Additional Evidence on the Effectiveness of Sea Duty Incentive Pay

Molly F. McIntosh • William C. Komiss
with
David L. Reese

DAB-2012-U-000152-Final
March 2012

CNA
ANALYSIS & SOLUTIONS

Approved for distribution: March 2012

Henry S. Griffis

Henry Griffis, Director
Defense Workforce Analyses
Resource Analysis Division

Executive summary

Given the magnitude of the resources that the Navy devotes to designing and executing compensation policies, Military Pay and Compensation Branch (N130) requested CNA's assistance in examining whether compensation policies are producing desired effects. The sponsor asked CNA to investigate the extent to which specific compensation policies promote equity, cost-effectiveness, flexibility, and strategic objectives. In this annotated briefing, we evaluate expanding the use of Sea Duty Incentive Pay (SDIP).

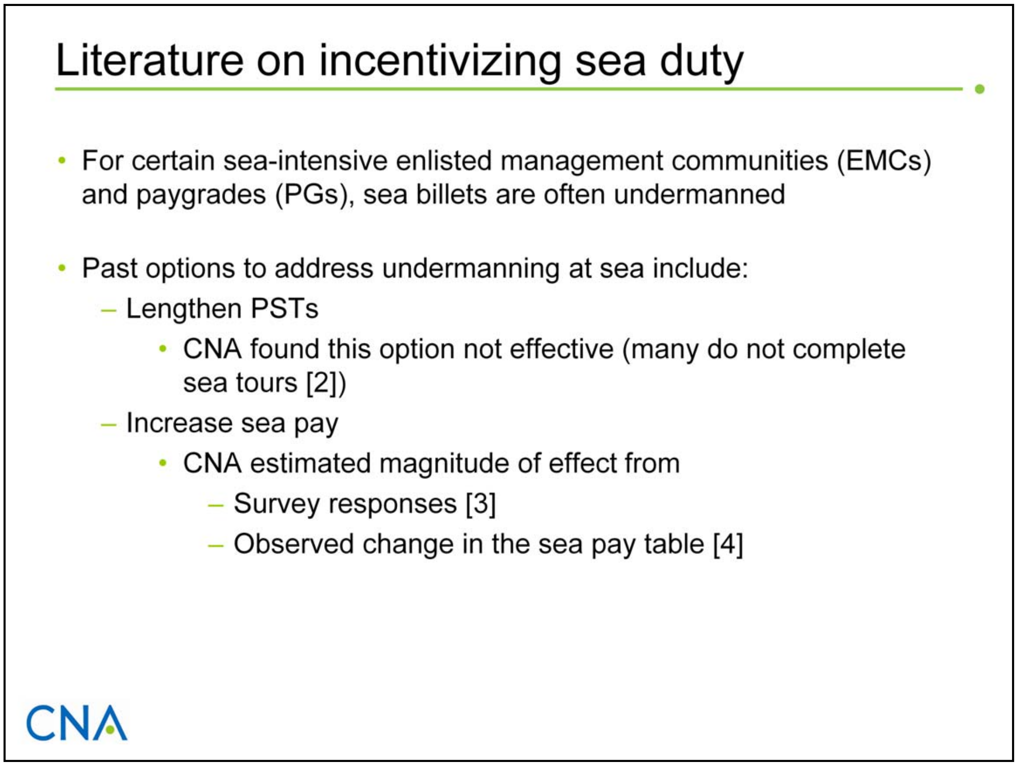
Our analysis is an extension of our 2010 study of whether SDIP can be used to increase voluntary sea time. In that study, CNA found that SDIP was a cost-effective tool for inducing voluntary sea duty extensions among sailors in eligible ratings and paygrades. In this study, we return to that analysis and use a model and set of variable definitions that are more appropriate for analyzing a sailor's decision to extend his/her sea tour. We continue to find that SDIP is effective at increasing sea duty among eligible ratings and paygrades. In addition, we find that SDIP is even more cost-effective than previously thought.

We also examine two SDIP "best practices." The first pertains to deciding when to add or remove eligible ratings and paygrades. We suggest that sea fill rate thresholds be applied as a rough guideline, where these thresholds reflect the the level of risk the Navy is willing to accept as a result of undermanning at sea. In making the eligibility decision, a rating's degree of mission criticality and insight on future changes in sea inventory and billets authorized should be considered. The second best practice is the setting of SDIP payment rates and what factors influence this decision. We argue that payment rates should be increasing in the extent of undermanning at sea, degree of mission criticality, paygrade, prescribed sea tours, and degree of skill. Furthermore, payment rates might also be allowed to vary over the course of an SDIP contract to encourage sailors to commit to longer sea tours.

Outline

- Background
- Research questions
- Previous (2010) study: Approach and findings
- Lessons learned from 2010 study
- Current study: Approach and findings
- SDIP best practices

In this annotated briefing, we begin by presenting some relevant background information as well as the research questions examined in this study. Because the analytical approach we use in this study is similar to that used in our 2010 research memorandum [1], we describe [1]'s approach and findings. Next, we review the lessons we learned from the analysis conducted in [1] and discuss how those lessons informed the current study's analytical approach. Finally, we discuss some SDIP best practices—namely, how to determine SDIP eligibility and payment rates to maximize the program's effectiveness.



This study adds to an existing body of literature examining the relationship between additional compensation and the likelihood that a sailor extends at sea. One option for incentivizing sea duty is to lengthen sailors' prescribed sea tours (PSTs), or the amount of time they are required to be at sea. In [2], however, the authors found that this strategy is unlikely to improve sea manning problems because a majority of sea tours are not completed.

A second option for incentivizing sea duty is increasing the pay awarded to sailors while at sea, or sea pay. In [3], sailors were surveyed as to whether they would extend at sea in exchange for additional compensation plus the promise of homebasing. Taking away the effect of homebasing, [3] estimates that more than 30 percent of eligible sailors would extend their sea tours by at least 1 year for a $150 increase in monthly sea pay (in 2010 dollars, this represents approximately $208), but a sailor's real-world sea duty extension behavior will likely differ from his or her intentions as gathered in a survey. Reference [4], however, analyzes the impact of a 2001 increase in the sea pay table. Controlling for individual and job characteristics as well as civilian earning opportunities, [4] estimates that the $50 increase in monthly sea pay (or approximately $62 in 2010 dollars) enacted in 2001 increased the likelihood of a sea duty extension among sailors on 48-month sea tours by 2.9 percentage points, or 5.8 percent.

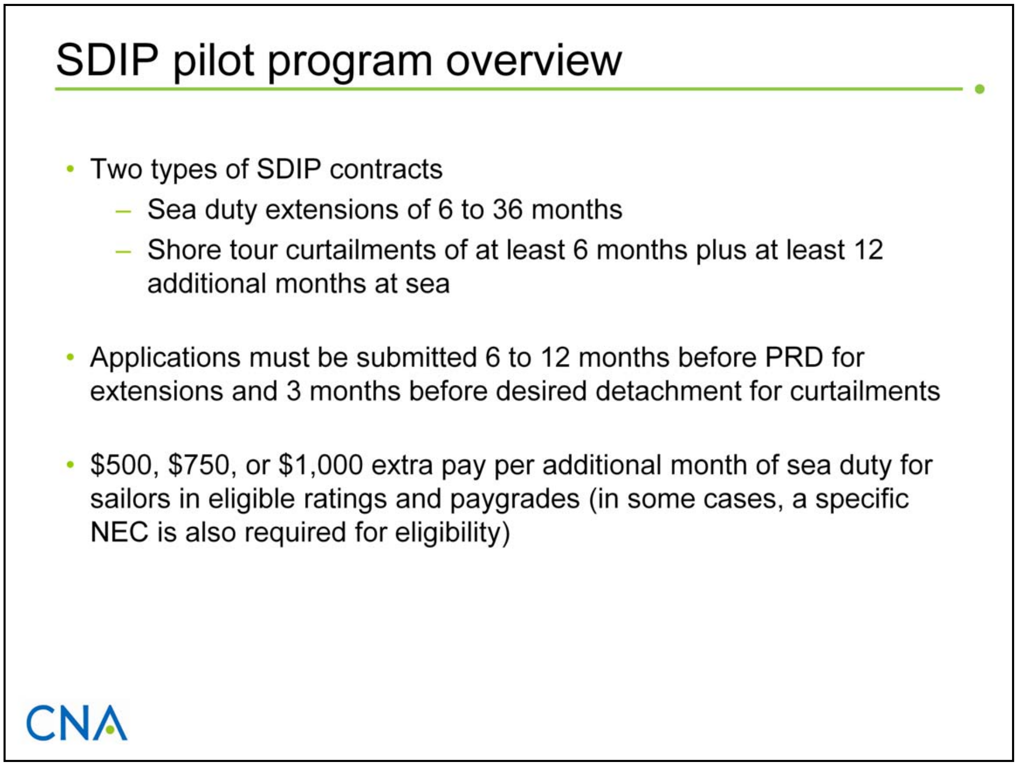
New sea duty incentive: SDIP

- SDIP awards extra compensation to sailors in chronically undermanned sea-intensive EMCs and paygrades who commit to extra sea duty
- CNA's 2010 study evaluated the effectiveness of SDIP
- This study looks for additional evidence of SDIP's effectiveness

CNA

While [4] demonstrates that increasing sea pay can induce sailors to commit to additional time at sea, changes to the sea pay table are arguably not sufficiently targeted. For instance, all sailors are paid the extra compensation, not just sailors who are in sea-intensive EMCs and paygrades. In addition, sailors receive the extra compensation for the entire length of their sea tours, not just for the additional months of sea duty associated with the sea duty extension. SDIP, a new pay that was rolled out in a pilot program in March 2007, is targeted specifically at EMCs and paygrades with persistent sea manning challenges. To this end, SDIP offers extra monthly compensation to sailors in qualified EMCs and paygrades who commit to additional sea duty by extending their sea tours or curtailing their shore tours.

As mentioned earlier, CNA evaluated the impact of SDIP on sea manning in eligible EMCs and paygrades in 2010 [1]. Specifically, [1] assessed SDIP's impact on the probability of an extension at sea and the length of sea duty extensions as well as the cost-effectiveness of SDIP relative to a change in the sea pay table. In this document, we return to the dataset used in [1] and employ a new and, as we will argue, more appropriate model and set of variable definitions to assess whether there is additional evidence on the effectiveness (and cost-effectiveness) of SDIP.



As mentioned previously, there are two types of SDIP contracts: a sea duty extension and a shore tour curtailment. Applications for SDIP should be submitted 6 to 12 months before a sailor's projected rotation date (PRD) for sea duty extensions and at least 3 months before the desired detachment date for shore tour curtailments. (In reality, however, a large share of SDIP extension applications—which make up the vast majority of all SDIP applications—are submitted less than 6 months from PRD.)

A sailor seeking to extend his or her sea tour under SDIP must commit to an extension that is a minimum of 6 and a maximum of 24 months for a sea tour within the continental United States (CONUS) or a maximum of 36 months for a sea tour outside CONUS. A sailor seeking to curtail his or her shore tour under SDIP must cut the tour short by at least 6 months and commit to a minimum of 12 additional months at sea.

An SDIP sailor receives a monthly bonus of $500, $750, or $1,000, depending on his or her rating, paygrade, and occasionally Navy Enlisted Classification (NEC), for each month of additional sea duty. Payment is distributed as a lump sum, delivered in the first month of SDIP sea duty. Sailors who fail to complete their SDIP contracts are required to repay the unexecuted portions of their contracts.

SDIP eligibility

- 13 authorization dates from Mar. 15, 2007, to Nov. 1, 2011
- Since inception of program
  - E5–E9 sailors have become eligible for SDIP in 23 ratings
  - Some ratings have been subsequently removed from eligibility
  - Some E5–E9 sailors have seen their payment levels changed

SDIP-eligible ratings by date of authorization

Year of authorization	Ratings gaining authorization	Ratings losing authorization
2007	AB, ABE, ABF, ABH, AO, DC, EM, EN, ET(SS)NAV, FC(AEGIS), MM(SW), MM(SSW)	None
2008	AWS, ELT(SS)	EM
2009	OS, GS, GSE, GSM*	None
2010	ET(SS), HM	AWS
2011	STG, MT	AB, ABE, ABF, ABH, DC, EN, FC(AEGIS), MM(SW), MM(SSW)

*In addition, on November 10, 2009, all E8-E9 sailors in nuclear-trained ratings became eligible if they held NEC 3302.

