Macroeconomic Multipliers: The Case of Guam

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Abstract

Macroeconomic multipliers are often used to estimate the economic impact of a prospective change. They were recently used by the U.S. Navy to analyse the impact on Guam’s economy of the proposed build-up of U.S. military force on Guam in 2010-2014, which is valued at $15 billion. The paper aims to (1) take a standard spending multiplier and present a conceptual framework for how to adjust it to better reflect Guam’s specific economic conditions, and (2) criticize the U.S. Navy’s study that used Hawaii’s multiplier in analyzing Guam’s economy, thus overstating the economic benefits of the proposed change.

Keywords  Guam, US Military Build-up, Economic Impact, Spending Multiplier
Introduction

The macroeconomic multipliers concept, the spending multiplier in particular, goes back to the work of John Maynard Keynes in the 1930s and is still taught as early as at the principles-level college economics course. Frequent use has been made of the concept to estimate the direct and indirect impacts of prospective changes in an economy, an approach that yields other multipliers such as employment, fiscal (or government budget) and trade balance. In the practitioner literature, the spending multiplier is often referred to as the ‘income multiplier’.

The spending multiplier captures the multiple and sequential rounds of spending resulting from additional incomes at each round. It consists of three types of effects: direct, indirect and induced. The direct impact represents first-round spending on the local economy while the indirect impact represents subsequent spending on the local economy. Because the spending multiplier takes a value greater than one, it is interpreted that the ‘one’ represents each dollar spent in the first round (that is, the direct effect) and the value in excess of one represents the amount of spending that occurs in subsequent rounds, which corresponds to the indirect and induced effects. Hence, if the spending multiplier is 2, this means that for every $1 spent in the first round, it generates an additional spending of $1 in the subsequent rounds.

The simplest version of the spending multiplier is calculated using the formula, 1 / (1-MPC), where MPC is the marginal propensity to consume out of consumer or household incomes. Alternatively, it is the additional spending that results from additional incomes earned by consumers/households. This formula implies that the higher the MPC (the higher the proportion of additional income spent = the lower the proportion saved), the greater the impact on total spending in the economy. This formula is simplest because it does not take into account the effect of taxes on consumers/households’ incomes and the effect of imports (products purchased outside of the local economy) on total spending in the local economy. Once these exclusions are accounted for, we developed a more advanced formula that is usually presented in standard macroeconomic textbooks as

\[
\text{Standard Spending Multiplier} = \frac{1}{1 - \text{MPC}(1-t) + \text{MPIm}}
\]

Where \( t \) = marginal tax rate on consumer/households’ incomes, and \( \text{MPIm} \) = marginal propensity to import. Formula (1) shows the following relationships: (1) the higher is the proportion of consumer/household’s income spent (i.e. the MPC), the higher is the spending multiplier; (2) the lower the tax rate on consumer/household’s incomes, the higher is the spending multiplier; and (3) the less imports into the local economy are as a proportion of the total local economy, the higher is the spending multiplier. In other words, the identified relationships correspond to three types of non-consumption leakages from the local economy, namely, household saving, taxes on household’s income and imports. Each of these leakages reduces the spending multiplier effect of every additional $1 spent on the local economy.

In addition to the spending multiplier, other multipliers can be estimated as a result of a change (e.g. an increase) in direct, indirect and induced spending: an employment multiplier (how many additional jobs); a fiscal multiplier (how taxes and government expenditures would change); and less often, a trade multiplier (how exports and imports would change).
Conceptual Framework for Estimating Guam’s Spending Multiplier

Starting with Formula (1), which shows the effect of MPC, t and MPIm, an attempt is made in this section to modify it to derive a spending multiplier that would be more suitable to use in analysing and projecting Guam’s economy. Such modification will require inclusion of the following factors that are specific to Guam’s economy and are likely to have a significant effect on the magnitude of the spending multiplier for Guam:

• spending on military bases, which is not likely to return to the local economy

• spending on internet purchases from off-island, which ideally would be captured as part of imports but most probably will not

• spending during off-island trips, which similarly would be part of imports but most probably is not included.

