NORTHROP GRUMMAN

DEFINING THE FUTURE

NASA New Start Inflation Index

Society of Cost Estimating and Analysis
Annual Conference   June 24 - 27, 2008
Industry Hills, California

Brian A. Welsh and Kenneth D. Odom

Analysis performed for NASA Cost Analysis Division of PA&E

Outline

NORTHROP GRUMMAN

- Problem
  - Background
  - Transition from SIC to NAICS
  - Past Findings

- Methodology
  - Alternative Study
  - Current New Start Index
  - Pythagorean Means
  - Observations
  - Forward Pricing Rate Agreements
  - Analysis
  - Future Research

- Conclusions

- References

Brian.Welsh@ngc.com June 2008

Problem

NORTHROP GRUMMAN

- "NASA simply is not allocated the budget resources to accomplish all of the many and varied space and aeronautics missions that our many constituencies would like us to do" NASA Administrator, Michael Griffin, March 5, 2008 [1]

- Does the current NASA New Start Inflation (NNSI) Index correctly represent the inflation experienced by NASA?

- This study analyzes the NASA New Start Inflation Index, examines similar research, and makes recommendations

> **Goal: To review the NASA New Start Inflation Index, review alternative studies, and recommend improvements**

3

Background

NORTHROP GRUMMAN

- Thousands of inflation indices exist

- Consumer Price Index (CPI) is a very common market basket of goods for the average American [3]

- The NASA market basket of goods has very different needs than the average market basket of goods

  - Complex, hand-crafted, aerospace products made from unique and expensive materials
  - No automation or mass production due to limited production quantities
  - Highly skilled and unionized labor force

> **The NASA market basket of goods varies greatly from the average consumer's market basket**

Past Findings

NORTHROP GRUMMAN

- "NRO Inflation Study" presented to the Bureau of Economic Analysis, 2007
  - An NRO inflation index was constructed from several sources including Global Insight direct labor inflation indices, Global Insight material inflation indices, Historical skill mix data on NRO programs, and others
  - The result is an inflation index that is more than double the Air Force 3600 raw indices

- "DoD Military Construction Inflation Index vs. Construction Industry Inflation Indices" presented by Brian Welsh and Vincent Russo at the 2007 SCEA Conference in New Orleans, LA
  - Construction industry published inflation indices have recently been averaging 2% higher than the DoD Military Construction inflation index
  - Construction cost drivers such as steel, cement, lumber, and labor also have inflation indices higher than the DoD MILCON inflation index

- "X Factor" presented by Annette Harris and Sasha Lanes at the 2004 SCEA Conference in Los Angeles, CA
  - Compared OSD inflation rates with actual submarine material growth costs
  - Inflation becomes a significant cost factor for long term projects like submarines and large ships
  - Ship building material inflation is greater than OSD inflation rates

5

NRO Inflation Study

NORTHROP GRUMMAN

- Composition
  - 81% Labor
  - 60% Engineers/Scientists/Management
  - 7% Computer Integrated Systems Design
  - 7% Manufacturing
  - 7% Clerical/Admin
  - 13% Material
  - 6% ODCs

- OSD Air Force 3600 Outlay Profile used to create weighted indices

- Study currently focusing on adding measures for
  - Employee benefits
  - Productivity
  - Depreciation
  - Overhead rates
  - Using Geometric Mean

Inflation research at the NRO is ongoing

Brian.Welsh@ngc.com June 2008

Current New Start Inflation Index

NORTHROP GRUMMAN

- Composition
  - Labor ($/hour)
    - Manufacturing Durable Goods
    - Electrical Equipment, Appliance and Component Manufacturing
    - Aerospace Products and Parts Manufacturing
  - Employment Cost Index – Total Compensation
    - Private Workers
    - Civil Manufacturing
    - Manufacturing Union Workers
  - Consumer Price Index – All Items

- Components are equally weighted (~86% Labor, 14% CPI)