CNA

Ratings have become eligible for SDIP on 1 of 13 authorization dates between March 15, 2007, and November 1, 2011. In total, 22 ratings have become eligible for SDIP since March 2007, including 10 surface ratings, 6 aviation ratings, 5 submarine or nuclear ratings, and 1 medical rating. Not all sailors in these ratings are eligible; instead, eligibility is also determined by paygrade (eligible sailors are generally E5s to E9s) and sometimes NEC. In addition, on November 10, 2009, all E8 and E9 sailors in nuclear-trained ratings became eligible if they held NEC 3302.

The table above shows which ratings gained and lost authorization each year since the pilot began. Throughout the course of the pilot, in addition to ratings being added and removed from the authorized list, some ratings have also had their monthly payment amounts changed. For more information on changes in rating eligibility and payment amounts, see the table in the appendix (page 32) or [1].

Research questions

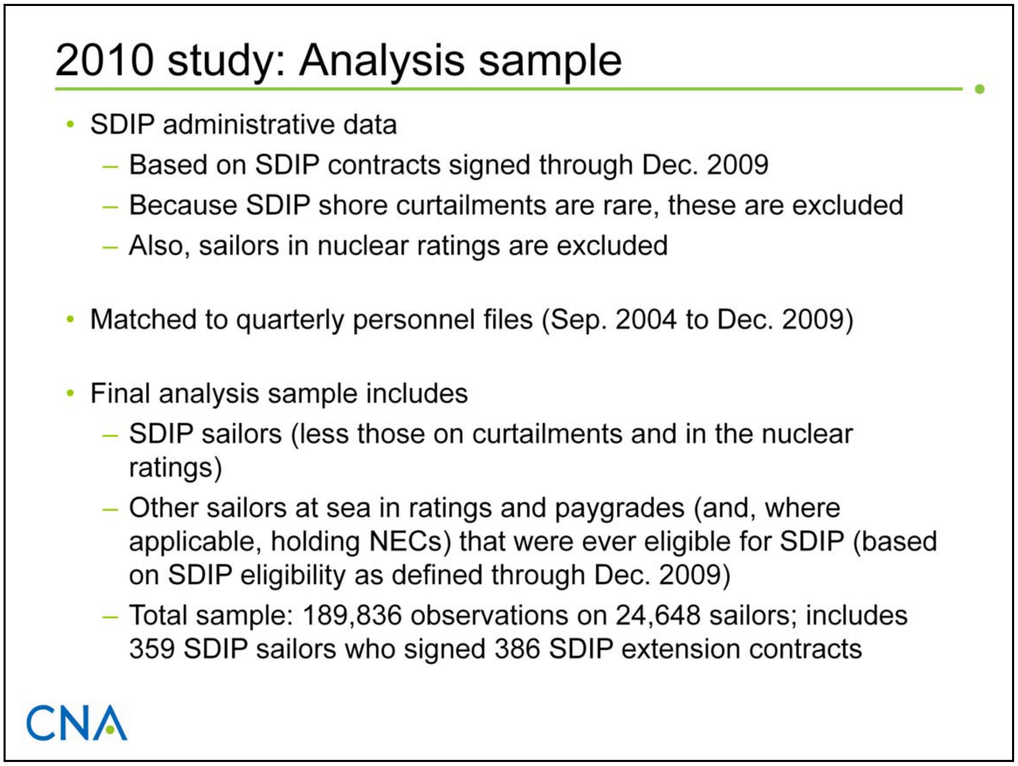
- Is there additional empirical evidence, beyond what CNA found in [1], of the effectiveness of SDIP?
  - Has SDIP improved manning at sea in eligible EMCs and paygrades?
    - Does SDIP increase the probability of a sea duty extension?
    - Does SDIP increase the length of sea duty extensions?
  - What's the effective price of an extra month of SDIP sea duty?
    - Different from the accounting price (total SDIP dollars spent divided by total months under SDIP contract)
    - Incorporates economic rent (i.e., sea duty extensions that qualify for SDIP but would have taken place even without the incentive)

CNA

The objective of this study is to determine whether additional empirical evidence, beyond that in [1], supports the hypothesis that SDIP has been effective. With that in mind, the current study addresses a set of research questions similar to that in [1].

First, we examine whether SDIP has improved manning at sea in enlisted management communities and paygrades that are eligible for SDIP. With respect to this question, SDIP would be an effective tool if SDIP increased the probability of a sea duty extension and/or increased the length of sea duty extensions.

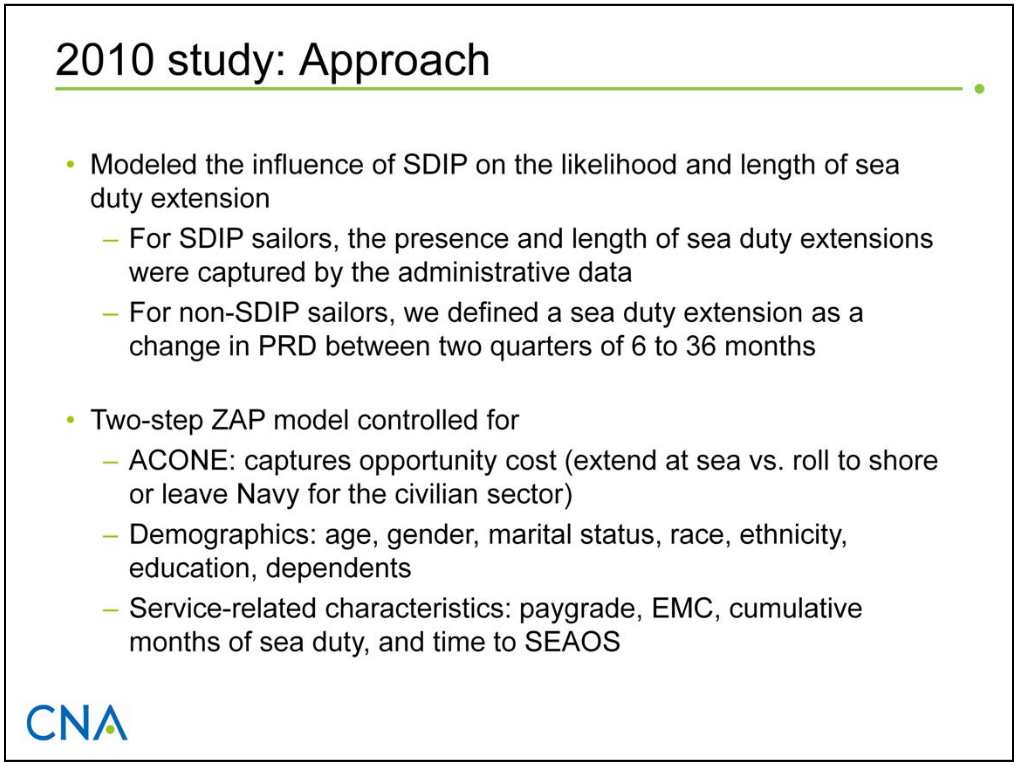
Second, we evaluate the effective price of an extra month of sea duty purchased with SDIP. As we discuss in more detail in the pages that follow, the effective price is different from the accounting price. The latter is simply the total amount spent on SDIP extension contracts divided by the number of sea duty months paid for in those contracts, whereas the former also takes into consideration economic rent, whereby sailors might be paid for extensions that would have happened in the absence of the incentive.



In [1], to identify and characterize SDIP sailors, CNA matched administrative data gathered at the time the SDIP contracts are written with our enlisted personnel files. The administrative data, on contracts signed through December 2009, contain SDIP-specific information (e.g., date of application approval, monthly SDIP rate, and length of extension in months). These data were matched with quarterly observations from our enlisted personnel files from September 2004 through December 2009. The study sample included all SDIP sailors plus sailors in ratings and paygrades (and, where applicable, holding NECs) that were ever eligible for SDIP (based on SDIP eligibility as defined through December 2009).

Since SDIP curtailments were relatively rare (we observe a total of 60 in the raw data), these were excluded from the analysis in [1]. Also excluded were sailors in nuclear ratings since these sailors have distinctly different opportunities in the civilian labor market. One approach would be to model the effect of SDIP on these sailors in a separate analysis, however there were not enough SDIP contracts among sailors in the nuclear ratings to allow for this.

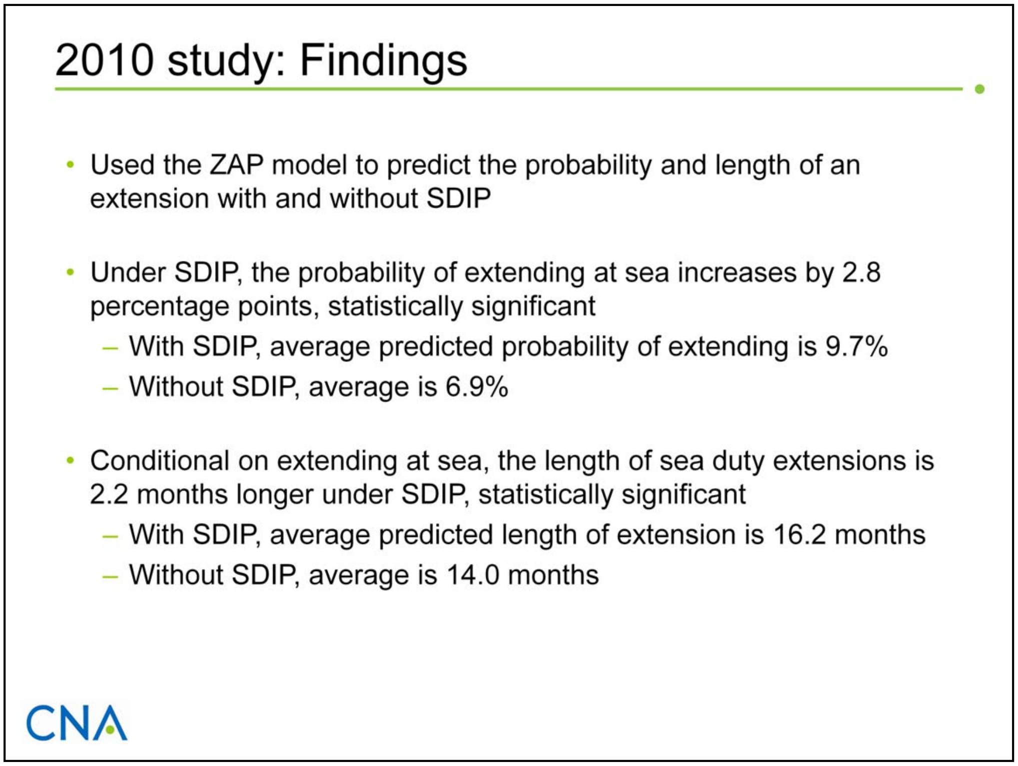
The final sample in [1] comprised about 190,000 quarterly observations on roughly 25,000 sailors from September 2004 through December 2009. Of these 25,000 sailors, 359 executed SDIP extensions at sea, signing a total of 386 extension contracts. See [1] for more descriptive statistics pertaining to this sample.



Reference [1] modeled the influence of SDIP on the decision to extend at sea and the length of a sea duty extension. For SDIP sailors, the administrative data captured the occurrence and length of a sea duty extension. For the non-SDIP sailors in our sample, we defined a sea duty extension as a change in PRD of at least 6 but no more than 36 months (following the extension lengths allowed under SDIP).

