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**The Financial Cost and Benefits of Multi-Year  
Procurements**

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Bruce R. Harmon

June 2013

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IDA Document NS D-4895

Log: H 13-000635

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# **The Financial Cost and Benefits of Multi-Year Procurements**

**Scot A. Arnold**  
**Bruce R. Harmon**

- What is the benefit to the government of using a multi-year procurement (MYP)?
  - Up-front price discount to alternative series of single-year procurements (SYP)
  - Added incentive for contractor to seek further recurring cost reductions
- What is the cost to the government of using an MYP?
  - Loss in congressional appropriation flexibility
  - Fewer opportunities to negotiate prices – higher recurring cost information asymmetry

## IDA | Description of Two Models

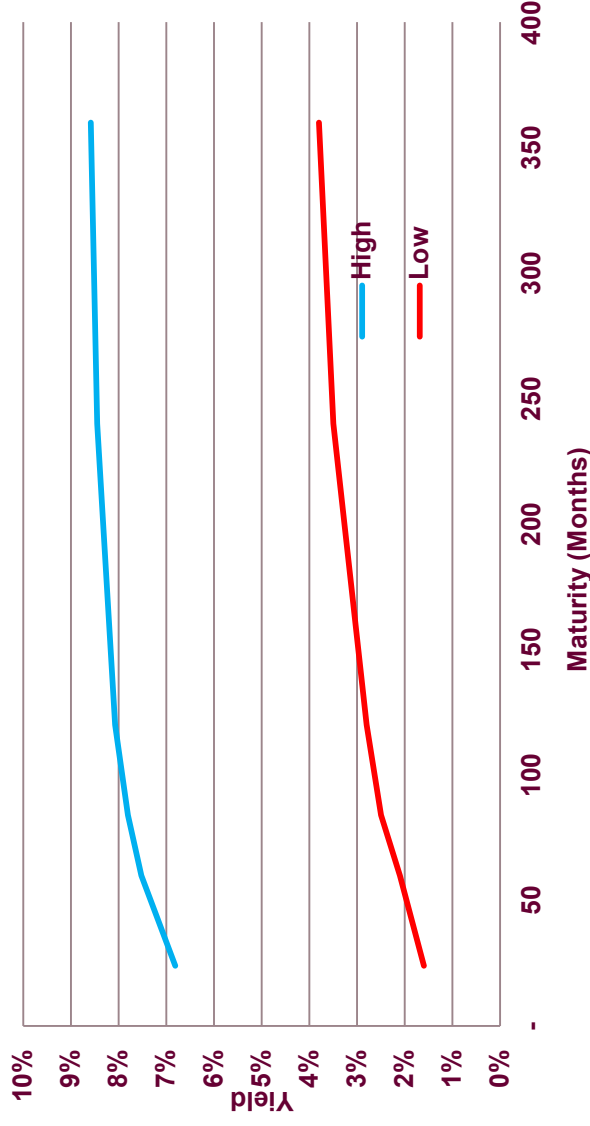
- Discounted cash flow analysis of contracts
- Model 1 is a comparative cost-benefit analysis quantifying the change in pricing and appropriation flexibility between different acquisition strategies
- Model 2 is the contractor's investment decision model to assess the implied cost reduction incentive within a procurement strategy

## IDA | Model 1 Details

- Scenario analysis
  - SYP case: series of up to 30 lot buys, e.g., 10-unit lot with a  $T_1$  unit cost of \$10
  - MYP case: series of SYP and MYP lot buys
- Economic and business factors
  - Inflation, interest, and discounting
  - Inflation required for nominal rates
  - Two interest rate regimes: high (synthetic) and today's low
  - Synthetic yield curve from a one-factor model
  - Discount rate tenor tied to program length



## Interest Rate Regimes



- High rate 1970–2005 average used to calibrate one-factor model
- Low rate January 2013 Treasury curve (FRED)\*

\* Federal Reserve Bank of St. Louis Economic Data

## IDA | Model 1: Economic and Business Factors

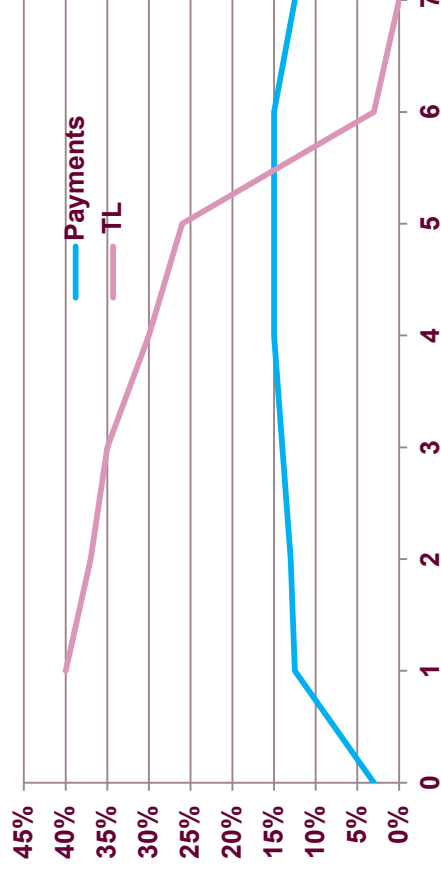
- MYP savings
  - Defined as a percentage reduction in cost relative to the SYP alternative
  - Applied to all of the MYP lots; e.g., a 10% savings relative to the five 10-unit lots in the SYP alternative is applied to all 50 units in the MYP case
- Learning and cost reductions
  - All cost reductions assumed to be revealed to government, with or without a lag, for both MYP and SYP contracts (*ex post* learning effect)
  - SYP prices incorporate *ex post* learning annually

