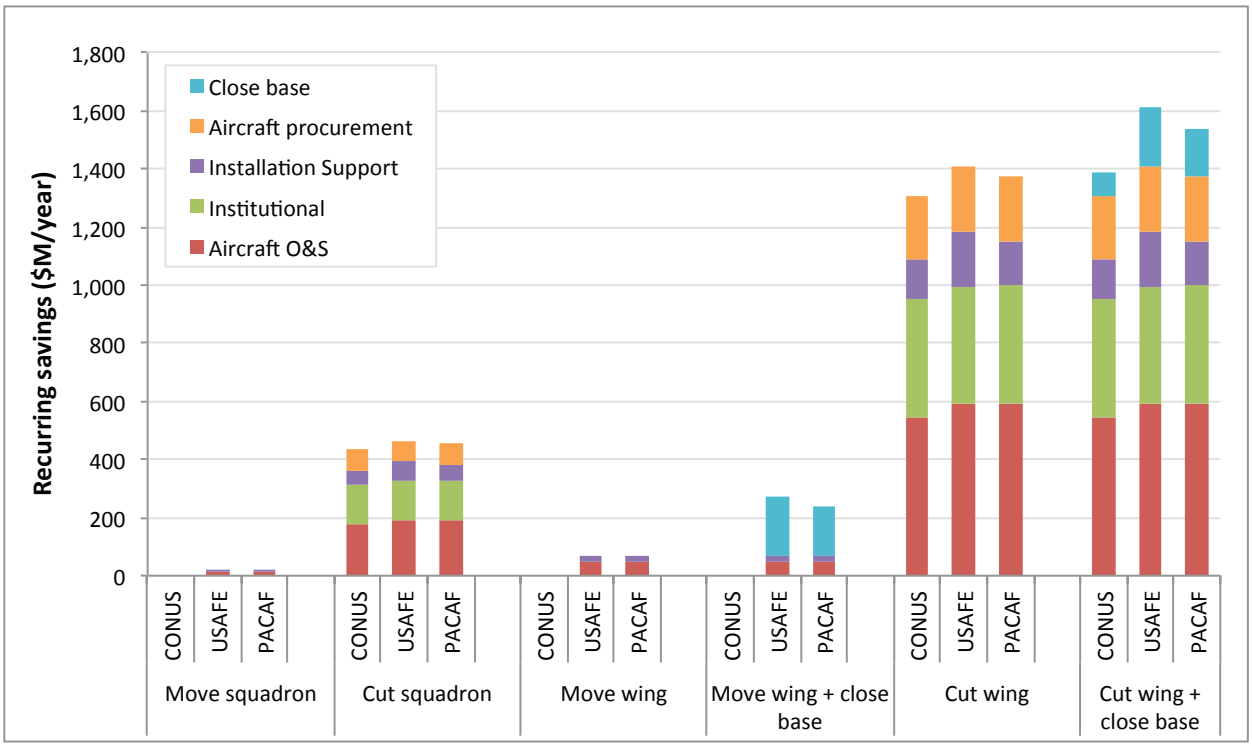
Summary Cost Analysis Example

To pull together these three pieces, we developed a summary example involving F-16 units. In Figure 6, we show the following policy options, from left to right:

- move a squadron of F-16s from OCONUS to CONUS
- cut a squadron of F-16s from the force
- move a wing of F-16s from OCONUS to CONUS
- move a wing of F-16s from OCONUS to CONUS and close an installation
- cut a wing of F-16s from the force
- cut a wing of F-16s from the force and close an installation.

For each policy option, we show estimated costs for CONUS, USAFE, and PACAF.

Figure 6. Recurring Savings for Posture Policy Options



SOURCE: Author's analysis.

The first set of columns draws cost data from our assessment of realigning forces; the second set of columns draws from our assessment of cutting force structure. The third set of columns mirrors the first set, scaled up to a 72 aircraft wing. The fourth set of columns adds to the third set the additional savings from closing the installation that those forces left.[59] The fifth set of columns shows the total savings from cutting a wing of aircraft, and the last column adds to the fifth set the savings from closing an installation after cutting the wing of aircraft.

Each set of columns makes a slightly different comparison between U.S. and foreign-based aircraft. We draw the reader's attention to the rightmost two sets of columns. When all the numbers are tallied, the difference between cutting a wing of fighters based in CONUS versus in USAFE or PACAF is about 7 percent or 4 percent of the total (same as for a squadron), respectively. If that fighter installation is closed, the overseas difference jumps to 14 percent for USAFE and 10 percent for PACAF.