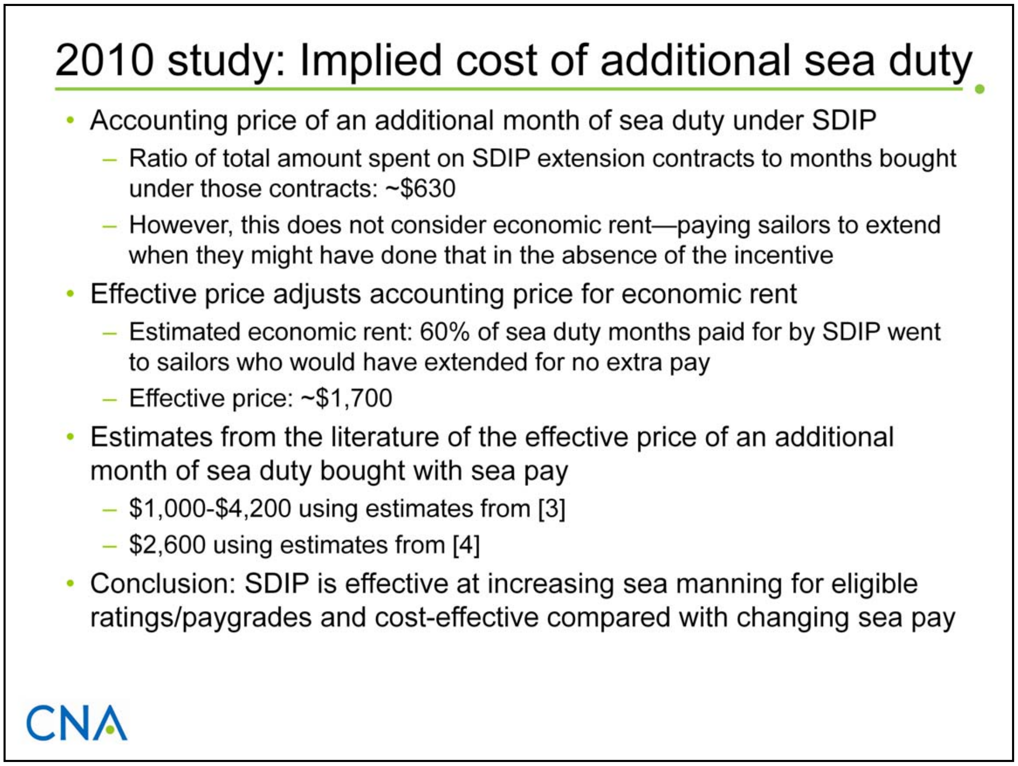
The approach in [1] allowed for the two outcomes, the likelihood and length of sea duty extension, to be modeled in two steps using a zero-altered Poisson (ZAP) model. In the ZAP model, the first outcome, deciding to extend at sea, is modeled as a binary outcome; it takes on a value of 1 if a sailor extends and 0 otherwise. Outcome 2, length of a sea duty extension, is captured by count data since the values it takes on are integers, such as 0 (when a sailor does not extend), 6, 7, and so on, up to 36 months.

The influence of SDIP is captured in [1] through a variable called ACONE (Annualized Cost of Not Extending), which approximates the opportunity cost of a sailor choosing to not extend at sea. In this framework, a sailor on a sea tour faces the decision to extend the sea tour, roll to shore, or leave the Navy. ACONE captures the compensation that the sailor would forgo by choosing to not extend at sea; it is constructed as the difference of (1) discounted future compensation if the sailor extends at sea and (2) the maximum of discounted future compensation if the sailor chooses to roll to shore or leave the Navy. ACONE is calculated over 36 months, corresponding to the longest sea duty extension allowed under SDIP. Reference [1] also controlled for demographic characteristics (e.g., age, gender, marital status, race, ethnicity, education, and the presence of dependents) and service-related characteristics (e.g., paygrade, EMC, cumulative months of sea duty, and time to Soft End of Active Obligated Service (SEAOS)).



Reference [1] used the estimated ZAP model to predict values for each of the two outcome variables for each sailor under two scenarios: (1) each sailor who was eligible for SDIP would receive SDIP payments if he/she extended and (2) each sailor who was eligible for SDIP would not receive SDIP payments if he/she extended. For each of the two outcome variables, the study reported the difference in the average across the two scenarios as the effect of SDIP.

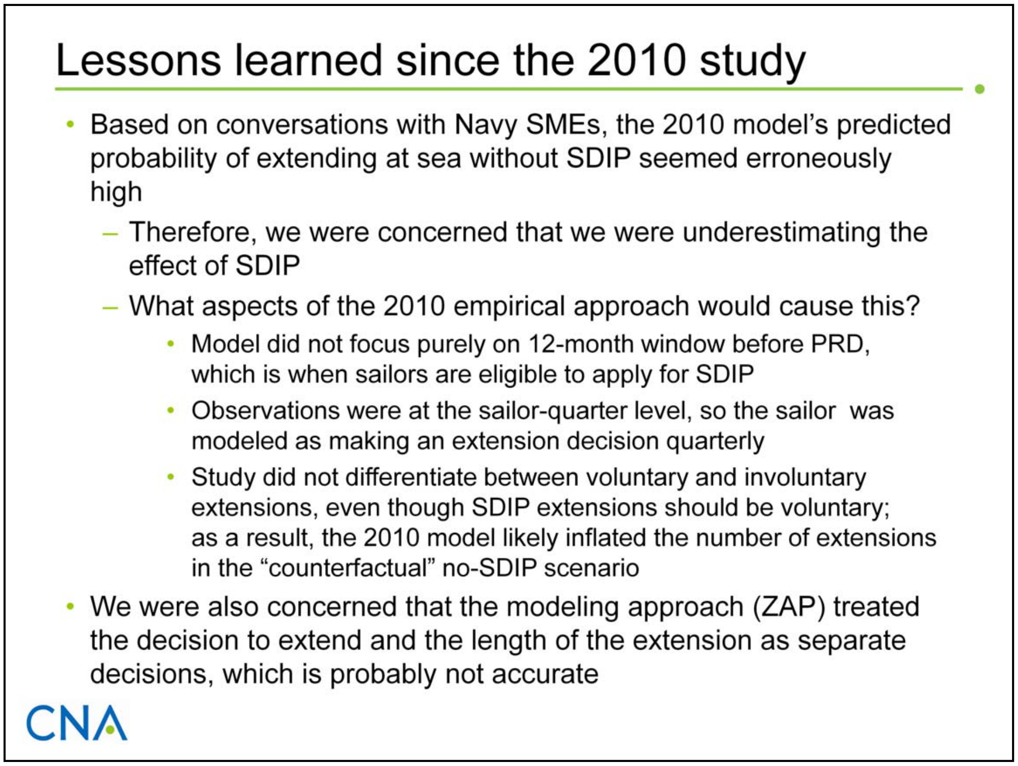
The results suggest that SDIP significantly increases the probability of extending at sea and the length of extensions. With SDIP, [1] found that the average probability of extending is 9.7 percent, compared with 6.9 percent without SDIP, or a difference of 2.8 percentage points. Similarly, [1] found that the average length of extensions, conditional on extending, is 16.2 months with SDIP and 14.0 months without SDIP, or a difference of 2.2 months. These differences are statistically significant at the 5-percent level.



The results from [1] have implications for the cost of eliciting additional sea duty in ratings that are chronically undermanned at sea. Reference [1] defined the accounting price of an additional month of SDIP sea duty as the ratio of the dollars spent on SDIP extension contracts to the number of months bought on those contracts, or $630. But this price does not account for economic rent—the idea that some SDIP sailors might have extended at sea even without the incentive. Using the model's predictions, [1] estimated the share of extension months bought under SDIP contracts that would have been observed in the absence of SDIP to be about 60 percent. That is, 60 percent of the months of sea duty purchased under SDIP went to sailors who would have extended for no additional compensation. Adjusting the accounting price for economic rent, [1] finds that the effective price of an additional month of sea duty bought under SDIP is $1,700.

This estimate can inform the cost-effectiveness of SDIP relative to a change in sea pay. Reference [1] finds that the effective price of an additional month of sea duty through hypothetical changes in sea pay (based on the homebasing survey described in [3]) ranges from $1,000 to $4,200 (or, in 2010 dollars, from $1,400 to $5,800). Reference [1] creates a second estimate, based on an observed change in sea pay described in [4], of $2,600 (or $3,200 in 2010 dollars). Because past behavior is probably a better predictor of future behavior than surveyed intentions, [1] argues that the cost of an additional month at sea generated by sea pay is likely to be closer to the second estimate. Also, if SDIP-eligible ratings are especially difficult to man at sea, the previous estimates could be underestimates since they are derived from data spanning all ratings at sea.

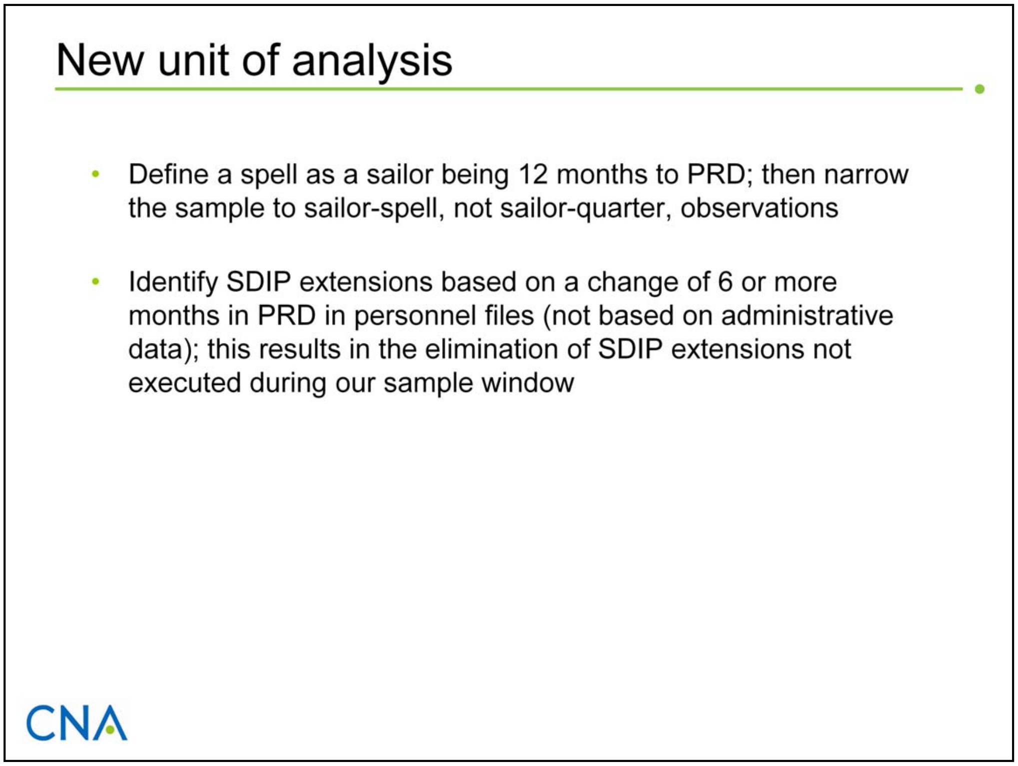
Therefore, [1] finds that SDIP is a more cost-effective option than changes in sea pay to elicit additional sea duty.



Since the completion of [1], we have had discussions with Navy subject matter experts (SMEs) and have come to the conclusion that our predictions of the likelihood of extending at sea in the absence of the SDIP program were erroneously high. If this is the case, [1] would have underestimated the effectiveness, and therefore the cost-effectiveness, of SDIP.

We have identified three aspects of the earlier approach that could have caused [1] to overestimate the likelihood of a sailor extending his sea tour without receipt of SDIP. First, the earlier study's sample included observations of sailors when they had more than 12 months to their PRD. This caused many observations of sailors who were ineligible for SDIP to be labeled as eligible for SDIP. Second, the study's sample included an observation for each sailor in each quarter during the sample period. While this caused the study to model the extension decision as if each sailor made this decision each quarter, it would be more accurate to assume that each sailor makes his/her decision once in the 12-month period before his/her PRD. Third, the earlier study did not differentiate between voluntary and involuntary extensions. Since SDIP extensions are voluntary, in this study we narrow our focus to voluntary extensions only.