## IDA | Model 1: Economic and Business Factors (Cont.)

- Learning and cost reductions (cont.)
  - MYP prices incorporate learning every five years
  - Assumes one learning curve for entire program
- Advance procurement (AP) and termination liability (TL)
  - AP is 3% of the contract cost
  - The TL is treated as a reserve
  - The cost of the TL = TL amount \* cost of capital (at matched duration)

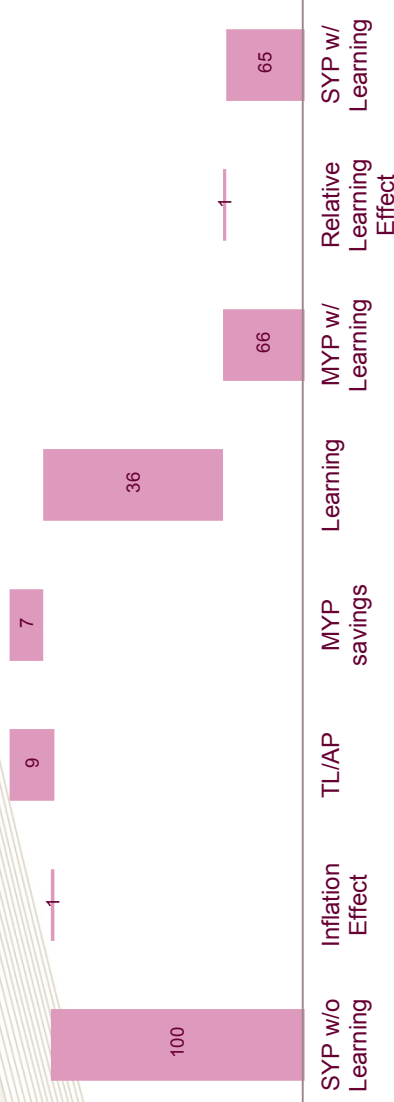
# IDA | AP, Payment Schedule, and TL

	<u>SYP</u>		<u>MYP</u>	
	<u>Payments</u>	<u>TL</u>	<u>Payments</u>	<u>TL</u>
Advanced	3%		3%	
Year 1	30%	34%	13%	40%
Year 2	40%	24%	13%	37%
Year 3	27%	0%	14%	35%
Year 4			15%	30%
Year 5			15%	26%
Year 6			15%	3%
Year 7			13%	0%