The main takeaway from this figure is that the costs of basing USAF units overseas are small relative to the costs of equipping, manning, and operating the unit. From a grand strategic perspective, a U.S. Air Force of a given size and capability will cost essentially the same regardless of where in the world it is based.

Putting Costs in Context

We developed one final calculation to place our cost analysis in the context of the overall debate on forward presence and grand strategy. We estimated the total cost differential for the USAF to maintain USAFE or PACAF in toto, with all of their forces and bases, *overseas rather than in CONUS*. We assessed these costs according to the following assumptions:

- All operational forces relocate to CONUS; proportional base support forces follow.
- All institutional forces (e.g., MAJCOM headquarters) are completely cut from the USAF end strength;[60] proportional base support forces are cut.
- All major installations, with or without aircraft, are closed; fixed costs are saved where applicable.
- No calculations were made of investments to move forces, close installations, or substitute rotational presence,[61] thus creating an upper bound on relative costs (and potential savings).

[59] This is a notional example, as there are no overseas bases with a 72-PAA wing of F-16s. The calculations are meant to be illustrative.

[60] While we excluded Ramstein Air Base, headquarters of USAFE, from our cost modeling, because it was an outlier, we do account for its additional costs. To do so, we used the same cost model as for the other bases to account for the fixed and variable components. Then we estimated the additional support dollars Ramstein had relative to other bases its size, which came to about $235 million per year. We included this figure in the total amount to be saved by closing Ramstein.

[61] Rotational presence costs could include changes to squadron size, training, overhead, and direct rotational deployment costs.

Under these assumptions, we estimate the total relative cost of USAFE as a whole to be roughly $2.2 billion per year, and PACAF to be $1.3 billion per year, for a total of $3.4 billion per year out of the entire USAF budget (numbers do not match due to rounding). When comparing these two totals against the USAF TOA, the cost to maintain the current USAFE and PACAF force structures and installations *overseas rather than in CONUS* represent about 2 percent of USAF TOA.

These rough figures comport rather well with a 2004 Congressional Budget Office analysis of the same issues for the Army.[62] In its most extreme options, this study assessed alternatives that would remove almost all Army forces from Germany and South Korea. Including construction and relocation costs, but excluding rotational deployments, the Congressional Budget Office estimated that if virtually all overseas Army forces were returned to CONUS, this would "yield annual savings of $1.2 billion, mainly from the lower costs associated with operating bases in the United States and from not having to pay overseas cost-of-living allowances." This translates to about 1.3 percent of the Army TOA for FY 2004.[63]

Implications

The analysis presented in this document has five significant implications for the ongoing debate on grand strategy and overseas presence.

1. There are measurable costs associated with overseas presence. Personnel costs are roughly one-quarter more per person, while base support fixed costs are roughly two to two-and-a-half times U.S. analogs. The former almost certainly reflects location-specific factors. The latter may reflect the role played by overseas USAF bases in the overall DoD global network, location-specific issues, or some combination thereof. Nonetheless, there is solid empirical evidence that overseas presence comes at a cost. In cases where there is a fixed cost component, consolidation of forces at fewer bases could produce recurring cost savings. But such an action must be weighed against the impacts and risks of vacating a particular base.

2. The costs of overseas presence are small relative the USAF's overall budget. From the perspective of national ends, ways, and means, a forward-deployed USAF costs about the same as a USAF confined to domestic bases. The net cost to the United States of a forward-deployed USAF is about $10 per capita per year, or about the same amount Americans spend on power for unused household appliances.[64] Air Force forward presence is not a major burden on the USAF, DoD, or the nation.

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[62] U.S. Congressional Budget Office, *Options for Changing the Army's Overseas Basing*, Washington, D.C., May 2012.

[63] DoD, *Department of Defense Budget, Fiscal Years 2004–2005, Financial Summary Tables (Selected Tables) Part I*, February 2003, p. 1.

[64] Alan Meier, Wolfgang Huber, and Karen Rosen, *Reducing Leaking Electricity to 1 Watt*, Berkeley, Calif.: Lawrence Berkeley National Laboratory, 1998.