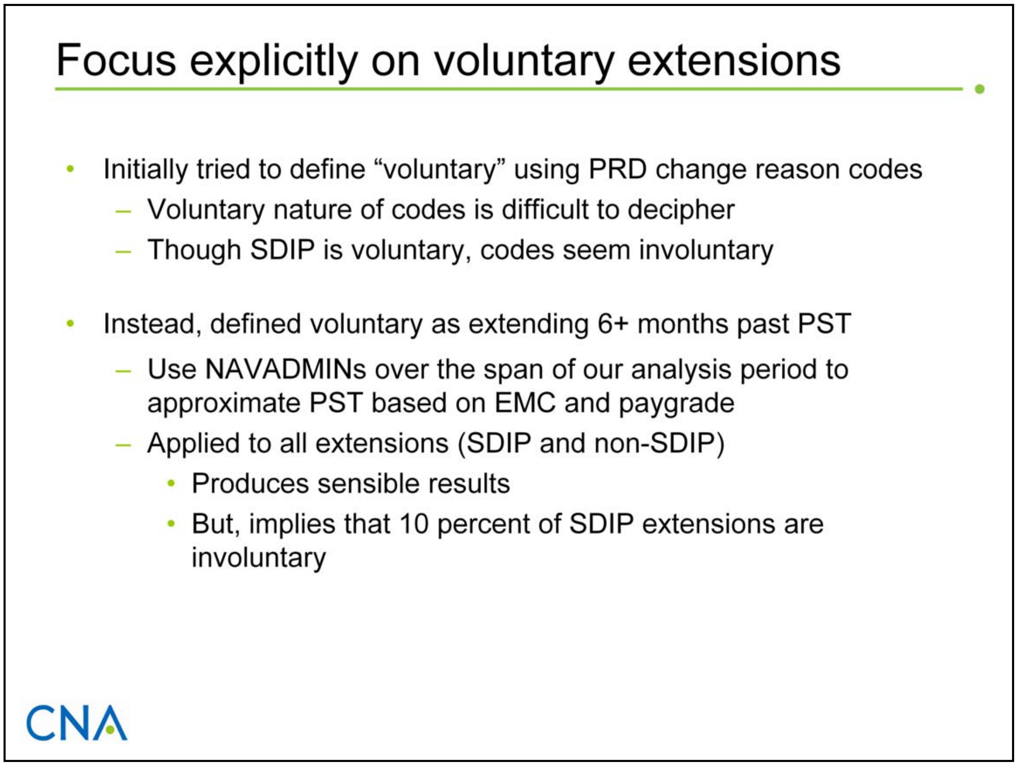
In addition, the ZAP model treats the decision to extend and the length of the extension as if they are made independently. It would be more appropriate to assume that these decisions are made jointly; therefore, they should be modeled jointly.



In this study, we address the above issues, returning to the same dataset as used in [1] but changing our approach.

First, we define a new unit of analysis centered on spells in which sailors are within 12 months of their PRDs. We start by excluding from the sample all sailor-quarter observations occurring more than 12 months before the sailor's PRD. Then, we define a sailor-spell as the 12-month period before the sailor's PRD. Next, we retain one observation per sailor-spell and note whether the sailor extended at sea during this spell and, if so, for how long. Finally, we measure all independent variables as their values at the beginning of the sailor-spell, with the exception of ACONE, which we define as the maximum value of ACONE during the sailor-spell.

Second, for SDIP sailors (whom we identify using SDIP administrative data), we determine whether an SDIP extension took place based on whether the sailor's PRD changed by 6 to 36 months, instead of relying on the new PRD information contained in the administrative data as in [1]. This results in the exclusion of SDIP extensions that were *contracted* but not *executed* during our sample window.



Another area of focus is voluntary extensions, among SDIP and non-SDIP extenders. Our first attempt at identifying voluntary extensions in the data was to examine PRD change reason codes as they appear in our personnel files. This approach, however, was unsuccessful for two reasons: (1) the descriptions included in the PRD change reason codes are often vague, making it was difficult to decipher voluntary from involuntary reasons for PRD changes, and (2) although SDIP extensions are voluntary, many of the PRD change reason codes associated with SDIP extensions seemed, at face value, to be involuntary.

Given this, we instead used the length of an extension relative to a sailor's PST to define voluntary sea duty extensions. In particular, we define voluntary sea duty extensions as those that extend 6 or more months past a sailor's PST since involuntary extensions are unlikely to surpass a sailor's PST. PSTs do not appear in our personnel files, so we estimate them using information from NAVADMINs during our sample period based on EMC and paygrade. This approach produces sensible results but does imply that 10 percent of SDIP contracts were awarded for involuntary extensions. Therefore, these SDIP extensions are dropped from the sample.

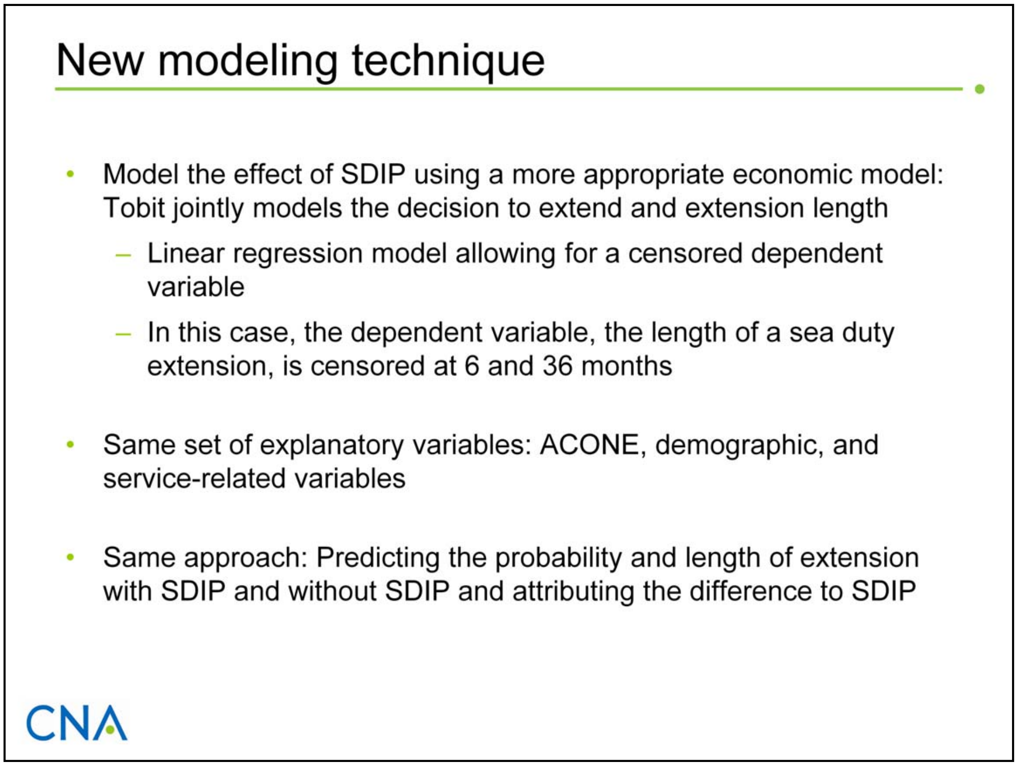
New sample

- Original sample in [1]:
  - 189,836 observations, 24,648 sailors
  - 359 SDIP sailors, 386 extension contracts
- New sample:
  - 27,606 observations, 20,885 sailors
  - Dropping unexecuted SDIP contracts brings the number of SDIP sailors down to 253 and the number of extension contracts down to 272
  - Dropping involuntary extensions brings the number of SDIP sailors down to 226 and the number of extension contracts down to 245

CNA

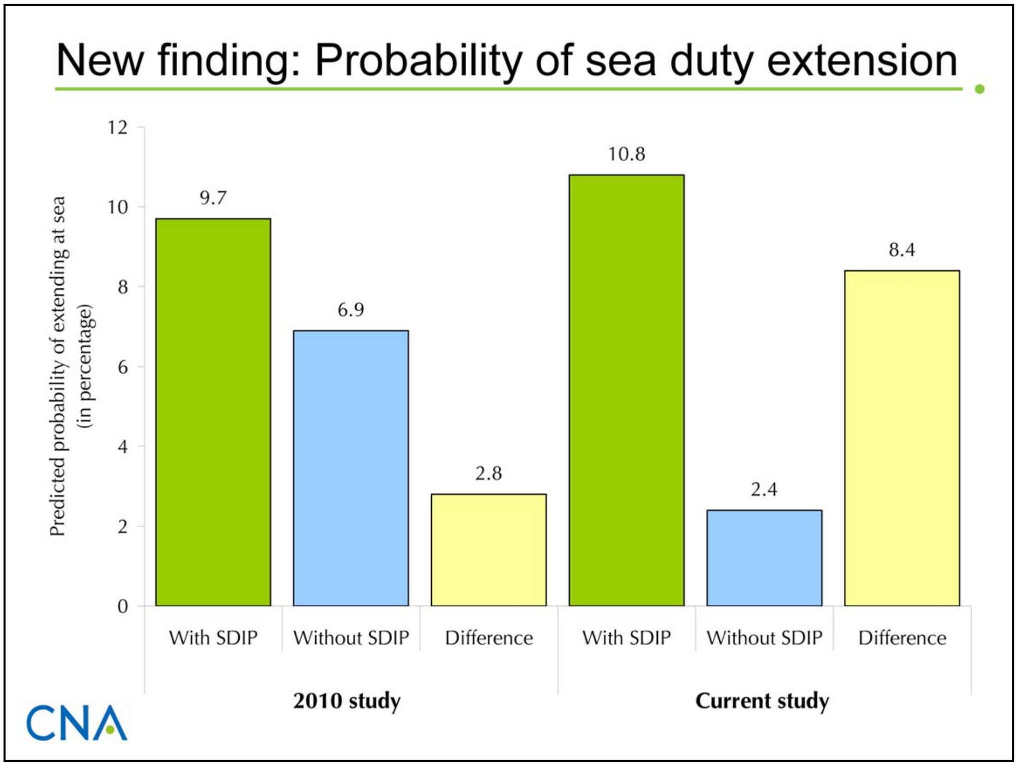
The new sample size is shown above. Two big changes are worth noting, relative to the sample used in [1]. First is the drop in the overall number of observations; this is caused by the change in unit of analysis from sailor-quarter observations to sailor-spell observations. Second is the drop in the number of SDIP sailors and extension contracts, which is the result of different sample exclusions:

- Dropping SDIP extension contracts that were not executed by June 10 (the end of our sample window). This cuts the number of SDIP sailors and SDIP extension contracts by 30 percent, from 359 to 276 SDIP sailors and from 386 to 272 SDIP extension contracts.
- Dropping involuntary extensions. This cuts the number of SDIP sailors by another 10 percent, from 276 to 226 SDIP sailors and from 272 to 245 SDIP extension contracts.



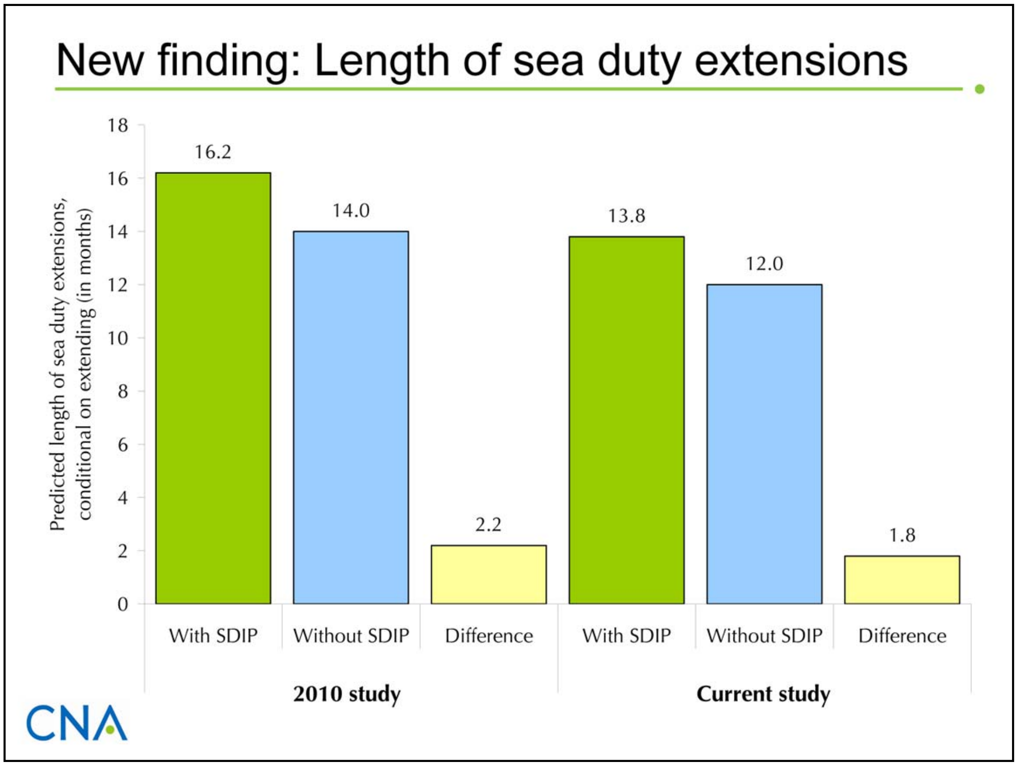
Our last modification to the approach used in [1] is a change in the econometric model. The ZAP model used in [1] treated the decision to extend and the extension length decision independently. It is likely, however, that these decisions are made jointly, so here we use a model (the Tobit model) that allows for joint decision-making. The Tobit model supposes that a latent, or unobservable, variable exists that measures a sailor's preferred sea duty extension length. While we cannot directly observe this variable, we assume that for values between 6 and 36 (inclusive) it equals the sailors' observed extension lengths. For values greater than zero but less than 6 or for values greater than 36, we assume that those sailors were not allowed to extend their sea tours, in accordance with SDIP policy, whereby the shortest extensions are 6 months and the longest are 36 months. For negative values, we assume that these sailors choose to not extend. Thus, the observed extension lengths in our data are equivalent to the values of the latent variable censored from below at 6 months and from above at 36 months. The key feature of the Tobit model is that it accounts for the fact that we observe extensions only of non-zero length for those who choose to extend for 6 to 36 months, and that these sailors are not likely to be representative of all SDIP-eligible sailors.