Thus, in addition to the three non-consumption leakages that are included in the standard spending multiplier (namely saving, taxes and imports) three additional leakages are particular to Guam’s situation and compete with purchases from the local economy: purchases from the military bases, the internet and off-island. That Guam has high leakage or low capture rates is noted in the US Department of Navy’s Draft Environmental Impact Statement (henceforth, DEIS) (DEIS, 2009 Vol. 9 Appendix F: 2–7). Hence, the MPC (in aggregate) can be decomposed into 4 components: the proportion of households’ disposable income spent on the purchase of goods from the local economy, the military bases, online sources and off-island sellers. Suppose the shares of total spending by the four components are \(a_1\), \(a_2\), \(a_3\) and \(a_4\), respectively. If these four components are exhaustive of where households buy their goods and services, then the sum of the shares must add up to one, that is, \((a_1 + a_2 + a_3 + a_4) = 1\).

Adjusting the standard spending multiplier in Formula (1) so as to focus only on spending in the local economy, we have

\[
\text{Guam’s spending multiplier} = \frac{1}{1 - a_1 \text{MPC}(1-t) + \text{MPIm}}
\]

that is, only a proportion \(a_1\) of household spending is spent on the local economy, and the amount it represents is the correct amount that is subsequently spent and respent in the local economy in accordance to the spending multiplier concept. The balance \((1-a_1)\) represents the proportion to have leaked out of the local economy. This is in addition to the amount of spending that leaks out through imports.

The policy implications for increasing Guam’s spending multiplier are straightforward and as easy as referring to Formula (2). First is to find ways to increase the marginal propensity to consume (MPC). However, caution must be taken in making the distinction between short-run and long-run benefits to the economy and the balance between consumption and saving. Second is to reduce the marginal tax rate (t), which is not an option for Guam since it adopts the marginal tax rates that prevail in the continental US. Third is to find ways to switch local spending towards local sellers, as opposed to purchases from the military base, online sources or off-island businesses. Examples of ways to do this would include ‘buy local’ campaigns that other jurisdictions have in place or are considering. Some months ago, a similar campaign was started on Guam. We may also explore...
ways to reduce the price disadvantage of local sellers vis-à-vis other sources. Lastly, one sure way to increase Guam’s spending multiplier is to reduce the island’s current dependence on imports by, for example, exploring the possibility of developing additional industries on the island that could produce those goods that are currently imported.

Comparing Guam’s Spending Multiplier with Hawaii’s

Because of the lack of data on Guam, analysts (often off-island consultants) use Hawaii’s macroeconomic models and multipliers to make projections on the Guam economy (Jacobs Consultancy, 2007; others cited in the DEIS, 2009). This is often done without a careful comparison of the two economies to see if the use of Hawaii’s economic parameters in place of Guam’s parameters is appropriate and would lead to accurate projections.

Formula (2) suggests that a starting point would be to compare the following parameters from Hawaii and Guam: marginal propensity to consume (MPC) in aggregate; share of household spending that goes to local sellers \(a_1\), which is affected by the shares that go to the three non-local sellers (military bases, online sellers, and off-island sellers); marginal propensity to import (MPIm); and marginal tax rate \(t\). These four parameters are now discussed in order to assess whether they are higher or lower for Guam relative to Hawaii’s, with the ultimate goal of determining whether the spending multiplier is higher or lower for Guam than for Hawaii. It is hypothesized that Guam’s spending multiplier is lower than Hawaii’s.

**MPC in aggregate**

There is some evidence that MPC tends to decrease with the level of real income (more accurately, disposable real income, which represents households’ purchasing power). Since Guam’s real income is lower than Hawaii’s, this suggests that MPC for Guam is higher than MPC for Hawaii, MPC\text{Guam} > MPC\text{Hawaii}.

**Share of household spending that goes to local sellers \(a_1\)**

The analysis of the relative value of \(a_1\) for Guam in comparison to Hawaii will proceed by treating spending on the local economy as a residual, that is the larger the proportion of disposable real income spent on purchases from military bases, online or off-island sources, the smaller the proportion spent on the local economy.

In comparing the share of disposable real income spent on military bases on Guam and Hawaii, we must consider several factors.

- Access to military bases increases with the proportion of the local population that is eligible to shop on military bases. Relatively speaking, the proportion of Guam’s local population that serves or has served in the military is higher than that for Hawaii. Thus, a higher proportion of Guam’s population will have access to military bases and would be more likely purchase items on the military bases.

- The price differential between military bases and local sellers is another factor to consider. The perception and general consensus is that prices are lower on military bases.
- Availability and variety of items from local sellers tend to be more limited on Guam than they are on Hawaii, which has the effect of making shopping on military bases more attractive.

All three of these factors suggest that the proportion of disposable real income spent on military bases ($a_2$) is likely to be higher for Guam than it is for Hawaii.

The next step is to analyse the share of household spending that goes to online sellers ($a_3$) and the factors that affect it.