3. The debate about overseas presence should distinguish personnel and force structure costs from basing costs. Many observers conflate a reduction in overseas presence with a reduction in force structure, claiming enormous savings from prospective changes to overseas posture.[65] In fact, from the grand strategic perspective, personnel and force structure, not presence or basing, is the biggest cost driver for DoD. While the USAF does spend a significant amount on installation support, our analysis found that much of that support (and therefore the cost) would simply move with forces if they relocated from overseas to the United States. The overall size of U.S. non-naval forces, and therefore the vast majority of their cost, is only minimally linked to where DoD has bases.[66] The size of the force is instead driven by force planning requirements. Thus, from a grand strategic perspective the important question is how many operations of what types the United States is planning to conduct (and therefore what size of force is needed) rather than where it bases its forces in peacetime.

4. The primary risk in the presence debate is making choices that produce relatively modest savings, but with potentially enormous strategic and fiscal consequences. Proponents claim that overseas presence enhances deterrence of potential adversaries, contributes to regional stability through capacity building and political influence, and enhances operational performance through regional familiarity for U.S. forces, interoperability with potential partners, and more assured access to en route and in-theater infrastructure.[67]

If proponents are even minimally correct about any of these effects and forward presence reduces the likelihood of a war against another major power, reduces the likelihood of a major stability operation in an important failed state, or allows U.S. and coalition forces to conduct an eventual operation more effectively and at lower human and financial cost, then the benefits of forward presence will have swamped the relative costs. Cost estimates for the Operation Iraqi Freedom range from about $800 billion[68] to several trillion dollars,[69] and estimates for Operation

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[65] The Sustainable Defense Task Force, for example, postulated $80 billion in savings from reducing the posture in Europe and Asia, but this estimate includes end strength reductions of 50,000 personnel (Sustainable Defense Task Force, *Debt, Deficits, and Defense: A Way Forward*, Washington, D.C., June 11, 2010). These reductions are separate from proposed rollbacks of Army and Marine Corps growth from the wars in Iraq and Afghanistan.

[66] The Navy forward-stations some of its forces and designates them Forward-Deployed Naval Forces (FDNF). FDNF ships and crews operate at a higher operational tempo than those home-ported in the United States. They have a higher availability than U.S.-based forces, but also have higher costs. Thus, the Navy's force structure costs are more tightly coupled with the proportion of its forces that are stationed overseas than are the other Services.

[67] See, for example, DoD, 2012b.

[68] Amy Belasco, *The Cost of Iraq, Afghanistan, and Other Global War on Terror Operations Since 9/11*, Washington, D.C.: Congressional Research Service, March 29, 2011.

[69] Linda J. Bilmes and Stiglitz, Joseph, *The Three Trillion Dollar War: The True Cost of the Iraq Conflict*, Location: New York, NY: W. W. Norton & Company, February 17, 2008.

Enduring Freedom range from about $570 billion (through FY2012)[70] to several trillion dollars.[71] If forward presence reduces the likelihood of even one such event then it will have delivered a tremendous return on investment.

5. The burden of proof in the presence debate should shift to *opponents* of presence.[72] Whereas it has traditionally fallen to proponents of presence to demonstrate benefits commensurate with costs that were presumed to be substantial, the more salient question now is whether opponents can demonstrate that presence cannot offer even the minimal benefit necessary to offset the costs.

[70] Anthony H. Cordesman, *The U.S. Cost of the Afghan War: FY2002–FY2013: Cost in Military Operating Expenditures and Aid and Prospects for "Transition"*, Washington, D.C.: Center for Strategic and International Studies, May 14, 2012.

[71] Belasco, 2011.

[72] This point would apply somewhat less so to naval forces, for the reason noted above.

Appendix: Details of Regression Analyses

This appendix shows some of the details of our regression analyses. First, we explain our approach to regression analysis, including some key assumptions. Second, we explain the results of our analysis of installation support cost data from AFTOC. Third, we explain the results of our analysis of PRV data from the RPAD to estimate infrastructure recapitalization costs. Finally, we explain how we scaled our infrastructure recapitalization costs with historical MILCON spending data.

Approach to Regression Analysis

We used a linear specification for the relationship of personnel to support costs and to PRV, rather than an alternative, such as logarithmic or quadratic. The primary reason for this is that USAF planning factors for personnel and facility planning explicitly include linear formulations for requirements determination. Personnel planning factors that define the number of personnel authorized for given activities (the manpower standards referred to in the body of this report), such as food service, medical support, and facility maintenance, often use linear relationships. These are formulated in the same way as our notional mathematical model in Figure 2, where the fixed component is the management overhead element, and the variable component is driven by the base population. Likewise, DoD facilities planning factors include linear requirements, such as an amount of space (e.g., square feet) required per person. Second, we found that most data plots suggest linear relationships. Finally, we tested alternative specifications for several cases. We found these alternatives to provide a worse fit to the data and to produce counterintuitive cost equations.