In estimating the Tobit model, we use the same set of explanatory variables as in [1]: ACONE and demographic and service-related characteristics. In this analysis, however, we change the way we calculate ACONE so that the option to leave the Navy is excluded because loss rates for E5s and above are low. Regardless, this has no discernible effect on the outcome; our results are qualitatively unchanged. As in [1], after estimating the Tobit model, we use the estimated parameters to predict the probability and length of extension with SDIP and without SDIP, and we attribute the difference to the effect of SDIP.



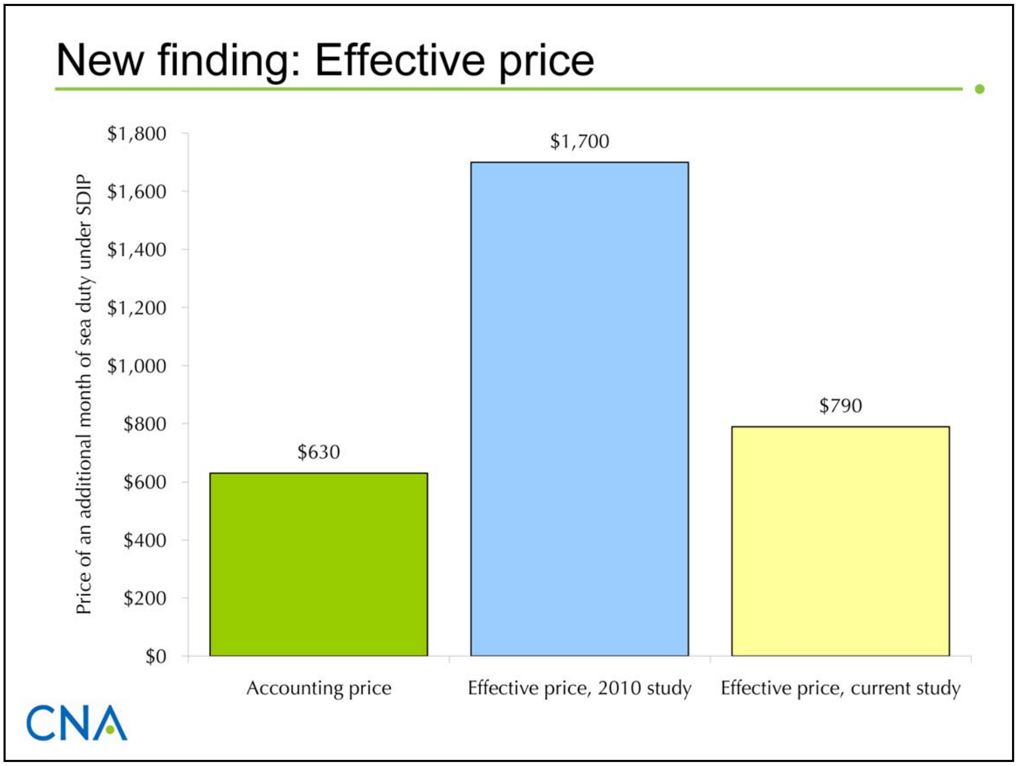
This slide and the next few show the results of the new analysis. First, we find that SDIP increases the probability of extending at sea by 8.4 percentage points. As the figure shows, the likelihood of extending at sea is 10.8 percent with SDIP compared with 2.4 percent without SDIP, for a difference of 8.4 percentage points. This effect is statistically significant at the 10-percent level.

As the figure shows, this finding is in sharp contrast to the finding in [1], where the probability of extending at sea increased by only 2.8 percentage points under SDIP. The difference between the estimates reported here and in [1] are almost entirely attributable to the difference in the estimated probability of extending voluntarily without SDIP. In [1], the predicted probability of extending without SDIP was 6.9 percent compared with 2.4 percent in the current study. Thus, we were successful in our efforts to address what Navy SMEs considered to be an unrealistically high predicted extension rate without SDIP in [1]. We achieved a more realistic estimate by redefining our unit of analysis, focusing on voluntary extensions, and using a more appropriate modeling technique.



Next, we find that, conditional on extending at sea, SDIP increases the average length of sea duty extensions by 1.8 months. As the figure shows, conditional on extending at sea, average extensions were 13.8 months with SDIP and 12.0 months without SDIP, for a difference of 1.8 months. This effect is statistically significant at the 1-percent level.

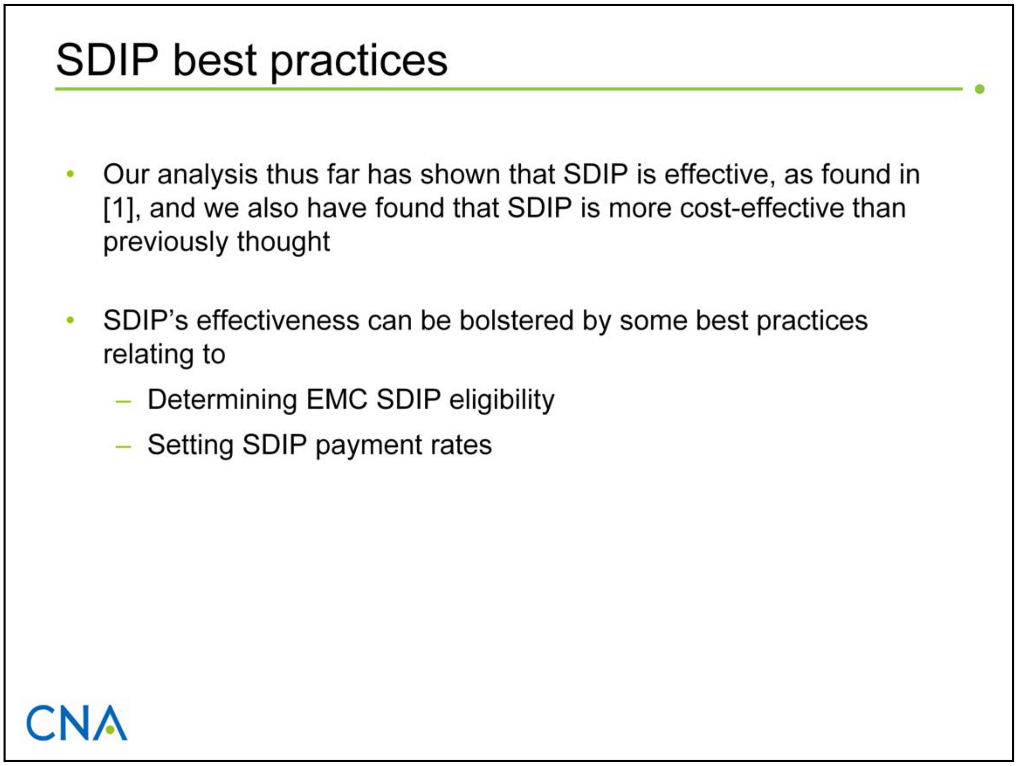
The magnitude of this finding is similar to that in [1], where the difference in average sea duty extension lengths that is attributed to SDIP is 2.2 months. While the size of the SDIP effects are similar across the two studies, the predicted extension lengths that are underpinning the estimates are not. As the figure shows, both with and without SDIP, the predicted extension lengths in [1] are higher than those in this study by about 2 months. This finding illustrates a systematic difference between the approaches to calculating predicted extension lengths in [1] and in the current study. In [1], CNA estimated the predicted length of sea duty extensions by averaging predicted extension lengths only among sailors who were predicted to extend or who had a predicted likelihood of extending of at least 50 percent. This approach was taken in order to have the model's predictions more closely replicate the extension behavior observed in the raw data. Here, with the more appropriate sample refinements and variable definitions, we follow the standard approach of estimating predicted length of sea duty extensions by averaging predicted extension lengths among *all* sailors, even those with predicted likelihoods of extending of less than 50 percent. If those sailors who have low predicted likelihoods of extending also have low predicted extension lengths (conditional on extending), our current estimates for the average length of sea duty extensions should be shorter than those found in [1].



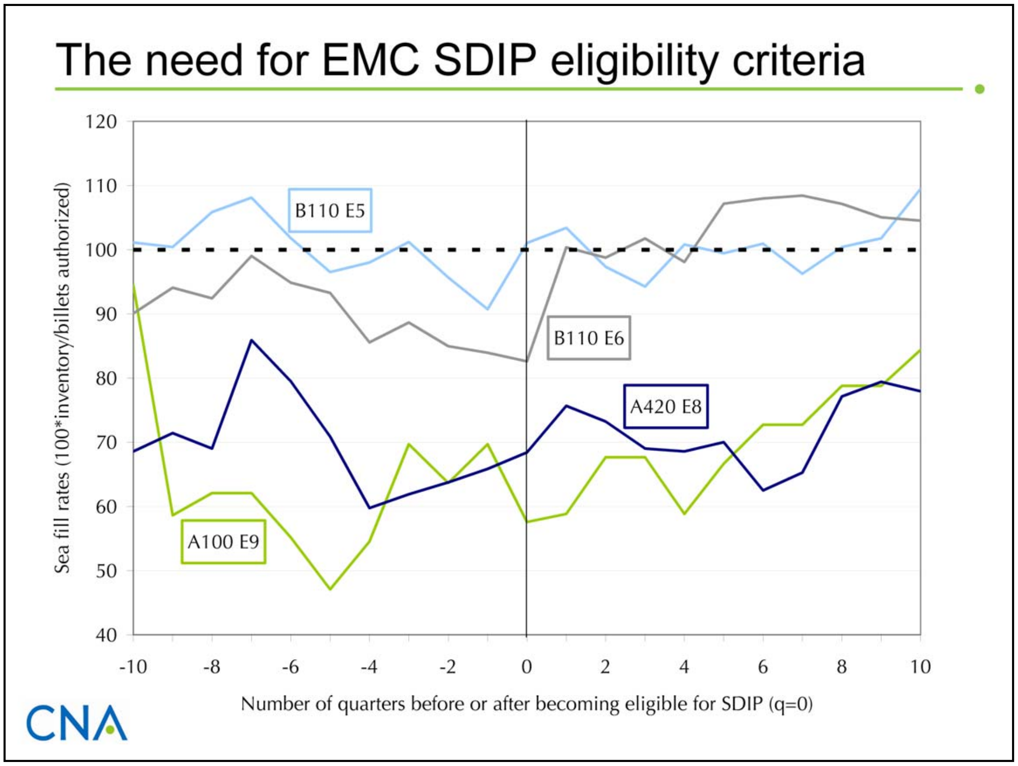
Thus far, we have shown that SDIP is effective at eliciting additional sea duty among eligible sailors and is more effective than estimates produced in [1]. Now, we reevaluate the effective price of an additional month of sea duty under SDIP.

The graph above shows the accounting price, $630, and the estimated effective price from [1], $1,700. Because our new estimates suggest that SDIP is more effective than previously thought, we also estimate a lower degree of economic rent of 19 percent compared with 60 percent, calculated in the same manner as discussed earlier. Lower economic rent translates into a lower effective price of just $790. (In the estimate of the new effective price, we have not removed the small number of SDIP contracts that we consider to be involuntary since the original accounting price includes these contracts. However, when we remove these contracts from both estimates, the results are qualitatively unchanged.)

In summary, our new estimates suggest that SDIP is more cost-effective than previously estimated in [1]. Therefore, SDIP is even more cost-effective relative to a change in the sea pay table. As in [1], the estimated effective price of an additional month of sea duty paid under sea pay is at least $1,000, but probably closer to $2,600.