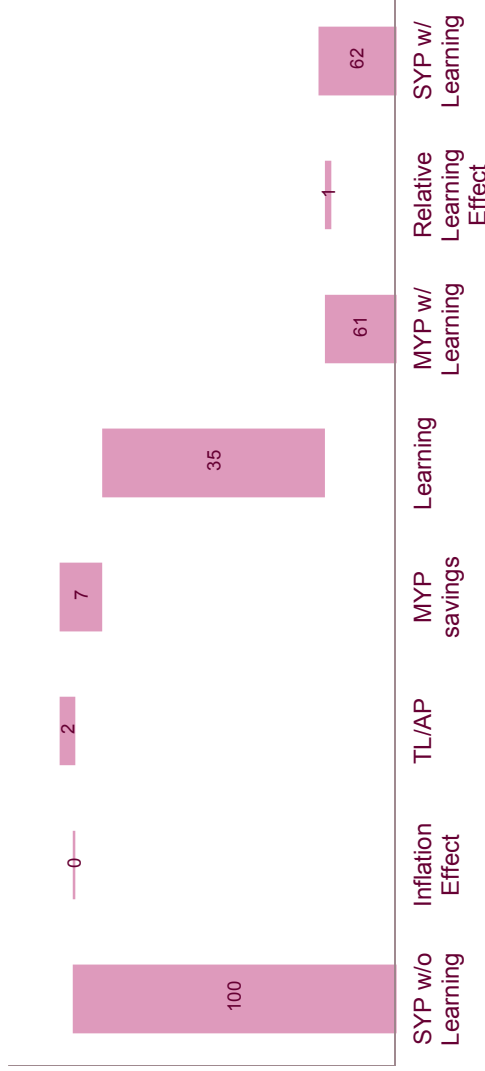


# IDA | Model 1 Scenario Analyses

## High Interest

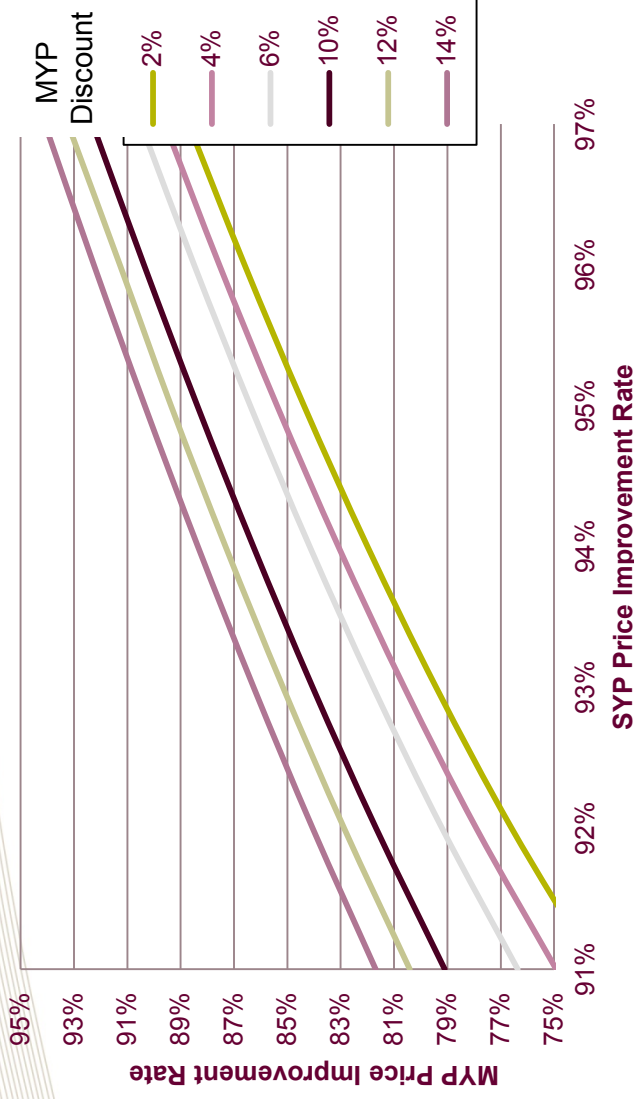


## Low Interest



- Strategies: 15 SYPs vs. 5 SYPs/2 5-yr. MYPs
- Inflation: small effect – most important cash flows get lowest inflationary weight
- TL/AP - sensitive to interest rates
- MYP savings are set to 10%
- Learning set to 95% for both cases
- SYPs get learning effects earlier

# IDA | MYP Decision Rules: Relative Learning vs. Discount

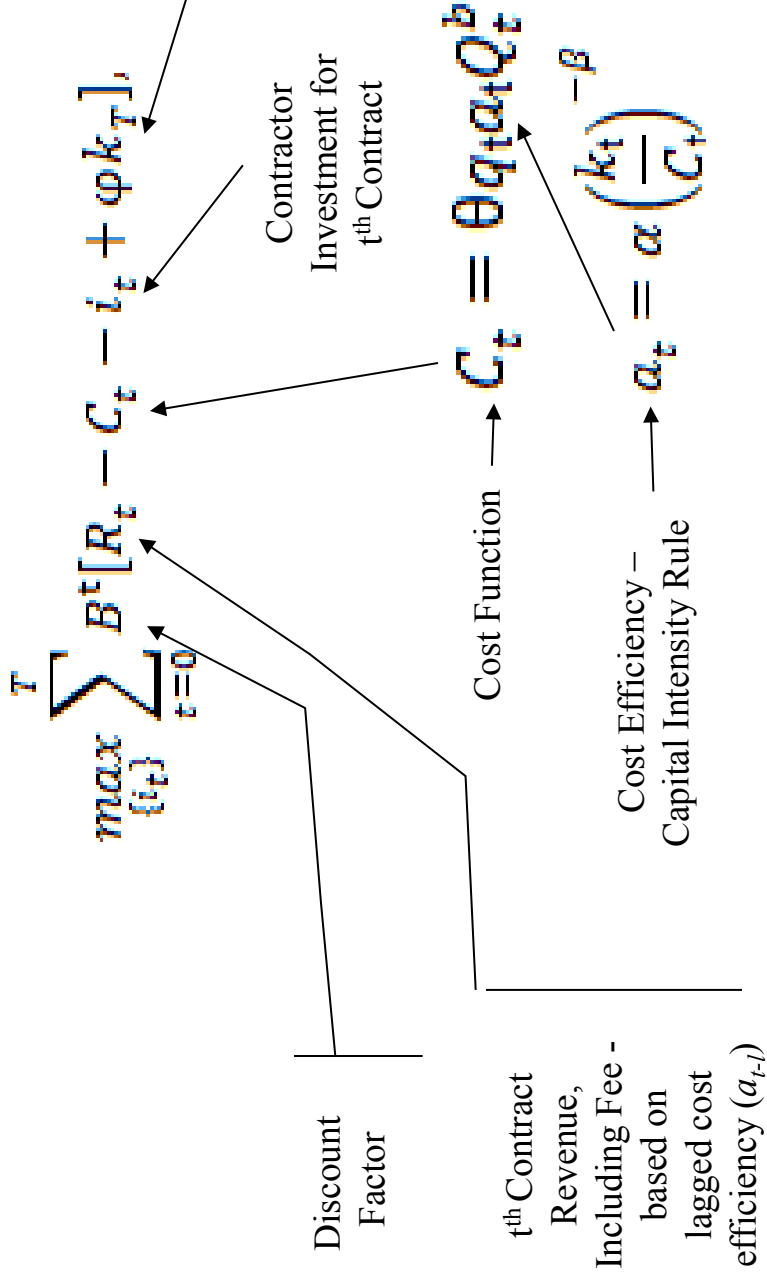


- Each line is the indifference curve between an SYP and MYP strategy, given the MYP discount
- If the MYP is expected to reduce re-pricing opportunities the chart shows the minimum discount required for the two acquisition plans to have equal NPV
  - A SYP plan with a 91% price improvement curve is equal to an MYP with an 82% curve and a discount of 14%
  - At the other extreme – a SYP plan with a 97% curve is equal to a MYP plan with a 94% curve and the 14% discount