- Shipping costs tend to be cheaper for Hawaii because of the lesser distance from the continental US but also perhaps because of the higher volume of goods shipped to Hawaii. It is important to note that the US Postal Service has begun offering flat box rates anywhere in the US, including Guam and CNMI (Commonwealth of the Northern Mariana Islands).

- Geographical restrictions apply when shipping from online sources. Whereas often no restriction applies when shipping an online purchase within the continental US, there is a little more restriction when shipping to Hawaii and Alaska, greater restriction when shipping to Guam and other US territories, and even more restrictions when shipping to international addresses. To some extent, this could be circumvented by purchasers having their orders shipped to relatives and friends in the continental US and asking them to ship them on to Guam. Of course, this would involve both time delay and additional postage costs.

- The price differential can be quite significant on the same item sold online or through a local vendor. Buyers take this into consideration in deciding which source to buy from. Often, the price discount from online sources is more than enough to compensate for shipping costs.

- Some products may not be available on Guam or have limited variety but be readily and conveniently available in greater variety from online sources.

Lastly, the share of household spending that goes to off-island sellers ($a_4$) and some of the factors that affect it are analysed.

- The percentage of local residents who travel off-island is a major factor, which is affected by the cost of travel (and its seasonal variations), the distance of travel (Guam is closer to many shopping havens in East and Southeast Asia), the purpose of travel (whether business or pleasure), the number of businesses on Guam that are local subsidiaries of companies with headquarters off-island, and the percentage of relatives and friends living off-island and hosting local residents as visitors.

- The price differential between local and off-island sources can be quite significant and more than enough to compensate for the airfare to nearby shopping locations (most popularly, the Philippines). This is particularly true when the volume of purchases is quite large, thus promising larger total savings.

- Some products may not be available on Guam or may be available only in a much less varied range, yet may be readily and conveniently available in greater variety from off-island sources.

It is therefore very likely that
• a larger proportion of local residents on Guam shop on military bases, in comparison to those in Hawaii, thus $a_2^{\text{Guam}} > a_2^{\text{Hawaii}}$

• the proportion of local residents on Guam who shop online is the same as or larger than the proportion of those in Hawaii who do so, thus $a_3^{\text{Guam}} \geq a_3^{\text{Hawaii}}$

• the same or a larger proportion of local residents on Guam shop off-island than do those in Hawaii, thus $a_4^{\text{Guam}} \geq a_4^{\text{Hawaii}}$

This suggests that the residual, $a_1$, would be lower for Guam than for Hawaii, $a_1^{\text{Guam}} < a_1^{\text{Hawaii}}$. This means that households on Guam purchase proportionately less from local sellers than do households in Hawaii.

**Marginal Propensity to Import (MPIm)**

Beyond a certain income threshold and barring trade restrictions, the smaller an economy, the greater is the reliance on imports (or the higher is the proportion of locally sold goods that are imported). Similarly to MPC, it might be the case that MPIm also decreases with real income. We can then say that the marginal propensity to import is higher for Guam than it is for Hawaii, that is $\text{MPIm}_{\text{Guam}} > \text{MPIm}_{\text{Hawaii}}$. DEIS states that Hawaii’s multipliers may be slightly higher than would be expected for Guam because leakages on Guam’s economy are likely greater due to a relatively higher amount of imported products’ (DEIS, 2009 Vol. 9 Appendix F: 2–5). It also attributes Guam’s heavy reliance on imports to its geographical isolation and low productive capacity (2–7).

**Marginal Tax Rate (t)**

Guam and Hawaii share two similarities: both use the same tax table provided annually by the US Internal Revenue Service (IRS), and neither has sales tax, which makes personal income tax the primary tax paid by households. Because the IRS tax table shows a progressive tax system, (that is, marginal tax rates increase with taxable income) and because per capita income in Hawaii is higher than it is for Guam, then we can say that the marginal tax rate for Guam is less than Hawaii’s, $t^{\text{Guam}} < t^{\text{Hawaii}}$.

**Summary**

The results are summarized in Table 1.