In the course of our analysis, we found it necessary to exclude some USAF bases from our cost model. The specific aim of our analysis was to develop generalized cost models that could enable comparisons between overseas and U.S. locations. We excluded some bases up-front, because we could identify that they were not good analogs for the types of bases in the United States and overseas in which we were interested. Others we excluded because we observed during our analysis that they had an outsized effect on the regression model values and fit, but were not relevant to our posture options. This outsized effect likely indicated that we were missing a key explanatory variable related to how the base is different than others. We ultimately excluded the following types of USAF bases from our regression analysis:

- *Guard- and reserve-only bases.* These have very different cost profiles from active duty bases (often because they have different support concepts, facilities, and footprints), and while the idea of shifting forces from active duty to the reserve component is a topic of discussion, this analysis did not consider that policy option.

- *Major command headquarters*. These bases usually had installation-support costs far higher than bases of similar populations, whether in the United States or overseas, and therefore tended to have an outsized effect on the regression model. The only major command headquarters located on foreign soil is Ramstein Air Base, the headquarters of USAFE. Because only one of our calculations included the closure of Ramstein, we excluded it from our cost model. We explain in the body of the report how we accommodated the costs of Ramstein for that single calculation.
- *Air logistics centers*, e.g., Hill Air Force Base. These bases, while having some active duty units, have large industrial operations, which drive their installation-support costs. While it is theoretically possible to account for these bases with additional variables, in practice that tends to dilute the fit of the regression models. Because those air logistics centers are not of interest to our broader posture analysis and because there are no overseas analogs to these bases, we excluded them.
- *Army installations with Air Force personnel*, e.g., Ft. Rucker. AFTOC does track USAF expenses for USAF forces stationed at several Army installations in the United States. Because the Army provides installation support to USAF forces at Army installations, those personnel would be supported in a way consistent with Army cost profiles, not Air Force ones. Those Army installations also would not be appropriate for the realignment of USAF forces from overseas to the United States.

We began with a data set of 199 locations (including all the categories listed above). We excluded 87 guard and reserve locations, and 23 active duty and other locations for the other reasons listed above. This left us with a set of 89 active duty locations suitable for our analysis, including overseas locations.

Finally, two categories of spending captured in AFTOC that we excluded are overseas contingency operations (OCO) funds and transportation working capital funding. Our cost analysis focuses on the *base budget* impacts of *permanently* stationed personnel and activities, so it was necessary to exclude OCO funds. Transportation working capital funding is for reimbursable transportation services provided to DoD customers, not local installation support, so we excluded it.

Regression Analysis of Installation Support Costs

Combining AFTOC data with Air Force personnel data, we iteratively tested a range of regression models that specified different independent and control variables to identify the primary drivers and best predictors of installation support costs. We selected the best regression model, which we show below in Table A.1. This table shows each of the regression terms, all of which had to have a p-value ≤ 0.1, a standard threshold for statistical significance. The table shows, for each regression term, the parameter estimate, the standard error, and the resulting lower and upper bound. This regression model has an adjusted R-squared value of 0.65.

Table A.1. Regression Analysis Results
(figures shown are in dollars)

Regression term	Parameter Estimate	Standard Error	Lower Bound	Upper Bound
U.S. with aircraft	66,000,000	27,600,000	38,400,000	93,600,000
U.S. no aircraft	(72,300,000)	32,000,000	(102,500,000)	(42,100,000)
USAFE	98,700,000	29,900,000	68,800,000	128,500,000
PACAF	75,200,000	33,100,000	42,100,000	108,300,000
Military – Operations	29,400	9,200	20,200	38,600
Military – Institutional	101,600	18,500	83,100	120,100
Civilian – Operations	194,100	41,000	153,100	235,100

SOURCES: Author's analysis of FY 2011 Air Force personnel data and FY 2009–2011 AFTOC data.
NOTE: All coefficients significant at $p \leq 0.1$ level.

In this table, the first four rows show fixed-cost components; the remaining rows show variable-cost components. The first row shows the baseline category; the parameter estimates for the remaining three categories are additive to the baseline. The fixed cost (i.e., y-intercept) of the baseline (a U.S. base with aircraft) is about $67 million per year.