# IDA | Model 1 Conclusions

- The opportunity cost associated with the AP and TL is a tax on the MYP savings.
- In low interest rate regimes, these costs are notionally small, but in higher interest rate regimes, they can offset the entire savings.
- The loss of the re-pricing option with an MYP means that the choice of whether or not to use an MYP is sensitive to the expectation for learning.
  - If high learning is expected with an SYP strategy, then even more learning must be attainable with the MYP strategy in addition to the MYP discount.
  - Although there is some tradeoff between the MYP discount and the expected realized learning from the MYP strategy, the discount most likely needs to be well in excess of 5–10%.
- Consider the case where the expected learning from the SYP strategy is 91%. The lost re-pricing option from the MYP implies a required price improvement of about 75% with a 4% MYP discount. This requirement is reduced to 82% with a 14% MYP discount.

- Contractor views acquisition forecast and plans investment decisions to maximize NPV across all T contracts:

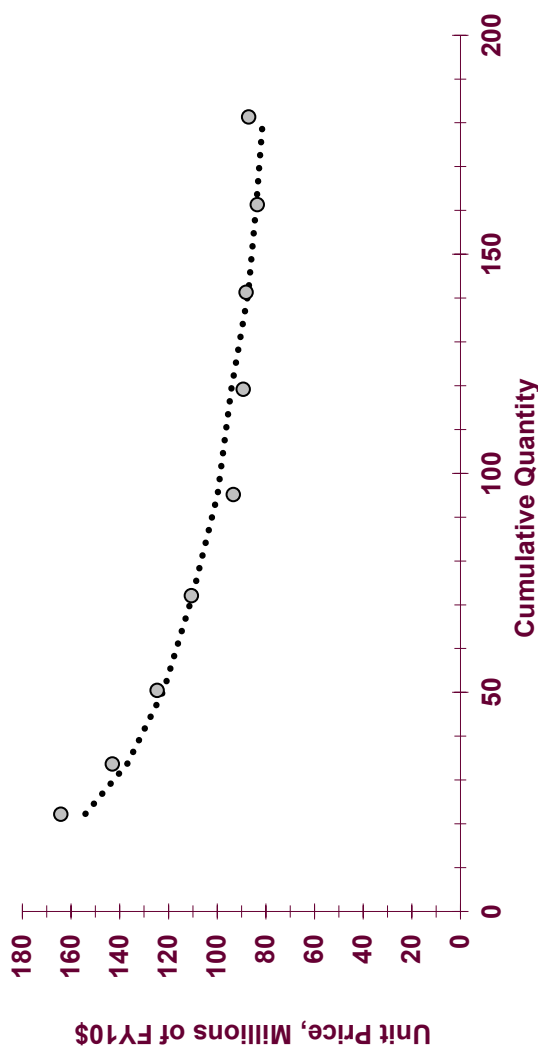




# IDA | Model Calibration with F-22 Acquisition

- Parameters were estimated iteratively by fitting model outputs to F-22 unit costs using program variables (lot quantities,  $T_1$ , and contractor investments) and other data relevant to the program.
- The DD Form 1547 database was used for corroborative analyses

$T_1$ cost ( $a_0$ )	\$325 Million (FY10)
Exogenous learning curve ( $b$ )	82% ( $b = -.286$ )
Regulatory lag period ( $\ell$ )	2 years
Facilities capital mark-up ( $\gamma$ )	17.5%
Annual discount factor ( $B$ )	0.85 (a discount rate of 17.6%)
Coefficient on capital ( $\beta$ )	0.15
Capital stock residual value ( $\varphi$ )	50%
Depreciation rate ( $\delta$ )	10% per year
MYP discount ( $\theta$ )	4%
Initial capital intensity ( $k_0/c_0$ )	20%
Initial contract fee (% of cost)	13%



## IDA | Model 2 Scenario Analyses

- Model 2 was used to estimate the relative effectiveness of the implied investment incentive in an MYP when compared to alternative procurement strategy scenarios.
- Four scenarios were examined, all using the same parameter values:
  - **Baseline MYP:** baseline production schedule and quantities with SYP for the first six lots and MYP for the final three lots (F-22 historical case).
  - **Baseline SYP:** baseline production schedule and quantities with SYP for the final three lots vice MYP in the base case.
  - **Extended 5 x 2 MYPs:** baseline production schedule through Lot 6 (FY 2006) followed by two 5-year MYP contracts with a production rate of 36 per year.
  - **Extended 10 SYPs:** baseline production schedule through Lot 6 (FY 2006) followed by 10 SYP contracts with a production rate of 36 per year.