Our statistical analysis supports the hypothesis that the SDIP program has significantly improved sea manning in the eligible ratings and paygrades, and it shows that SDIP is even more cost-effective than found in [1]. The program's effectiveness, however, can be bolstered by pursuing some SDIP best practices. In particular, in this section we consider when EMCs should be added to or removed from SDIP eligibility (and what should drive that decision) as well as what factors should be considered when setting SDIP payment rates.



The figure above demonstrates the need for clearly defined EMC SDIP eligibility criteria. It shows sea fill rates, measured as 100 times the ratio of sea inventory to billets authorized (BAs), for some of the EMCs and paygrades that gained eligibility during our sample period. Because these EMCs became eligible at different times, we focus on the data in the quarter in which the EMCs became eligible—quarter zero. Observations to the left and to the right of zero are before and after, respectively, the EMC became eligible for SDIP. The dashed horizontal black line corresponds to 100 percent sea manning, where sea inventory and BAs are equal. In the figure, we focus on four EMC-paygrade groups: A100 E9, A420 E8, B110 E5, and B110 E6. (For a rating-EMC crosswalk, see the appendix.) We chose these EMC-paygrade groups because they have reasonably large sample sizes (otherwise, small changes in inventory or BAs can lead to large changes in the fill rate), they do not lose eligibility during our sample, and they represent the sea fill rate behavior in pre- and post-SDIP eligibility that is generally found across all eligible EMCs and paygrades.

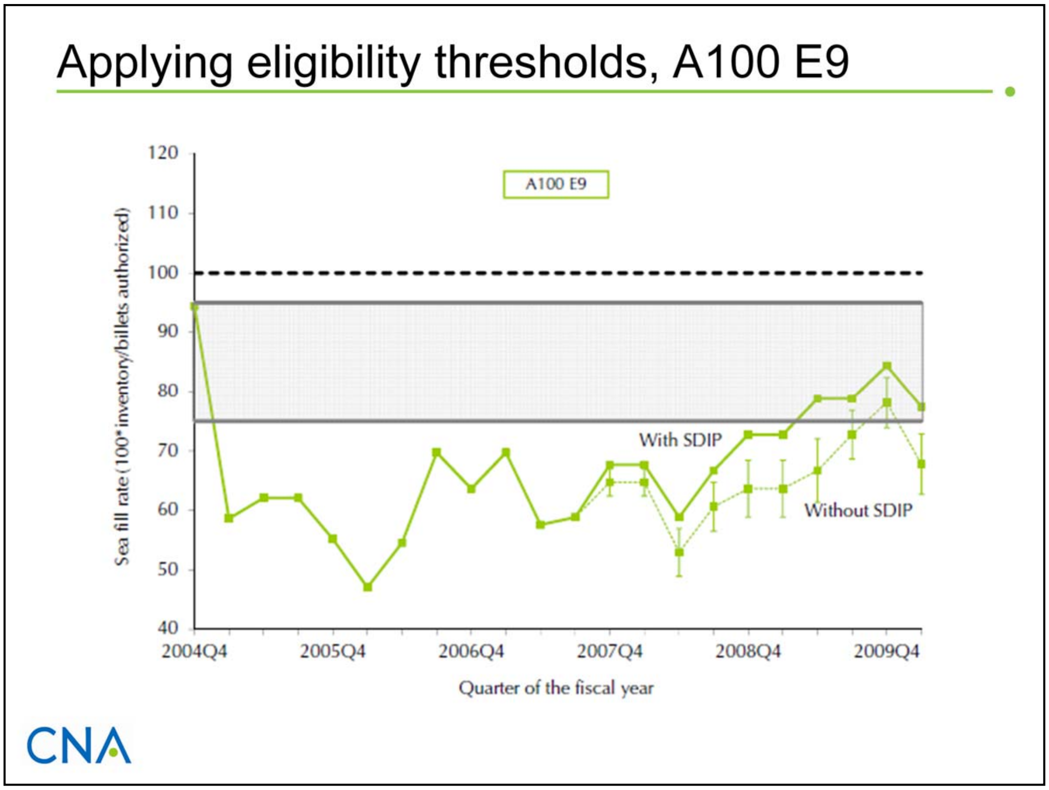
It is clear from this figure that there is a great deal of variation in pre-SDIP-eligibility sea fill rates. Specifically, in the last quarter before gaining SDIP eligibility, sea fill rates in these EMC-paygrade groups ranged from a low of 66 percent (for A420 E8) to a high of 91 percent (for B110 E5). (For comparison, Navy-wide sea fill rates were roughly 100 percent when SDIP began and fell to 96 percent by the end of our sample, December 2009.) While this figure is surely an oversimplification of the EMC SDIP eligibility decision—N130 or Enlisted Community Managers may have other information, pertaining to future changes in inventory or BAs, that could explain some of this variation—it does suggest that creating some business rules as to when EMCs gain (and lose) SDIP eligibility is warranted. In the next few slides, we examine potential business rules and how they might be used.

Business rules for EMC SDIP eligibility

- Conceptually, SDIP eligibility should be determined by how sea fill rates compare with some thresholds, where these thresholds reflect an “acceptable” level of risk due to undermanning at sea
  - If sea fill rate is below lower threshold, eligibility is turned “on”
  - If sea fill rate is above upper threshold, eligibility is turned “off”
- Acceptable levels of risk, and the exact level of these thresholds, should be determined by the Navy, taking into consideration
  - Trade-off between increasing sea manning in one EMC vice another
  - How undermanning at sea affects mission readiness

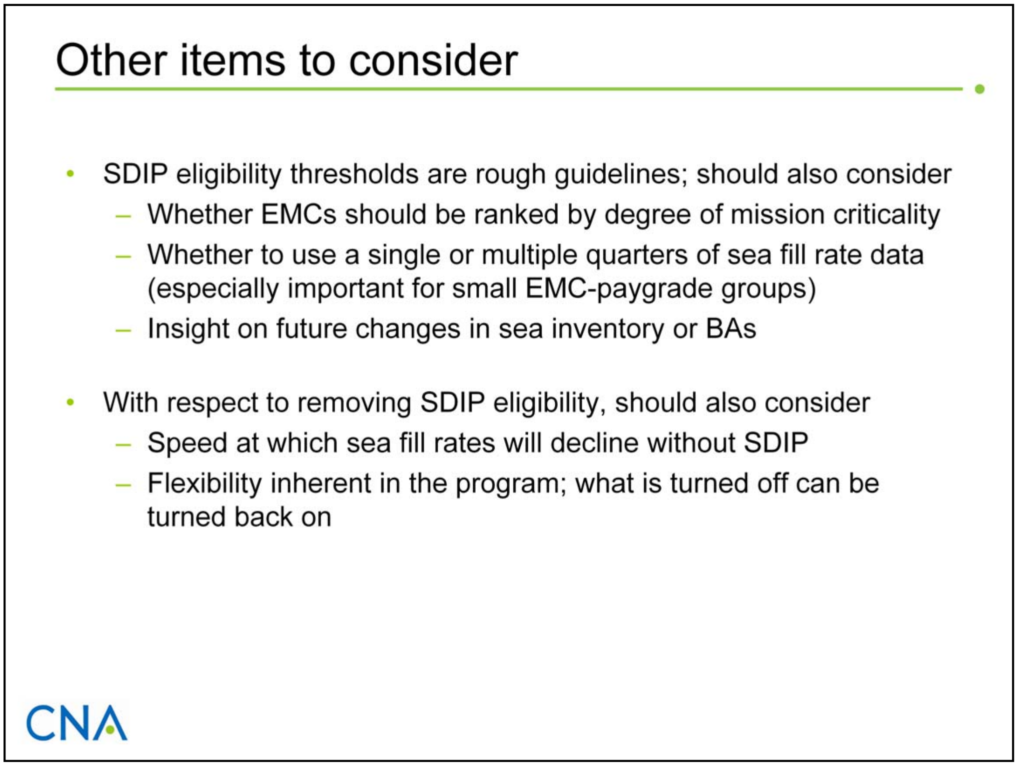
Conceptually, designing business rules for EMC SDIP eligibility should be driven by comparing sea fill rates with some thresholds. These thresholds should reflect a so-called acceptable level of risk due to undermanning at sea. If an EMC-paygrade’s sea fill rate is below the lower threshold, it should be eligible for SDIP. Conversely, if an EMC-paygrade’s sea fill rate is above the upper threshold, it should be ineligible for SDIP.

What level of risk is acceptable, as well as the exact values of these thresholds, is something that the Navy should determine, taking two things into account. First, given the constrained fiscal environment, there is a trade-off between increasing sea manning in one EMC vice another. Second, SDIP eligibility thresholds should consider, to the extent possible, the relationship between undermanning at sea and mission readiness. A review of historical sea manning rates by EMC around the time of a change in PSTs might reveal what sea fill rates the Navy has historically found to be acceptable versus unacceptable. This could be explored in a future study.



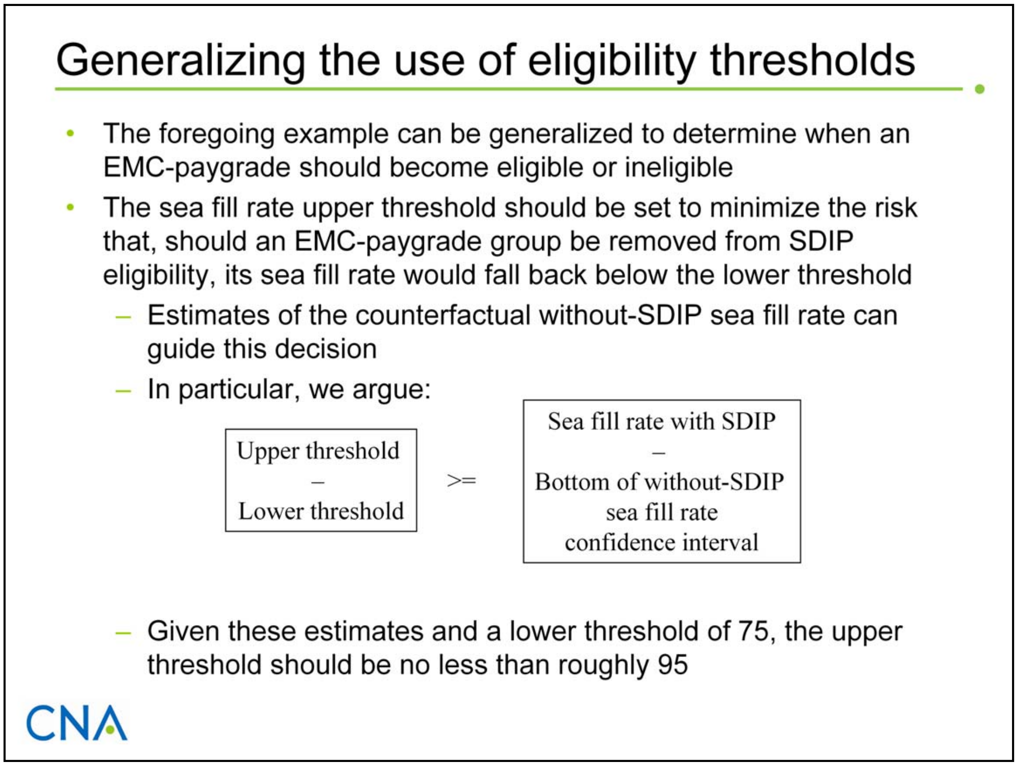
Here, we demonstrate how these thresholds could be used in practice, along with empirical estimates of the effectiveness of SDIP. Using A100 E9 as an example, the figure above shows sea fill rates by fiscal year quarter. The heavy green line shows the sea fill rate with SDIP, and the thin green line shows the counterfactual sea fill rate without SDIP (estimated in [1]). The two lines are equal until the first SDIP contracts are executed in the fourth quarter of FY 2007. Since the without-SDIP sea fill rates are estimates, we include 95-percent confidence intervals (vertical bars). A similar figure appeared in [1] where the confidence intervals were used to show strong statistical evidence that the sea fill rates with and without SDIP are different from one another (because the confidence intervals on the without-SDIP sea fill rate and the heavy line for the with-SDIP sea fill rate do not intersect). Here, we use the confidence intervals again but in a different way.