The USAFE and PACAF terms add about $99 million and $75 million beyond U.S. bases, respectively. The net result of these individual parameter estimates is that the fixed costs (i.e., the amount saved only when closing a base) we attribute to USAF bases are as follows:

- U.S. bases with aircraft: $66 million
- USAFE bases with aircraft: $165 million
- PACAF bases with aircraft: $141 million.

This fixed cost for installation support forms the core of our total fixed-cost calculation. Later in this appendix we also discuss infrastructure recapitalization.

We selected three significant explanatory variables that define the variable cost component, i.e. the per-person installation-support costs. Operational personnel are estimated to have a variable cost of about $29,000 per year. This means that at any base, the addition of one operational person is associated with an increase in total installation-support costs of $29,000 per year. For institutional military personnel (of which there are few at overseas bases), it is about $102,000 per person, and for civilians supporting operational activities, about $194,000 per person. However, there are very few civilians in operational units. There are usually fewer than 100 at major overseas locations, so these do not figure significantly into our analysis.

The estimates with respect to operation versus institutional personnel are for the baseline case of U.S. bases. Given the sparseness of the data for overseas bases (only five bases with aircraft each in USAFE and PACAF), doing a separate regression analysis was not feasible. We did, however, test to see whether the variable costs were higher for OCONUS than for CONUS,

using an interaction term. We found that the interaction term was positive, which would be consistent with such a relationship, but did not reach statistical significance.

Regression Analysis of Plant Replacement Value

We performed similar regression analyses of PRV data to estimate infrastructure recapitalization costs. Combining RPAD data with Air Force personnel data, we iteratively tested a range of regression models that specified different independent and control variables to identify the primary drivers and best predictors of PRV. We selected the best regression model, which we show in Table A.2. This table shows each of the regression terms, all of which had to have a p-value ≤ 0.1, a standard threshold for statistical significance. The table shows, for each regression term, the parameter estimate, the standard error, and the resulting lower and upper bound. This regression model has an adjusted R-squared value of 0.33.

Table A.2. Air Force PRV Regression Results
(figures shown are in dollars)

Regression Term	Parameter Estimate	Standard Error	Lower Bound	Upper Bound
U.S. with aircraft	1,200,000,000	338,000,000	863,000,000	1,540,000,000
Overseas	1,173,000,000	306,000,000	867,000,000	1,480,000,000
Military – all	180,000	80,000	97,700	258,000
Civilian – all	149,000	42,500	107,000	192,000

SOURCE: Authors' analysis of Air Force personnel and RPAD data.
NOTE: All coefficients significant at the $p \leq 0.1$ level.

The y-intercept of the base case, U.S. bases, is $1.2 billion in PRV. The variable PRV is about $180,000 per operational military person and $149,000 per civilian. For recurring costs based on the 67-year recapitalization factor, this translates to about $17.9 million per base (U.S.) and $2,700 per military person for fixed and variable components, respectively. The PACAF and USAFE dummy variables were not statistically significant when considered separately. But considered as a single group, overseas bases have an additional $1.2 billion in PRV per base.