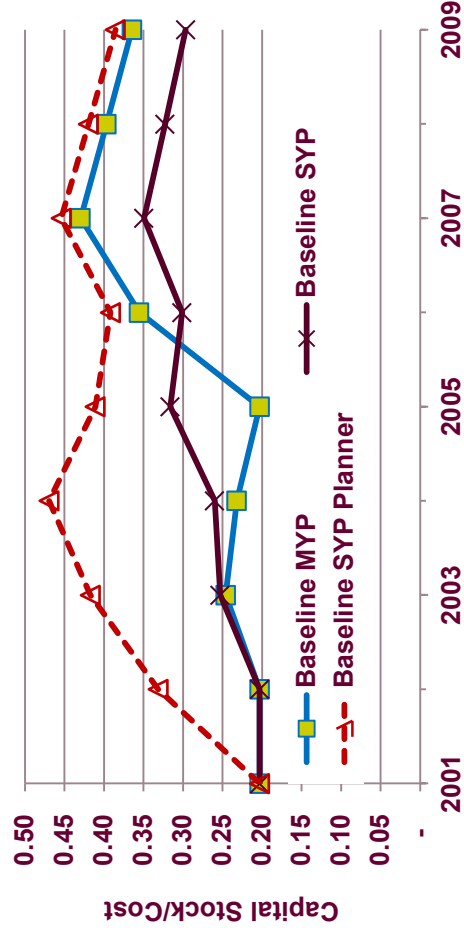
## IDA | Social Planner – First Best Case Investment

- In addition to these four scenarios, there were two benchmark scenarios: the baseline and extended SYP cases.
- These scenarios are called *Baseline SYP Planner* and *Extended 10 SYPs Planner*.
  - A social planner can see the future and thus can choose an investment plan to minimize the total cost of the program.
  - The planner solves the following:

$$\min_{\{i_t\}} \sum_{t=0}^T B^t [C_t + i_t - \phi k_T]$$

# IDA | Baseline Scenario Results

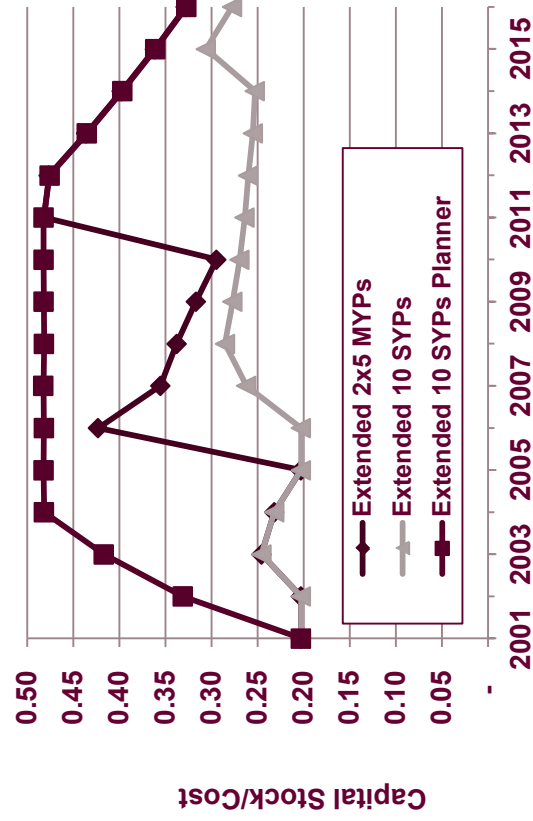
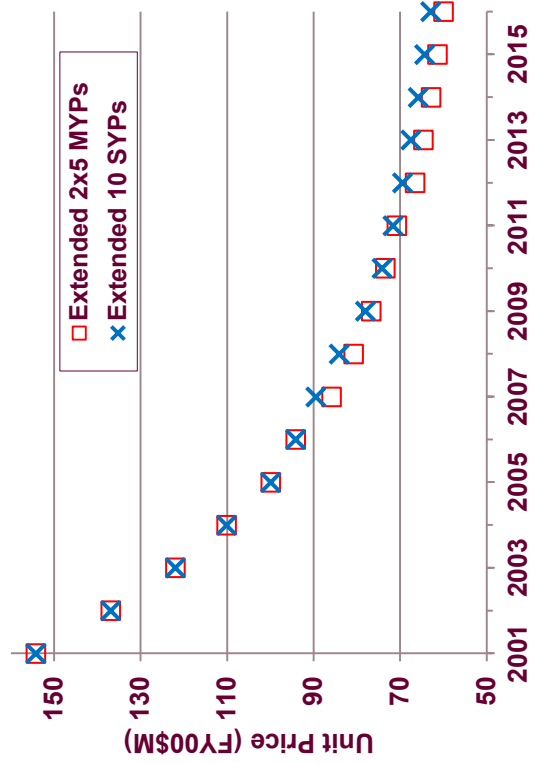
Output Value	Baseline MYP	Baseline SYP	Baseline SYP Planner
Unit price total program (FY10\$M)	103.5	103.3	101.3
Unit accounting cost, total program (FY10\$M)	88.7	89.5	86.0
Realized profit, total program	16.6%	15.5%	17.8%
Unit price, last 3 lots (FY10\$M)	84.1	84.2	82.8
Unit accounting cost, last 3 lots (FY10\$M)	68.9	73.2	71.0
Realized profit, last 3 lots	22.0%	15.0%	16.6%
Total investment (FY10\$M)	579	520	756
Contractor net present value (FY10\$M)	1,320	1,273	1,251