Table 1 gives an indeterminate answer to whether Guam’s spending multiplier is lower than Hawaii’s, which makes it an empirical question. To speculate in the affirmative assumes that the combined effect of Guam’s lower $a_1$ and higher MPIm dominates the effect of Guam’s lower t, which is very probably the case. Because of data limitation, the identified speculation will have to remain as just that.
Macroeconomic Multipliers: The Case of Guam

After long anticipation (since 2006), Guam is currently months away from finding out whether the proposed military build-up will in fact take place. This build-up has three main components, each concerning a particular branch of the US military (DEIS, 2009: ES-1):

- US Marine Corps: (a) Develop and construct facilities and infrastructure to support approximately 8,600 Marines and their 9,000 dependents relocated from Okinawa to Guam, and (b) Develop and construct facilities and infrastructure to support training and operations on Guam and Tinian (CNMI) for the relocated Marines.

- US Navy: Construct a new deep-draft wharf with shoreside infrastructure improvements creating the capability in Apra Harbor, Guam, to support a transient nuclear powered aircraft carrier.

- US Army: Develop facilities and infrastructure on Guam to support relocating approximately 600 military personnel and their 900 dependents to establish and operate an Army AMDTF.

The limited data by which to forecast Guam’s future prospects has led to much speculation as to how this military build-up will affect the island’s economy, along with its social, cultural and environmental effects. It was not until November 20, 2009, when the US Department of the Navy made the draft of the Environmental Impact Statement (DEIS) available to the public, that it was possible to quantify many of the perceived effects of this proposed military build-up. This paper focuses mainly on the economic impact analysis provided by the DEIS, which is found in Volume 9 Appendix F.

### Table 1 Analysis of Parameters that Affect Guam and Hawaii’s Spending Multiplier

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Compare values of Guam's vs. Hawaii's</th>
<th>Rationale</th>
<th>Effect on spending multiplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregate marginal propensity to consume (MPC)</td>
<td>MPC\textsubscript{Guam} &gt; MPC\textsubscript{Hawaii}</td>
<td>MPC decreases with real income level and real income on is lower than Hawaii’s</td>
<td>Guam &gt; Hawaii*</td>
</tr>
<tr>
<td>Share of household spending that goes to local sellers (a)</td>
<td>a\textsubscript{Guam} &lt; a\textsubscript{Hawaii}</td>
<td>Guam households spend proportionately more on purchases from outside of the local economy, such as from military bases, online and off-island sources</td>
<td>Guam &lt; Hawaii**</td>
</tr>
<tr>
<td>Marginal propensity to import (MPIm)</td>
<td>MPIm\textsubscript{Guam} &gt; MPIm\textsubscript{Hawaii}</td>
<td>Guam is a smaller economy than Hawaii and is proportionately more dependent on imports</td>
<td>Guam &lt; Hawaii**</td>
</tr>
<tr>
<td>Marginal tax rate (t)</td>
<td>t\textsubscript{Guam} &lt; t\textsubscript{Hawaii}</td>
<td>Income levels are lower on Guam than in Hawaii and the US tax system is progressive</td>
<td>Guam &gt; Hawaii*</td>
</tr>
</tbody>
</table>

* (**) Ceteris paribus, the difference between the value of this particular parameter for Guam and Hawaii has the effect of increasing (decreasing) Guam’s spending multiplier relative to Hawaii’s.

Application to the Proposed Military Build-Up on Guam

After long anticipation (since 2006), Guam is currently months away from finding out whether the proposed military build-up will in fact take place. This build-up has three main components, each concerning a particular branch of the US military (DEIS, 2009: ES-1):

- **US Marine Corps:** (a) Develop and construct facilities and infrastructure to support approximately 8,600 Marines and their 9,000 dependents relocated from Okinawa to Guam, and (b) Develop and construct facilities and infrastructure to support training and operations on Guam and Tinian (CNMI) for the relocated Marines.

- **US Navy:** Construct a new deep-draft wharf with shoreside infrastructure improvements creating the capability in Apra Harbor, Guam, to support a transient nuclear powered aircraft carrier.

- **US Army:** Develop facilities and infrastructure on Guam to support relocating approximately 600 military personnel and their 900 dependents to establish and operate an Army AMDTF.
The economic issue can be stated as follows: Of the estimated $15 billion of military spending related to military build-up on Guam, how much will benefit the local economy through higher spending on local goods and services, more local jobs and higher incomes to local residents, and higher taxes to the local government (net of higher expenses to provide public services to a larger local population)?

Throughout the DEIS, two types of impacts (or effects) were analysed: direct and indirect (where it is noted that the indirect impact includes the induced impacts (DEIS, 2009 Vol. 9 Appendix F: 1-6).

The DEIS provides estimates under two different scenarios: the unconstrained scenario represents the upper-bound (or most optimistic) of the forecasted economic effects, while the constrained scenario represents the lower-bound (or the least optimistic) of the forecasted economic effects (DEIS, 2009 Volume 9 Appendix F: 1-7). The DEIS estimates under both scenarios will be presented here.