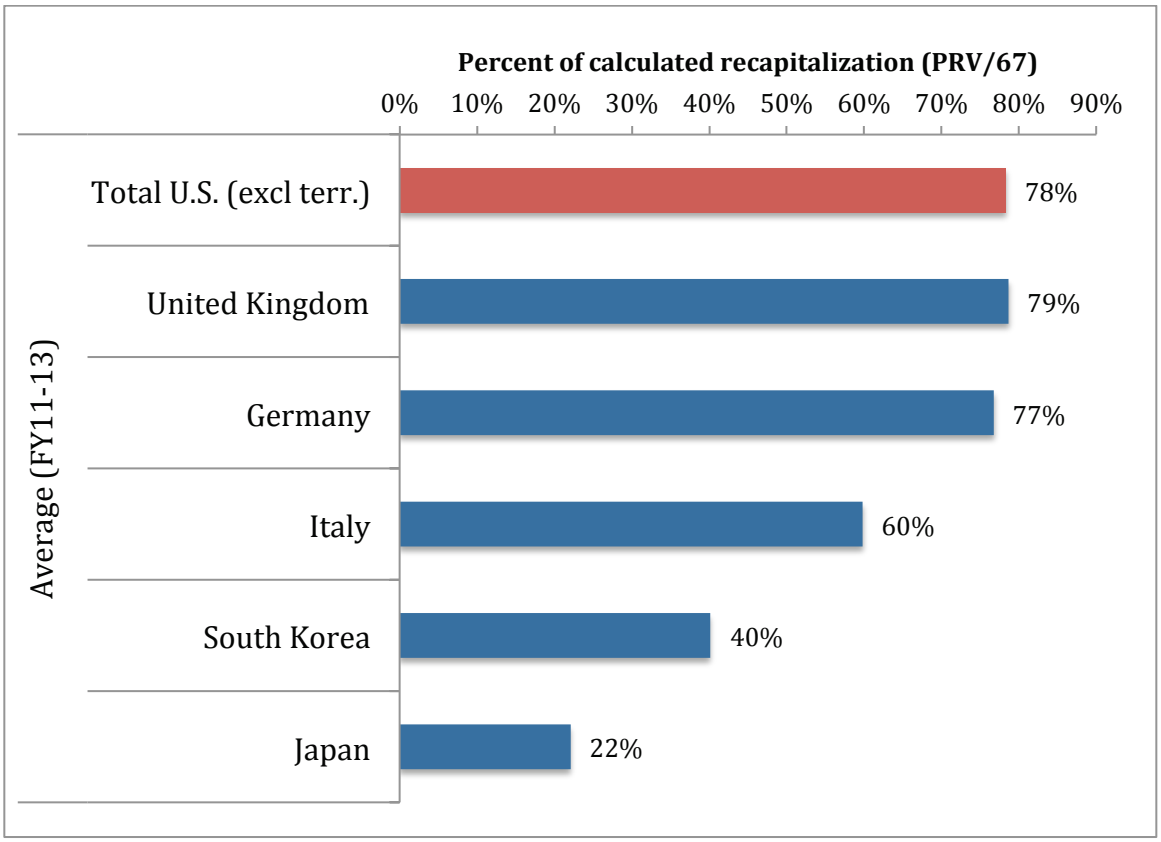
To calculate the total for overseas bases, we add the baseline parameter and the "overseas" parameter. Thus, for all overseas bases, the total fixed cost component equals $2.37 billion. This translates to a recurring cost of about $35.4 million per year, roughly double that of U.S. bases. The variable cost remains the same.

Next, we explain our method for adjusting these estimates of recapitalization requirements with actual historical MILCON spending data.

Adjusting PRV-Derived Recurring Infrastructure Recapitalization Costs

As stated in the body of this report, the cost factors we derived for infrastructure recapitalization spending are predicted requirements, based on PRV of facilities in those regions. To better understand the difference between the requirement estimates our method produces and actual MILCON spending, we developed a comparison to actual spending. We drew MILCON spending figures from recent DoD budget documents.[1] The results of this comparison are shown in Figure A.1.

Figure A.1.
Comparison of PRV-Derived Recapitalization and MILCON Spending



SOURCES: FY 2013 Budget Documents and FY 2011 Baseline Report, "Construction Programs (C-1), Department of Defense Budget Fiscal Year 2013."

In this figure, various countries and regions are shown along the y-axis. The length of each bar shows how MILCON spending (average for FY2011–2013) for that region has compared

[1] MILCON from FY 2013 Budget Documents and PRV from FY 2011 Baseline Report, "Construction Programs (C-1), Department of Defense Budget Fiscal Year 2013," using "appropriation amount" for MILCON. The figures we use for this analysis do not include any OCO funding.

with our PRV-estimated recapitalization requirement.[2] Starting at the top, the first red bar shows that for the United States (excluding territories), MILCON spending during that time period was about 78 percent of our PRV-derived requirements estimate. Spending for the United Kingdom and Germany are very close to this ratio. Spending in Italy is lower, and spending is significantly lower in Japan and South Korea.

We deduce several things from this. First, the similarity among the United States, United Kingdom, and Germany is consistent with our understanding that the latter two countries provide little, if any, MILCON support purely for recapitalization.[3] Second, DoD MILCON spending for U.S. installations in these three countries is, on average, no more than about 80 percent of a simple 67-year PRV-based recapitalization calculation. Further, South Korea and Japan appear to offset a significant amount of MILCON spending that DoD would normally provide for facility recapitalization.

Because of what these findings suggest, we adjust our PRV-derived recapitalization requirements to better capture what *actual DoD spending* would be for installations in these regions. Therefore, for our cost models, we make the following adjustments to the estimates:

- United States and Europe: 80 percent of calculated value
- Japan and South Korea: 40 percent of calculated value.

[2] FY2011 costs are actual spending; FYs 2012 and 2013 are budgeted costs.

[3] It is our understanding that these two countries do sometimes provide labor or funding to mitigate the costs of construction for new capability or capacity.