# IDA | Extended Scenario Results

## Output Value

	Extended 2x5 MYPs	Extended 10 SYPs	Extended 10 SYPs Planner
Unit price total program (FY10\$M)	80.7	82.6	79.6
Unit accounting cost total program (FY10\$M)	68.4	72.2	67.8
Realized profit, total program	17.9%	14.4%	17.4%
Unit price, last 10 lots (FY10\$M)	70.3	72.7	69.7
Unit accounting cost, last 10 lots (FY10\$M)	58.8	63.2	59.8
Realized profit, last 10 lots	19.5%	15.0%	16.6%
Total investment (FY10\$M)	1,303	1,050	1,614
Contractor net present value (FY10\$M)	2,010	1,820	1,729



# IDA | Model 2 Conclusions

- Model 2 shows that the added incentive effect from the longer regulatory lag in an MYP leads to more cost reduction investment by the contractor.
- The problem for contracting authorities is whether these reductions can be factored into lower contract prices.
- Model 1 and 2 agree: without the opportunity to negotiate new prices, the savings will be retained by the contractor.
- Residual cost reductions made in the last contract of a series are fully retained by the contractor.
- Only additional contracts following an MYP give the government the opportunity to capture the additional cost savings that flow from contractor incentives.
- With anticipated future MYP contracts, Model 2 raises the possibility that contractors may elect to postpone cost reductions until that point in the future.
- Given the strong investment incentive embedded in the MYP contract, the government should anticipate those additional cost savings as it is negotiating the price.

## IDA | Summary and Conclusion

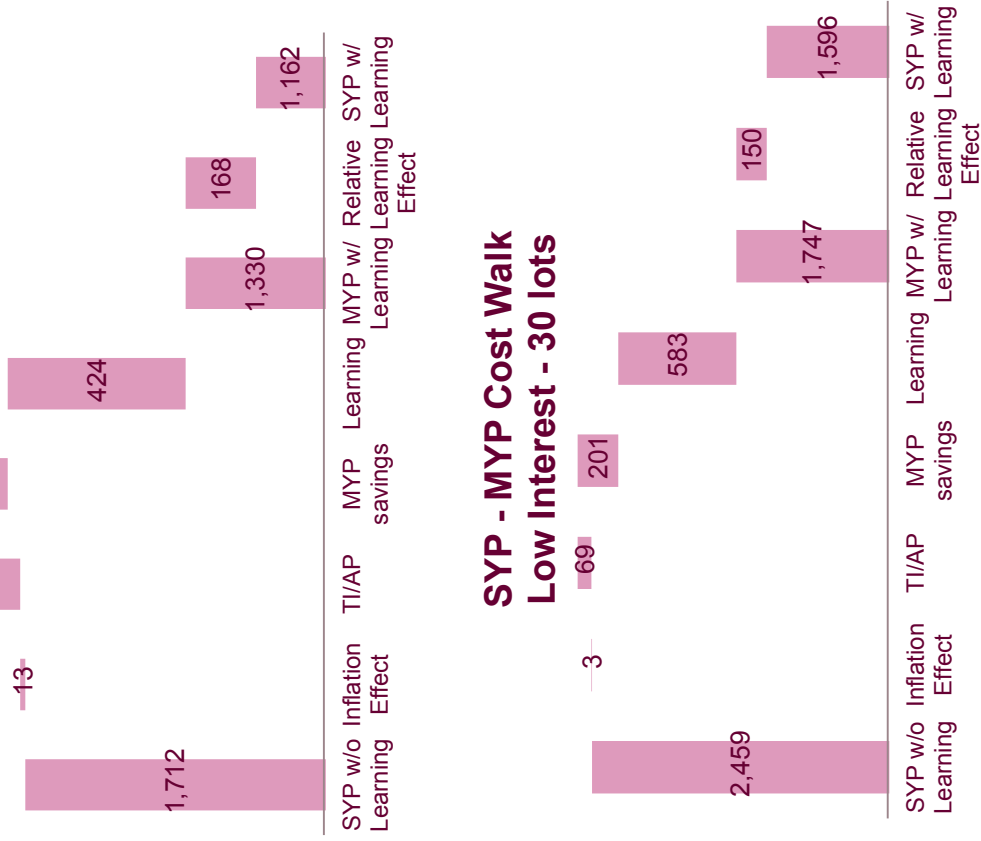
- Both models agree that the net savings from MYP contracts can be eroded by the loss in either appropriations or re-pricing flexibility.
- Long-term contracts can be very effective incubators for contractor-led efficiency searches that ultimately lower procurement costs.
- Procurement strategies that use these types of contracts need to be carefully designed with the same or even greater understanding of the underlying production costs.
- Given the program officials' ability to wring out procurement costs, the decision as to whether to use an MYP strategy rests on whether the NPV of the discount (i.e., the present value of the discount less the required incremental AP and TL costs) exceeds the value of the re-pricing option afforded through more frequent SYP negotiations.
- This decision can be analyzed quantitatively using the simple methods outlined in this presentation.
- Further research should be done to verify the methodology by examining historical contract cost data.