The analysis period is from 2010 to 2020, with the sub-period 2010–2014 corresponding primarily to the construction period, with 2014 being the year when the majority of the military personnel and their families will be relocated to Guam. The sub-period 2015–2020 represents the post–build-up period, also referred to in the DEIS as the operational phase, and the new steady state for the Guam economy. DEIS estimates show that the new steady state will be higher than the baseline or pre–build-up period.

I set out to review the DEIS with two goals in mind. The first one is to recalculate the figures for the economic impact of the military build-up using the information provided in the DEIS and my understanding of the methodology used, based only on what I read, not on any background calculations that have been performed by the DEIS analysis team, since this type of information is not available to me or the public. The second goal is to challenge the parameters used in the calculation along the lines presented in the earlier section, that is, that the spending multiplier for Guam is lower than that for Hawaii, on which DEIS estimates were based. This is important because it has the effect of overstating the positive economic impact of the military build-up and thus presenting an inaccurate picture of the effect of the proposed change on the island economy.

**Recalculating Economic Impacts**

The total values of construction contracts on Guam and military base operations serve as a starting point. The gross values of military contracts during the construction phase are provided in the DEIS, Volume 9 Appendix F Table 4.3-35 for the years 2010–2016 while total expenditure on base operations for the years 2010–2020 are available in Table 4.3-37.

From these values, DEIS assumptions on parameters/proportions are used to derive the labour requirement, that is, the number of workers and supervisors required to perform construction projects and military base operations. As is stated in DEIS, Volume 9 Appendix F Table 4.3-1, for every $10 million military construction contract, 75 workers and 4 supervisors will be required. The same table also states that from 56% to 61% of the required workers will be foreign workers on H2B visas. The rest will be made up of local workers and those from other Pacific islands. In this analysis, we combine these categories because no separate marginal propensity to purchase from the local economy is provided for workers from other Pacific islands.
The numbers of workers and supervisors are then multiplied by their respective average annual incomes to derive the total incomes for three groups: local workers, H2B workers, and supervisors. DEIS, Volume 9 Appendix F Table 4.3-14 provides estimates of annual incomes to be $27,999 for non-supervisory workers and $85,830 for supervisors.

In addition, incomes of on-base personnel are estimated using the numbers of military personnel and civilian military support provided by DEIS multiplied by their respective annual incomes, which were estimated at $28,895 for enlisted personnel and $41,435 for military support personnel (DEIS, Volume 9 Appendix F Table 4.3-37).

**Direct Impact**

Direct impact on Guam’s overall economy, measured by Gross Island Product (GIP, henceforth) is then estimated by tracing the amount of goods and services that are purchased from local sources as a result of demand from the following sources:

- construction contractors
- base operation contractors
- local construction workers
- H2B construction workers
- construction supervisors
- on-base personnel (including enlisted military and civilian military workers).

To facilitate this calculation, DEIS, Volume 9 Appendix F provides us with the following information:

- 19% of construction contracts are purchased from local suppliers (Table 4.3-35)
- 17% of base operations contracts are awarded to local companies (Table 4.3-37)
- 45% of local workers’ incomes are spent locally (Table 4.3-35)
- 20% of H2B workers’ incomes are spent locally (Table 4.3-35)
- 47% of construction supervisors’ incomes are spent locally (Table 4.3-35)
- 12% of enlisted military personnel’s incomes are spent locally (Table 4.3-37)
- 47% of civilian military workers’ incomes are spent locally (Table 4.3-35)

One might take issue with the values of some of these parameters and/or the methods by which these values were estimated. We will take them as provided by the DEIS to show that, even if the same parameters values were used, our estimates would still differ from those presented in the DEIS. For instance, the assertion that H2B workers spend only 20% of their income on local purchases relies on the implicit assumption that their housing would be provided by their employers.
Table 2 shows that DEIS estimates of direct impacts under both scenarios are very similar. This is not surprising since both are based on forecasted military spending and military population to be relocated. The table also shows the extent to which DEIS estimates overstate the direct impact of the military build-up. Calculated relative to our own estimates (indicated as PCEI [Pacific Center for Economic Initiatives] estimates), DEIS estimates tend to be twice as large during the construction phase and 30% higher during the operational phase.