Bibliography

Adams, Gordon, and Matthew Leatherman, "A Leaner and Meaner Defense," *Foreign Affairs*, Vol. 90, No. 1, January/February 2011, pp. 145–146.

AFI—*See* Air Force Instruction.

Air Force Instruction 38-201, *Management of Manpower Requirements and Authorizations*, Washington, D.C., September 26, 2011. As of March 29, 2013: http://www.e-publishing.af.mil/shared/media/epubs/AFI38-201.pdf

Air Force Instruction 65-503, *U.S. Air Force Cost and Planning Factors*, Washington, D.C., February 4, 1994, Table A19-1, "Standard Composite Rates by Grade." As of March 29, 2013: http://www.e-publishing.af.mil/shared/media/epubs/AFI65-503.pdf

Art, Robert J., "Selective Engagement in an Era of Austerity," in Richard Fontaine and Kristin Lord, eds., *America's Path: Grand Strategy for the Next Administration,* Washington, D.C.: Center for a New American Security, May 2012.

Barno, David W., Nora Bensahel, and Travis Sharp, *Hard Choices: Responsible Defense in an Age of Austerity*, Washington, D.C.: Center for a New American Security, October 2011. As of March 29, 2013: http://www.cnas.org/files/documents/publications/CNAS_HardChoices_BarnoBensahelSharp_0.pdf

———, "How to Cut the Defense Budget Responsibly: Maintaining Global Leadership with Less," *Foreign Affairs*, November 2, 2011.

Belasco, Amy, *The Cost of Iraq, Afghanistan, and Other Global War on Terror Operations Since 9/11*, Washington, D.C.: Congressional Research Service, March 29, 2011.

Bilmes, Linda J., and Stiglitz, Joseph, *The Three Trillion Dollar War: The True Cost of the Iraq Conflict*, New York, N.Y.: W. W. Norton & Co., February 17, 2008.

Buddin, Richard J., Brian P. Gill, and Ron W. Zimmer, *Impact Aid and the Education of Military Children*, Santa Monica, Calif.: RAND Corporation, MR-1272-OSD, 2001. As of March 29, 2013: http://www.rand.org/pubs/monograph_reports/MR1272.html

Cordesman, Anthony, H., *The U.S. Cost of the Afghan War: FY2002–FY2013: Cost in Military Operating Expenditures and Aid and Prospects for "Transition"*, Washington, D.C.: Center for Strategic and International Studies, May 14, 2012.

Department of the Air Force, *Fiscal Year (FY) 2012 Budget Estimates: Military Personnel Appropriation,* February 2011.

DoD—*See* U.S. Department of Defense.

Feaver, Peter D., "Debating American Grand Strategy After Major War," *Orbis*, Fall 2009, pp. 547–552.

Friedman, Benjamin, "How Cutting Pentagon Spending Will Fix U.S. Defense Strategy: Austerity Is the Best Possible Auditor," *Foreign Affairs*, November 2011.

Grissom, Adam, "What Is Grand Strategy? Reframing the Debate on American Ends, Ways, and Means," Santa Monica, Calif.: RAND Corporation, forthcoming.

Laster, Jill, "Spangdahlem A-10 Squadron to Shut Down," *Air Force Times*, February 16, 2012.

Layne, Christopher, *The Peace of Illusions: American Grand Strategy from 1940 to the Present*, Ithaca, N.Y.: Cornell University Press, 2006.

Lostumbo, Michael J., Michael J. McNerney, Eric Peltz, Derek Eaton, David R. Frelinger, Victoria A. Greenfield, John Halliday, Patrick Mills, Bruce R. Nardulli, Stacie L. Pettyjohn, Jerry M. Sollinger, and Steven Worman, *Overseas Basing of U.S. Military Forces: An Assessment of Relative Costs and Strategic Benefits*, Santa Monica, Calif.: RAND Corporation, RR-201-OSD, 2013. As of May 28, 2013: http://www.rand.org/pubs/research_reports/RR201.html

Meier, Alan, Wolfgang Huber, and Karen Rosen, *Reducing Leaking Electricity to 1 Watt*, Berkeley, Calif.: Lawrence Berkeley National Laboratory, 1998.