In the figure above, we set the EMC SDIP eligibility thresholds at 75 and 95 percent. (This is purely for the purposes of this example; we do not mean to imply that these specific thresholds are what the Navy should choose.) At the time the EMC-paygrade became eligible for SDIP (March 2007), A100 E9 sea fill rates were below the lower 75-percent threshold. Since becoming eligible for SDIP, the A100 E9 sea fill rate rose. Indeed, from the second quarter of FY 2009 through the first quarter of FY 2010, the sea fill rate exceeded the lower threshold. Were this EMC-paygrade group removed from eligibility, the sea fill rate would return to the without-SDIP sea fill rate. Given the size of the confidence intervals, we cannot rule out the possibility that the without-SDIP sea fill rate would eventually fall below the lower 75-percent threshold.



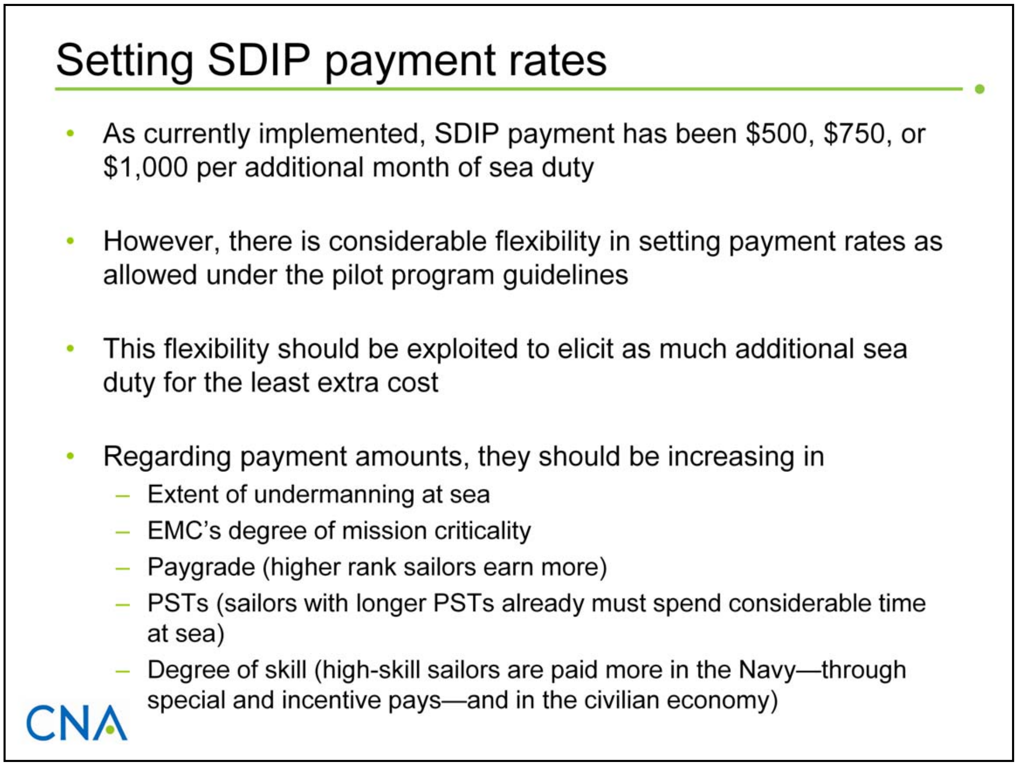
EMC SDIP eligibility thresholds should be thought of as rough guidelines for determining which EMCs should be eligible for SDIP. The decision should also address other issues. First, since it is likely that more EMCs will have sea fill rates below the lower threshold than can be funded, mission criticality could factor into the decision to offer SDIP. Second, one must decide whether eligibility will be determined by one or more quarters of sea fill rate data—the latter reflecting persistence in the trend. This is especially important for small EMC-paygrade groups because even a small change in their inventory or BAs could create deceptively large swings in their fill rates. Finally, in applying these thresholds, any known future changes that will affect sea fill rates (e.g., retention decisions, near-term PRDs, advancements, or changes to the billet structure) should also be considered.

When deciding whether to remove an EMC from SDIP eligibility, there are two additional items to consider. First is the speed at which sea fill rates will decline without the SDIP incentive. This is driven by the number of sailors on SDIP contracts and the remaining duration of those contracts when weighing whether to keep the EMC on SDIP or to remove it. If the SDIP sailors are near the beginning of their SDIP contracts, the fall in sea fill rates if SDIP eligibility is removed will be delayed relative to whether those SDIP sailors are near the ends of their SDIP contracts. Second, the SDIP program design incorporates a good deal of flexibility in terms of changes to the group of eligible EMCs. This flexibility means that turning off eligibility for an EMC does not have to be permanent. Instead, eligibility could be turned off for a short while if sea fill rates are expected to rise (for reasons other than SDIP) and turned back on when that is no longer the case. This flexibility also acts as a buffer when it comes to turning off SDIP eligibility since an EMC can be made eligible for SDIP again relatively easily if it is decided that the absence of the incentive is detrimental to that EMC’s sea manning.



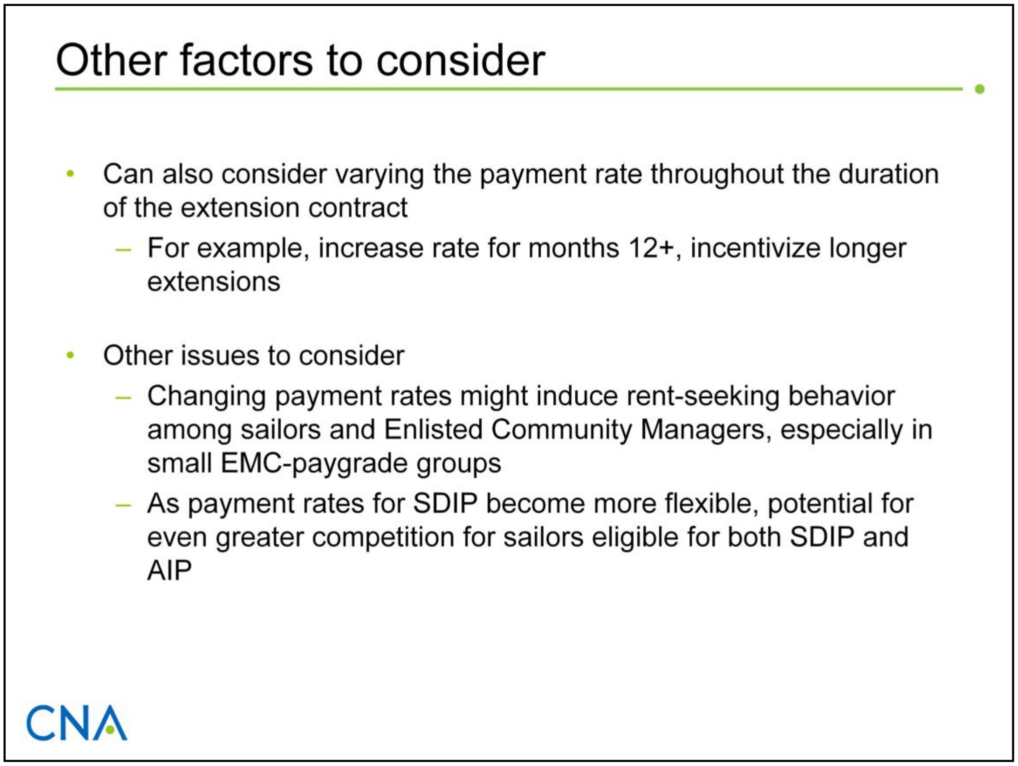
The discussion on the previous slide focuses on whether an EMC-paygrade group should be removed from SDIP eligibility, after having been made eligible. Similar logic can be used for determining whether SDIP eligibility should be granted in the first place; sea fill rates for a candidate EMC-paygrade group can be assessed and monitored to detect when they are in danger of being sufficiently undermanned at sea to require SDIP. Also, the figure in the previous slide can be used to track when a sea fill rate has risen enough (so that it exceeds the upper threshold) that the EMC no longer needs SDIP.

Deciding where to set the upper threshold can be informed by counterfactual without-SDIP sea fill rates. Specifically, the upper threshold can be chosen so that it minimizes the risk that, should an EMC be removed from SDIP eligibility, its sea fill rate would fall below the lower threshold. This results in a somewhat formulaic approach to choosing the upper threshold. Referring back to the figure on the previous slide, the upper threshold should be set so that the difference between it and the lower threshold is at least as large as the difference between the with-SDIP sea fill rate and the bottom of the confidence interval on the without-SDIP sea fill rate. For the A100 E9 group shown in the figure, this difference is no larger than 16 across the quarters in which the EMC-paygrade group is eligible for SDIP. So, if the lower threshold is set at 75, the upper threshold should be set no lower than 92 (75 plus 17) in order to minimize the risk that sea fill rates will once again fall below the lower threshold after SDIP is removed. Looking across all EMC-paygrade groups, there is some variation in what the estimates would imply for where the upper threshold should be set. In general, given a lower threshold of 75, the estimates suggest an upper threshold of no less than approximately 95.



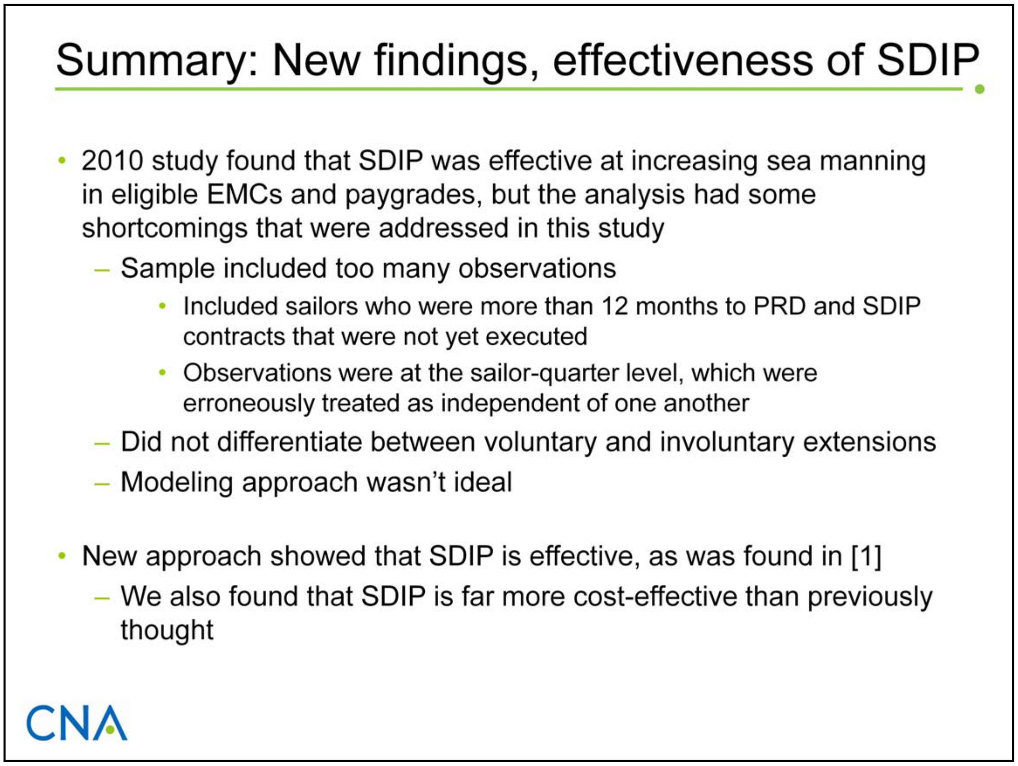
The second SDIP best practices issue we consider is the setting of payment rates. In the program’s current implementation, SDIP payment amounts have taken on values of $500, $750, or $1,000 of additional compensation per additional month of sea duty. However, the pilot program has a considerable amount of flexibility in setting payment rates. In an effort to make SDIP as effective, and therefore as cost-effective, as possible, this flexibility in setting the payment rates should be exploited. Here, we discuss some of the many factors to consider when setting payment rates for SDIP.

We argue that payment rates should be increasing in several dimensions. First, SDIP payment amounts should increase with the extent of undermanning at sea; the larger the need for more sailors at sea, the greater the incentive should be. Second, the payment amount should increase in mission criticality to incentivize additional sea duty in the places that most affect readiness. Third, sailors in higher paygrades should be paid more than lower rank sailors, holding all else equal. Because base pay increases with rank, higher rank sailors will require larger incentives to commit to additional sea duty. Fourth, sailors in EMCs with longer PSTs, who are already required to spend a considerable amount of time at sea, will require larger incentives as well. Finally, the incentive should increase with a sailor’s (or EMC’s) degree of skill. High-skill sailors get paid more in the Navy (through special and incentive pays) and in the civilian economy as well, so they will require a larger incentive to serve longer sea tours. In future work, we could explore what empirical implications our model would have for identifying optimal payment rates for SDIP.