**Indirect Impact**

The indirect impact represents spending on local goods and services after the first round of spending, which gives rise to the direct impact. In calculating the indirect effect, the following information is taken from DEIS, Volume 9 Appendix F Table 4.3-35: 45% of local workers' incomes are spent on the local economy. The rationale for this is that once the first round of spending has taken place, the amount spent to purchase local goods and services now becomes income to local residents, making 0.45 the relevant parameter to use in calculating the spending multiplier. This comes out to be 1.818181 (based on 1 / (1-0.45)), meaning that for every dollar of direct, first-round spending in the local economy, approximately $0.82 of additional spending takes place in the subsequent rounds of spending. This is compared to the personal expenditures output multiplier of 1.89, which was based on various multipliers from Hawaii's model (DEIS, 2009 Volume 9 Appendix F Table 4.3-37).

Table 3 shows that, compared to our estimates, the DEIS estimates of indirect impact under the unconstrained scenario is more than 100% overstated during the construction phase and around 40% overstated by 2020. Our estimates came close to the DEIS estimates under the constrained scenario.
Table 3 Indirect Impact of Military Build-up on the Guam Economy (measured as Gross Island Product, GIP) in millions of current dollars

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<tbody>
<tr>
<td>0% of construction contracts are purchase from local suppliers</td>
<td>0.74</td>
<td>1.35</td>
<td>1.46</td>
<td>1.54</td>
<td>7.43</td>
<td>1.36</td>
<td>1.36</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>17% of base operations contracts are awarded to local companies</td>
<td>0.65</td>
<td>1.21</td>
<td>1.31</td>
<td>1.38</td>
<td>6.65</td>
<td>1.21</td>
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</tr>
<tr>
<td>45% of local workers’ incomes are spent locally</td>
<td>16.81</td>
<td>41.78</td>
<td>71.01</td>
<td>137.14</td>
<td>59.03</td>
<td>18.55</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
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<tr>
<td>20% of NCB workers’ incomes are spent locally</td>
<td>10.53</td>
<td>26.17</td>
<td>44.34</td>
<td>54.32</td>
<td>56.41</td>
<td>37.27</td>
<td>11.62</td>
<td>0.00</td>
<td>0.00</td>
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<tr>
<td>47% of construction supervisors’ incomes are spent locally</td>
<td>6.92</td>
<td>17.19</td>
<td>29.22</td>
<td>35.94</td>
<td>37.05</td>
<td>24.48</td>
<td>7.63</td>
<td>0.00</td>
<td>0.00</td>
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</tr>
<tr>
<td>12% of military personnel’s incomes are spent locally</td>
<td>1.45</td>
<td>4.60</td>
<td>4.60</td>
<td>4.60</td>
<td>30.08</td>
<td>31.72</td>
<td>31.72</td>
<td>31.72</td>
<td>31.72</td>
<td>31.72</td>
<td>31.72</td>
</tr>
<tr>
<td>47% of civilian military workers’ incomes are spent locally</td>
<td>1.63</td>
<td>3.89</td>
<td>3.89</td>
<td>3.89</td>
<td>27.41</td>
<td>29.25</td>
<td>29.25</td>
<td>29.25</td>
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</table>

TOTAL INDIRECT IMPACT

PCEI Estimates | 38.72 | 96.18 | 155.96 | 189.30 | 255.05 | 184.78 | 101.34 | 62.19 | 62.19 | 62.19 | 62.19 |

DEIS estimates-unconstrained scenario | 92 | 227 | 377 | 459 | 536 | 391 | 181 | 87 | 87 | 87 | 87 |

DEIS estimates-constrained scenario | 41 | 101 | 166 | 201 | 252 | 194 | 103 | 63 | 63 | 63 | 63 |

% OVERSTATEMENT VS. PCEI ESTIMATES

DEIS estimates-unconstrained scenario | 137.60% | 136.01% | 141.73% | 142.36% | 110.16% | 111.60% | 78.60% | 39.89% | 39.89% | 39.89% | 39.89% |

DEIS estimates-constrained scenario | 5.89% | 5.01% | 6.44% | 6.13% | -1.19% | 4.99% | 1.69% | 1.30% | 1.30% | 1.30% | 1.30% |

Table 4 Combined Impact of the Military Build-up on Guam in millions of current dollars