# Backup

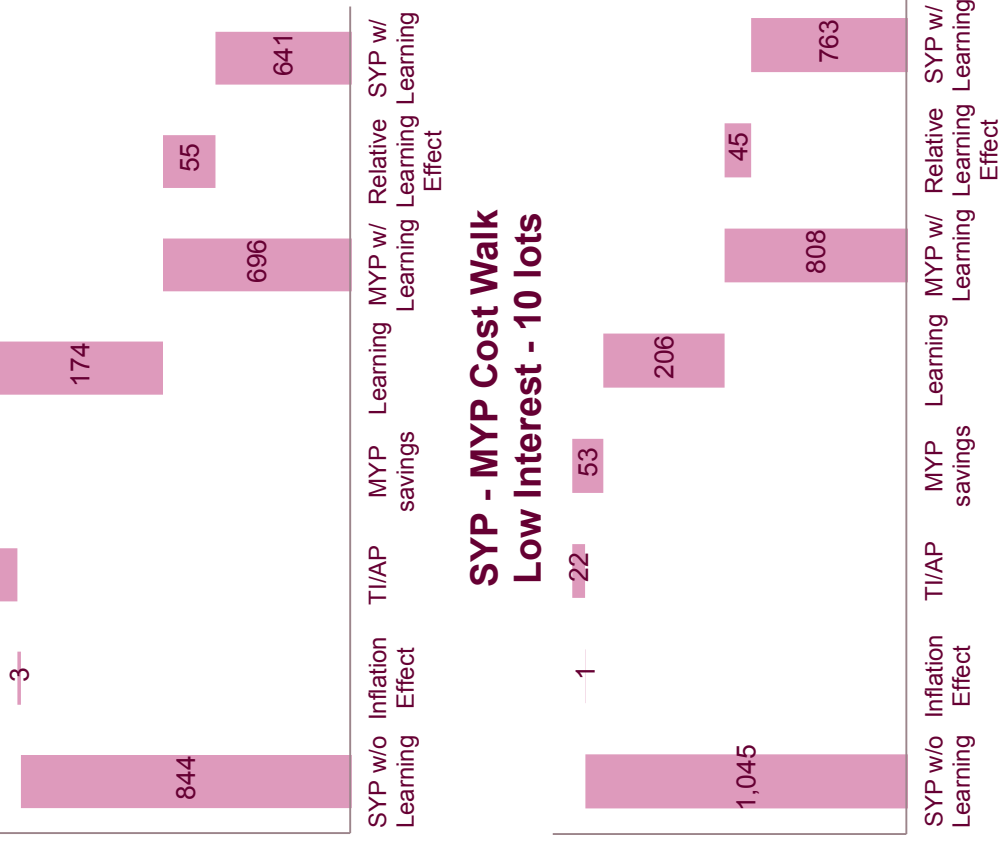


# IDA | Scenario Comparisons

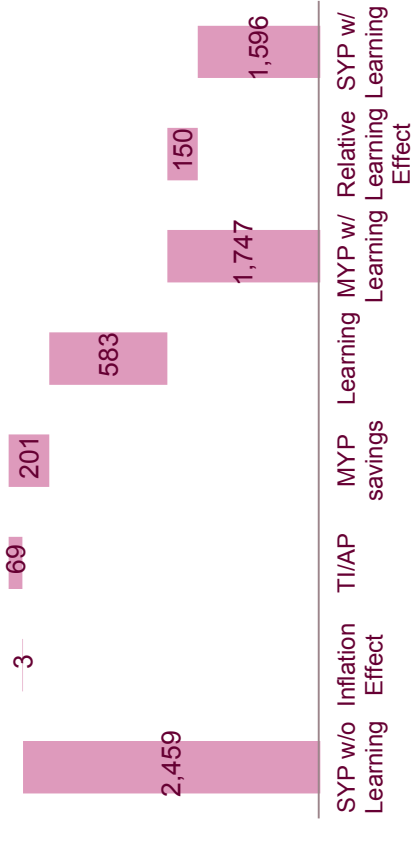
**SYP - MYP Cost Walk  
High Interest - 30 lots**



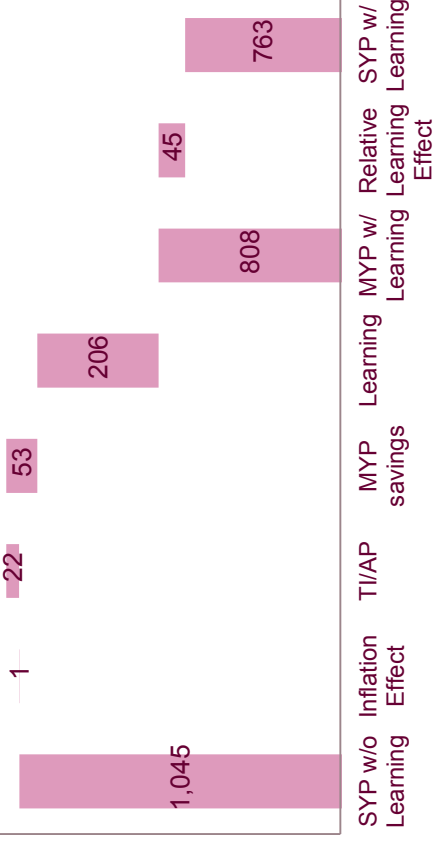
**SYP - MYP Cost Walk  
High Interest - 10 lots**