- Raw Inflation Index only

Current New Start Inflation Index

NORTHROP GRUMMAN

NASA New Start Inflation Index
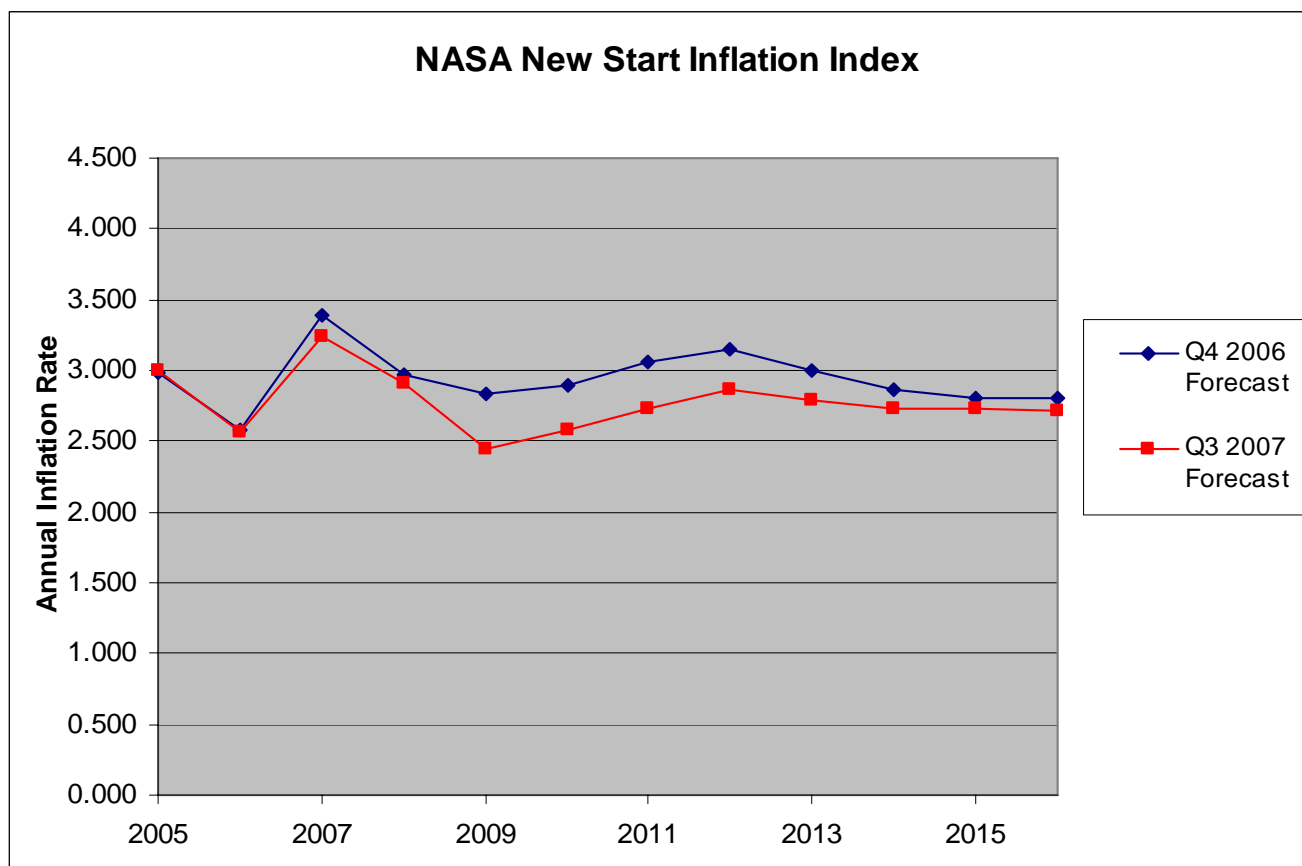
- Q4 2006 Forecast (2008 – 2016) Geometric Mean = 2.93% inflation per year [3], [5]

- Q3 2007 Forecast (2008 – 2016) Geometric Mean = 2.72% inflation per year

Inflation forecasts for the New Start Index appear to be going down

8

Geometric Mean

- The CPI uses the geometric mean.[6]

- If an index goes from 4 to 5 using an arithmetic mean that would be a 25% increase but then in the next year if the index goes from 5 back to 4 using the arithmetic mean it is only a 20% decrease. A geometric mean treats both these changes equally and the resulting percent change from 4 to 5 and back to 4 would be 0.