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<tbody>
<tr>
<td>PCEI Estimates</td>
<td>86.05</td>
<td>213.74</td>
<td>346.58</td>
<td>426.87</td>
<td>566.77</td>
<td>410.63</td>
<td>225.21</td>
<td>138.20</td>
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<td>138.20</td>
<td>138.20</td>
</tr>
<tr>
<td>DEIS estimates-unconstrained scenario</td>
<td>185.00</td>
<td>455.00</td>
<td>755.00</td>
<td>919.00</td>
<td>1080.00</td>
<td>794.00</td>
<td>374.00</td>
<td>187.00</td>
<td>187.00</td>
<td>187.00</td>
<td>187.00</td>
</tr>
<tr>
<td>DEIS estimates-constrained scenario</td>
<td>135.00</td>
<td>331.00</td>
<td>547.00</td>
<td>664.00</td>
<td>800.00</td>
<td>599.00</td>
<td>297.00</td>
<td>163.00</td>
<td>163.00</td>
<td>163.00</td>
<td>163.00</td>
</tr>
</tbody>
</table>

% OVERSTATEMENT VS. PCEI ESTIMATES

DEIS estimates-unconstrained scenario | 115.00% | 112.87% | 117.84% | 118.36% | 90.55% | 93.36% | 66.07% | 35.31% | 35.31% | 35.31% | 35.31% |

DEIS estimates-constrained scenario | 56.89% | 54.86% | 57.83% | 57.77% | 41.15% | 45.87% | 31.88% | 17.94% | 17.94% | 17.94% | 17.94% |

Table 4 combines the estimates for direct and indirect impact. Compared to our estimates, the DEIS estimates under both unconstrained and constrained scenarios are overstated by 41–118% during the construction phase, and by 17–93% during the operation phase. As expected, the extent of overstatement is worse under the unconstrained scenario than under the constrained scenario.

Figure 1 compares the three estimates of the combined effect of the proposed military build-up on Guam’s GIP. It shows that both DEIS estimates are above our estimates, with the extent of overstatement higher for the unconstrained scenario than the constrained scenario.

Figure 1 Combined Impacts on the Gross Island Product (GIP), in millions of current dollars Local spending multiplier used = 1.818181
Using alternative values of Guam’s spending multiplier

This section shows the extent to which the economic impact on Guam’s GIP is affected by the value assigned to the local spending multiplier. Figures 2 and 3 show two alternative values of the local spending multiplier, both lower than the one derived from the DEIS: 1.50 in Figure 2 and 1.20 in Figure 3.

**Figure 2** Combined Impacts on the Gross Island Product (GIP), in millions of current dollars
Local spending multiplier used = 1.50

![Combined Impact on GIP, millions $ local spending multiplier = 1.50](image)

**Figure 3** Combined Impacts on the Gross Island Product (GIP), in millions of current dollars
Local spending multiplier used = 1.20

![Combined Impact on GIP, millions $ local spending multiplier = 1.20](image)
Table 5 summarizes the extent to which DEIS estimates of the combined impact of the military build-up on Guam’s GIP in both constrained and unconstrained scenarios are overstated when compared to the combined impact derived using alternative values for the local spending multiplier. As is demonstrated in Table 4, the lower is the actual local spending multiplier, the larger the extent to which DEIS estimates overstate the true picture. This applies to both unconstrained and constrained scenarios.

<table>
<thead>
<tr>
<th>Local spending multiplier used ↓</th>
<th>UNCONSTRAINED SCENARIO</th>
<th>CONSTRANDED SCENARIO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% overstatement of DEIS combined impact vs. PCEI estimates</td>
<td>% overstatement of DEIS combined impact vs. PCEI Estimates</td>
</tr>
<tr>
<td></td>
<td>2014</td>
<td>2020</td>
</tr>
<tr>
<td>1.818181 (DEIS)</td>
<td>90.55%</td>
<td>35.31%</td>
</tr>
<tr>
<td>1.70</td>
<td>103.80%</td>
<td>44.71%</td>
</tr>
<tr>
<td>1.60</td>
<td>116.54%</td>
<td>53.76%</td>
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<td>1.50</td>
<td>130.97%</td>
<td>64.01%</td>
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<td>166.51%</td>
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<td>1.20</td>
<td>188.72%</td>
<td>105.01%</td>
</tr>
<tr>
<td>1.10</td>
<td>214.96%</td>
<td>123.65%</td>
</tr>
</tbody>
</table>