**SYP - MYP Cost Walk  
Low Interest - 30 lots**

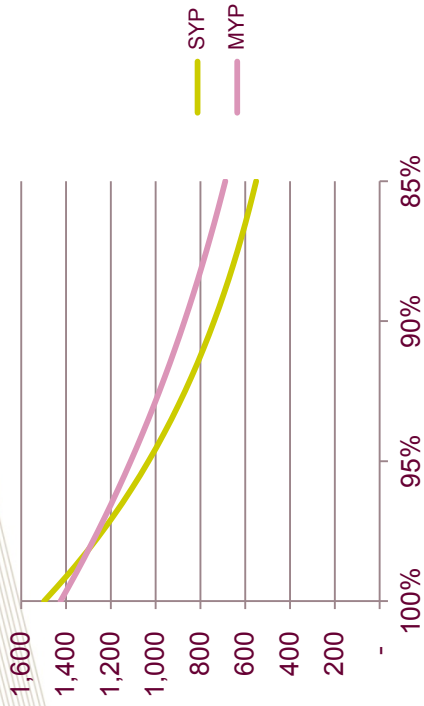


**SYP - MYP Cost Walk  
Low Interest - 10 lots**

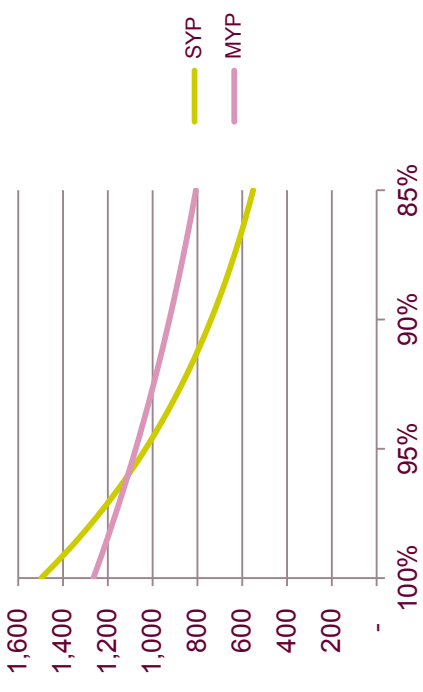


# IDA | Learning Curve Sensitivity Analyses

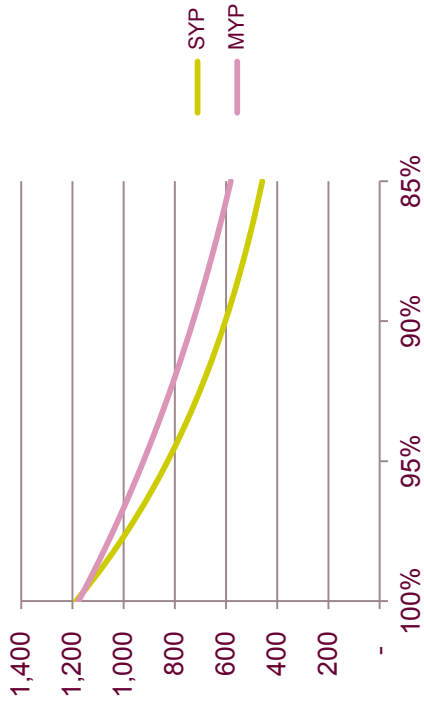
15/3 L 10% S



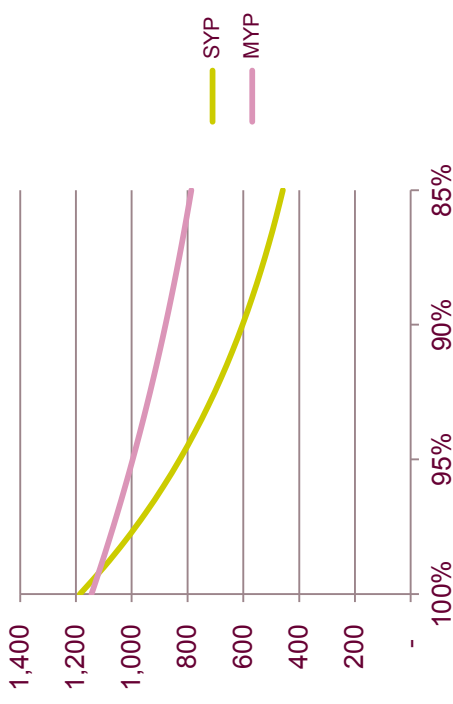
15/3 L 20% M



15/3 H 10% S



15/3 H 20% M



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