In addition, we offer that the payment rate can change throughout the course of a contract, so that the first part of the contract earns one monthly rate and the second part earns another monthly rate. In particular, this could be used to incentivize longer extensions if the payment rate increases, say, for months 12 and higher. There are other practical issues to consider, including the fact that changing SDIP payment rates over time can lead to rent-seeking behavior. Especially in smaller EMC-paygrade groups, sailors and their Enlisted Community Managers have an incentive to hold out on signing an SDIP contract if they believe the payment rates might be increased following a low take-up of SDIP contracts. This behavior is limited by the fact that sailors have a finite period in which to apply for SDIP (for extension contracts, this is the 12 months before their PRDs); however, the risk remains.

One final consideration is that, as SDIP payment rates become more flexible, the potential arises for even greater competition for sailors who are eligible for both SDIP and Assignment Incentive Pay (AIP). AIP awards sailors extra compensation for taking hard-to-fill shore billets, and the additional monthly compensation is determined through an auction. In some cases, SDIP and AIP compete for sailors who are eligible for both incentives. If an EMC is undermanned both at shore and at sea, the EMC might be eligible for both incentives. In that case, AIP and SDIP work against one another. If SDIP payment amounts increase (i.e., in response to increasing difficulty in manning an EMC at sea), the potential for this competition may also increase.



Similar to the 2010 study [1], we find that SDIP was effective at increasing sea manning. In this study, we address some of the shortcomings of the 2010 study, such as the following:

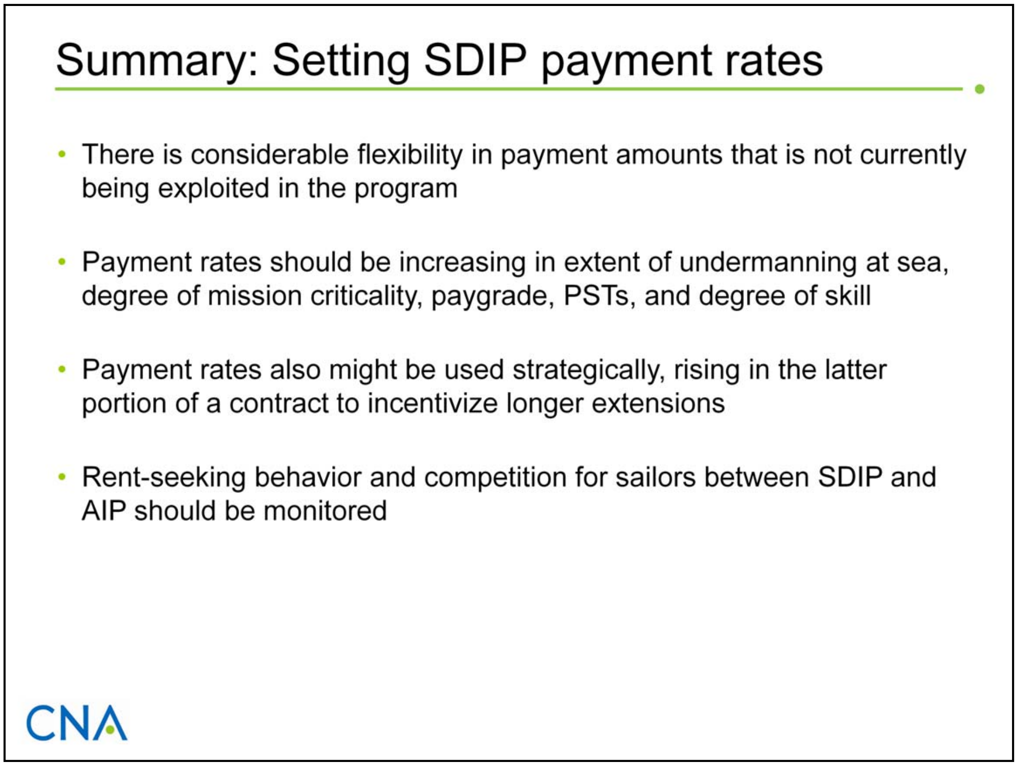
- The sample included too many observations, including sailors who were outside the 12-month window before PRD and SDIP contracts that were not executed before the end of our sample window.
- The approach did not differentiate between voluntary and involuntary extensions.
- The model treated the extension decision and the extension length decision independently, whereas these decisions are likely to be made jointly.

This study addressed these shortcomings and produced additional evidence on the effectiveness of SDIP in increasing manning at sea in eligible ratings and paygrades. Indeed, we find here that SDIP is effective, as was found in [1]. In addition, we find that SDIP is even more cost-effective than was found in [1]. Therefore, our analysis suggests that SDIP is an even more attractive alternative to other types of compensation that incentivize sea duty, or to increases in PSTs, than it was previously thought to be.

Summary: Determining EMC SDIP eligibility

- Thresholds for sea fill rates should be determined, given the level of risk the Navy is willing to accept in the form of undermanning at sea
- Important implementation issues include
  - Whether EMCs are ranked by mission criticality
  - How many quarters of sea fill rate data are used to decide eligibility
  - How future changes to sea inventory and BA might affect sea fill rates independently from SDIP

Regarding EMC SDIP eligibility, we find a clear case for creating business rules given the large degree of variability in pre-SDIP sea fill rates among SDIP-eligible EMC-paygrade groups. Sea fill rate thresholds should be determined by the Navy, where these thresholds reflect the level of risk the Navy is willing to accept as a result of undermanning at sea. There are important implementation issues to consider. First, EMCs might be ranked by mission criticality in the eligibility decision. Second, a single quarter or multiple quarters of data might be used to determine whether a sea fill rate has crossed a threshold. Third, the eligibility decision should take into account how future changes in sea inventory and BAs might affect sea fill rates independently from the effect of SDIP.



Finally, regarding SDIP payment rates, there is considerable flexibility allowed under the SDIP pilot program that currently is not being exploited. We offer that changing payment amounts might make the program more cost-effective. We suggest that payment rates should be increasing in the extent of undermanning at sea, degree of mission criticality, paygrade, PST, and degree of skill. Also, payment rates might be used strategically to incentivize longer sea tours, by increasing the monthly payment amount for the last part of a contract. Finally, we advise that rent-seeking behavior among sailors and Enlisted Community Managers, as well as increased competition for sailors between the SDIP and AIP programs, should be monitored.

Appendix

SDIP eligibility by rating, EMC, paygrade (PG), NEC, and date of authorization

				Date of authorization												
				2007		2008	2009			2010			2011			
Rating	EMC	PG	NEC	15-Mar	25-Jun	27-Aug	2-Apr	23-Jul	10-Nov	17-May	25-Jun	1-Oct	3-Jan	8-Jul	10-Aug	1-Nov
Surface ratings																
DC	B200	E8	4811	–	–	–	–	$500	$500	–	–	–	–	–	–	–
		E9	All	–	$750	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	
EM	B210	E5	All	–	$500	–	–	–	–	–	–	–	–	–	–	–
EN	B110	E5	All	–	$500	–	–	–	–	–	–	–	–	–	–	–
		E5	4366, 4398[a]	–	–	$500	$500	$500	$500	$500	–	–	–	–	–	–
		E6	All	$500	$500	–	–	–	–	–	–	–	–	–	–	–
		E6	4366, 4398[a]	–	–	$500	$500	$500	$500	$500	–	–	–	–	–	–
		E8	All	–	–	$750	$750	$750	$750	$750	$750	$750	$750	$750	$750	–
		E9	All	–	$750	$750	$750	$750	$750	$750	$750	$750	$750	$750	$750	–
FC(AEGIS)	B311	E5	All	$500	$500	$750	$750	$750	$750	$750	$750	$750	$750	$750	$750	–
		E6	All	–	$500	$500	–	–	–	–	–	–	–	–	–	–
		E7	All	–	$750	$500	–	–	–	–	–	–	–	–	–	–
		E8	1104[b]	–	$750	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	–
		E9	1104[b]	–	$750	$500	–	–	–	$500	$500	$500	$500	$500	$500	–
GS	B120	E8	All	–	–	–	–	$750	$750	$750	$750	$750	$750	$750	$750	$750
GSE	B121	E7	All	–	–	–	–	$500	$500	$500	$500	$500	$500	$500	$500	$500
GSM	B122	E7	All	–	–	–	–	$500	$500	$500	$500	$500	$500	$500	$500	$500
MM(SW)	B130	E7-E8	All	–	–	–	–	$500	$500	$500	$500	$500	$500	$500	$500	–
		E9	All	–	$750	$1,000	$1,000	$750	$750	$750	$750	$750	$750	$750	$750	–
OS	B440	E5-E6	0318, 0324	–	–	–	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500
		E6-E7	0319	–	–	–	$750	$750	$750	$750	$750	$750	$750	$750	$750	$750
STG	B340	E5-E9	0527	–	–	–	–	–	–	–	–	–	–	$750	$750	$750
Aviation ratings																
AB	A100	E9	All	$750	$750	$750	$750	$750	$750	$750	$750	$750	$750	$750	$750	–
ABE	A101	E8	All	$750	$750	$750	$750	$750	$750	$750	$750	$750	$750	$750	$750	–
ABF	A102	E8	All	$750	$750	$750	$750	$750	$750	$750	$750	$750	$750	$750	$750	–
ABH	A103	E7	All	–	$750	–	–	–	–	–	–	–	–	–	–	–
		E8	All	$750	$750	$750	$750	$750	$750	$750	$750	$750	$750	$750	$750	–
AO	A420	E8	All	–	$750	$750	$750	$750	$750	$750	$750	$750	$750	$750	$750	$750
AWS	A510	E4-E6	7886	–	–	$500	$500	$500	$500	–	–	–	–	–	–	–
Submarine and nuclear ratings																
All nuc. ratings	D1xx	E8-E9	3302	–	–	–	–	–	$750	$750	$750	$750	$750	$750	$750	$750
ELT(SS)	D133	E5-E6	3356, 3366	–	–	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500
ET(SS)NAV	C121	E6	14NV	–	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500
		E7-E9	14NV	–	$750	$750	$750	$750	$750	$750	$750	$750	$750	$750	$750	$750
ET(SS)[c]	C121, C126	E5-E6	All	–	–	–	–	–	–	–	–	$500	$500	$500	$500	$500
MM(SSW)	C151	E7	All	–	$750	$750	$750	$750	$750	$750	$750	$750	$750	$750	–	–
MT	C180	E8	All	–	–	–	–	–	–	–	–	–	–	–	$500	$500
Medical ratings																
HM	C065	E5-E9	8402	–	–	–	–	–	–	–	–	$750	$750	$750	$750	$750
		E5-E9	8403, 8494	–	–	–	–	–	–	–	–	–	$750	$750	$750	$750
		E5-E9	8425	–	–	–	–	–	–	–	–	–	$500	$500	$500	$500

Notes: [a]Sailors with NEC 4398 were removed from SDIP eligibility as of 17 May 2010. [b]Sailors were required to have NEC 1104 to be eligible for SDIP as of 17 May 2010. [c]Eligibility is restricted to Rating Control Numbers 1003 and 1004 which correspond to maintainers instead of operators.

The table above provides detailed information on the timing of SDIP eligibility and payment amounts by EMC, paygrade, and NEC. (The authors thank Mr. Gary Grice of N120 for providing these data.)

References

[1] Molly F. McIntosh and William C. Komiss. *Evaluating Sea Duty Incentive Pay*. CNA Research Memorandum D0023216.A2/Final. Sep. 2010.

[2] Martha Koopman and David Gregory. *Incomplete Tours: Causes, Trends, and Differences*. CNA Annotated Briefing D0016916.A2/Final. Nov. 2007.

[3] Heidi Golding and Henry Griffis. *Options for Sea Pay Reform*. CNA Annotated Briefing A4798004300. Apr. 1998.

[4] Heidi Golding and David Gregory. *Sailors' Willingness To Complete Sea Tours: Does Money Matter?* CNA Research Memorandum D0006886. Dec. 2002.

This page intentionally left blank.

DAB-2012-U-000152-Final

CNA ANALYSIS & SOLUTIONS

4825 Mark Center Drive, Alexandria, VA 22311-1850 703-824-2000 www.cna.org