Military Impacted Schools Association, "DoD Impact aid Funding for Military Children," no date. As of March 29, 2013: http://militarystudent.whhive.com/Content/Media/File/Funding/appropriations_dod_2010.pdf

Moroney, Jennifer D. P., Patrick Mills, David T. Orletsky, and David E. Thaler, *Working with Allies and Partners: A Cost-Based Analysis for the U.S. Air Forces in Europe*, Santa Monica, Calif.: RAND Corporation, TR-1241-AF, 2012. As of March 29, 2013: http://www.rand.org/pubs/technical_reports/TR1241.html

Obama, Barack, "Remarks by President Obama to the Australian Parliament," Washington, D.C.: White House, November 17, 2011. As of March 29, 2013: http://www.whitehouse.gov/the-press-office/2011/11/17/remarks-president-obama-australian-parliament

Office of the Secretary of Defense, *Fiscal Year (FY) 2013 Budget Estimates,* Volume 1, Part 1 of 2, *Justification for FY 2013 Operation and Maintenance, Defense-Wide,* February 2012. As of March 29, 2013:

http://comptroller.defense.gov/defbudget/fy2013/budget_justification/pdfs/01_Operation_and_Maintenance/O_M_VOL_1_PARTS/Volume_I_Part_I.pdf

Pettyjohn, Stacie L., *U.S. Global Defense Posture, 1783–2011,* Santa Monica, Calif.: RAND Corporation, MG-1244-AF, 2012. As of March 29, 2013: http://www.rand.org/pubs/monographs/MG1244.html

Preble, Christopher A., *The Power Problem: How American Military Dominance Makes Us Less Safe, Less Prosperous, and Less Free*, Ithaca, N.Y.: Cornell University Press, 2009.

SAF/FMCC, FY2007–FY2011 AFTOC data, received February 2012.

Sanders, Ralph, *The Politics of Defense Analysis*, Cambridge, Mass.: Dunellen, 1973.

Sharp, Jane M. O., *Europe After an American Withdrawal: Economic and Military Issues*, Stockholm International Peace Research Institute, New York, N.Y.: Oxford University Press, 1990.

Snyder, Don, and Patrick Mills, *A Methodology for Determining Air Force Deployment Requirements*, Santa Monica, Calif.: RAND Corporation, MG-176-AF, 2004. As of March 29, 2013: http://www.rand.org/pubs/monographs/MG176.html

Snyder, Don, Patrick Mills, Adam C. Resnick, and Brent D. Fulton, *Assessing Capabilities and Risks in Air Force Programming: Framework, Metrics, and Methods*, Santa Monica, Calif.: RAND Corporation, MG-815-AF, 2009. As of March 29, 2013: http://www.rand.org/pubs/monographs/MG815.html

Sustainable Defense Task Force, *Debt, Deficits, and Defense: A Way Forward*, Washington, D.C., June 11, 2010. As of March 29, 2013: http://www.comw.org/pda/fulltext/1006SDTFreport.pdf

U.S. Air Force, *Air Force Priorities for a New Strategy with Constrained Budgets*, Washington D.C., February 2012.

U.S. Congressional Budget Office, *Options for Changing the Army's Overseas Basing*, Washington, D.C., May 2012.

U.S. Department of Defense, *Facilities Recapitalization Front-End Assessment,* Washington, D.C., August 2002.

———, *2004 Statistical Compendium on Allied Contributions to the Common Defense,* Washington, D.C., 2004.

———, *DoD Real Property Inventory Data Element Dictionary, RPIM, Version 4.0*, April 22, 2010a.

———, *National Defense Budget Estimates for FY 2012*, Washington, D.C., March 2011a.

———, *Selected Acquisition Report (SAR): F-35*, Washington, D.C., RCS: DD-A&T(Q&A)823-198, December 31, 2011b. As of March 29, 2013: http://www.dod.mil/pubs/foi/logistics_material_readiness/acq_bud_fin/SARs/DEC%202011%20SAR/F-35%20-%20SAR%20-%2031%20DEC%202011.pdf

———, *Defense Budget Priorities and Choices*, Washington, D.C., January 2012a. As of March 29, 2013: http://www.defense.gov/news/Defense_Budget_Priorities.pdf

———, *Sustaining U.S. Global Leadership: Priorities for 21st Century Defense*, Washington, D.C., January 2012b.

U.S. Department of Education, Office of Elementary and Secondary Education, "About Impact Aid: Impact Aid Programs," August 27, 2008.

U.S. Government Accountability Office, *Military Base Realignments and Closures: Key Factors Contributing to the BRAC 2005 Results,* Washington, D.C., GAO-12-513T, March 8, 2012.

Walt, Stephen M., "The End of the American Era," *National Interest*, October 2011.

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