1 (not likely) DIRECT IMPACT ONLY, NO INDIRECT IMPACT DIRECT IMPACT ONLY, NO INDIRECT IMPACT

The figures in Table 5 can be used as a ‘quick’ adjustment factor for other variables projected in DEIS using constant proportions. For example, if the more accurate local spending multiplier were 1.50, then peak estimates of GIP would be 130% overstated under the unconstrained scenario and 71% overstated under the constrained scenario. In particular, if the local spending multiplier of 1.50 is the correct assumption, then the military build-up under the unconstrained scenario would boost the Gross Island Product level by 18% above the baseline in the year 2014 and 3% above the baseline in the year 2020. Similarly, GovGuam tax revenues would be 81% higher than the baseline in 2014 and 21% higher than the baseline in 2020. The other variables would be interpreted similarly since a lower estimate for the economic impact (especially the indirect impact) indicates that the following effects will be of a lesser magnitude than was estimated in the DEIS:

- increase in government tax revenues
- increase in the total population
- increase in the the number of workers required
- increase in the income of the total labour force
- increase in the demand for housing and the possible shortage of housing during the peak year.

Of course, if the true local spending multiplier were even lower than 1.50, the magnitude of the above effects would require further downward adjustments.
Conclusion

This study is the first attempt to provide a conceptual framework to explain the often expressed hypothesis that Guam’s multipliers are lower than those of Hawaii. Until data become available, this hypothesis will continue to be unverified. The implications of using an accurate spending multiplier to analyze effects of proposed changes on the Guam economy were demonstrated in the context of an actual proposed change, the military build-up.

Our analysis shows that, even in the case where we use the assumption by the US Department of the Navy that Guam’s spending multiplier is slightly lower than Hawaii’s (1.818181 vs. 1.89), our analysis resulted in lower estimates for the direct, indirect and combined effects, thus referring to the difference between our estimates and those stated in the DEIS as an ‘overstatement of DEIS estimates vs. our estimates’). We have also shown in this paper that this magnitude of overstatement could be significant. This study further demonstrates how the extent of the overstatement increases and the accuracy of the DEIS estimates decreases as lower values of Guam’s spending multipliers are used.

Implication of Research Findings

Our findings suggest a need to revisit some of the assumptions (including the numerical values of some important parameters) on which the DEIS estimates are based as a first step in correcting the overstatement of the DEIS estimates of the economic benefit of the military build-up on Guam. This is important since economic benefits present only one side of the analysis but it is against this side that the other side (the costs) would be compared as the proposed change is evaluated carefully. Unfortunately, the DEIS was deficient in providing estimates of the costs (even in the narrowest sense, i.e. explicit or monetary costs) associated with the proposed military build-up on Guam. DEIS presents cost estimates only to the extent of providing projections of additional staffing (human resources) that would be required as a result of projected increases in the target population that would be served by the different government agencies. Because these population and staffing projections are based on the indirect impact on the Guam economy, these projections and the corresponding costs must be adjusted downward in light of the lower economic impact estimates we have presented in this paper. Using the DEIS model, this downward adjustment would be proportionate to that for the economic impact so that the net effect remains the same. Whether this is true depends on the actual cost calculation of the required additional GovGuam staffing and the structure of the cost, which might challenge the simple practice of adjusting the cost figures proportionately to the lower economic impact. Hence, the difference between the economic benefits and costs, that is to say the net effect of the proposed military build-up, might increase or decrease, thus affecting the proposal’s attractiveness to different stakeholders.

One positive implication of our findings is with regard to worries of the leaders and the people of Guam that the economic impact of the military build-up during the peak year 2014 would be too much to handle, as also would the recession-like period that is projected to follow once the military build-up is completed and Guam’s economy returned to its new equilibrium level. Should the proposed military build-up remain attractive according to the evaluation suggested above, our estimates suggest that the impact on the island’s economy and the pressure on the island’s limited resources during the peak year would be less than is presented in the DEIS. In a way, our lower
estimates translate to what the island’s leaders felt they would like to achieve when they made the request to the US Department of Defense to lengthen the impact period by another four years (from 2010 to 2018 as opposed to 2010 to 2014), the goal being to spread out the impact of the proposed military build-up and to allow the economy and community some breathing room to adapt and respond more effectively. Although the impact period in our analysis remains the same, the magnitude of the impact has been shown to be less and presumably more manageable.

One should also go back to the root of the problem, Guam’s low spending multiplier, and find ways to increase it so that future higher incomes would have a greater positive impact on the local economy. The most promising approach to increasing Guam’s spending multiplier would be to reduce its persistently heavy reliance on imports by creating new industries capable of producing goods and services that are currently being imported. In moving in this direction, it is important to keep the lessons learned from the old (1950s) import substitution strategy and make sure that resource efficiency is also given consideration as new industries are pursued.

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References