- Typically 1 is added to each period's percent change because a geometric mean cannot be used with negative values or zero, so 0.25 and -0.2 would be 1.25 and 0.8. Then 1 is subtracted at the end of the sequence.

$$A(x_1,...,x_n) = \frac{1}{n}(x_1 + ... + x_n)$$

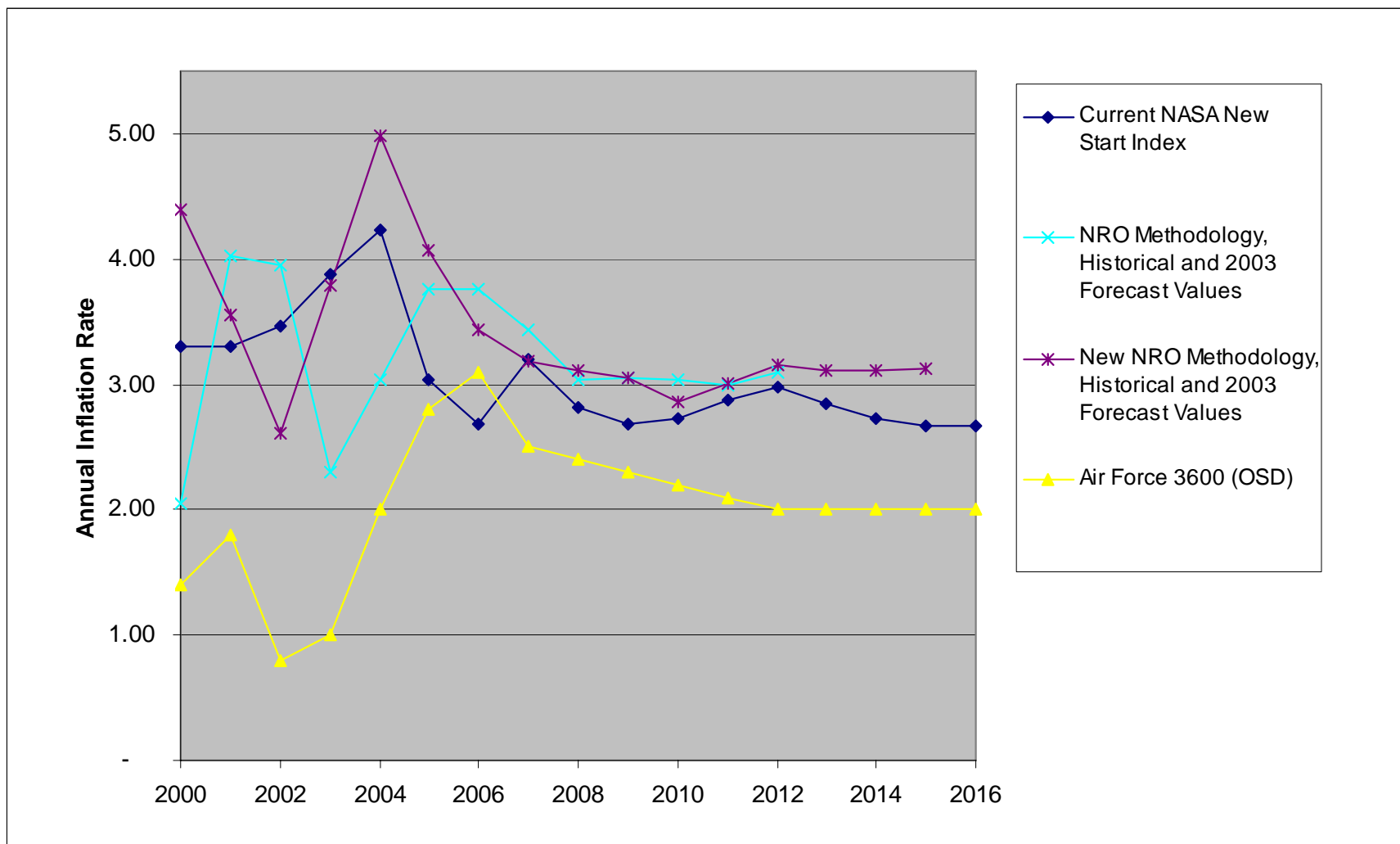$$G(x_1,...,x_n) = \sqrt[n]{x_1...x_n}$$

$$A(x_1,...,x_n) \geq G(x_1,...,x_n) \geq H(x_1,...,x_n)^{[7]}$$

$$H(x_1,...,x_n) = \frac{n}{\frac{1}{x_1} + ... + \frac{1}{x_n}}$$

The geometric mean should be used for inflation index averages

9

Inflation Rate Comparisons

NORTHROP GRUMMAN

Space inflation is demonstrated to be higher than OSD allows
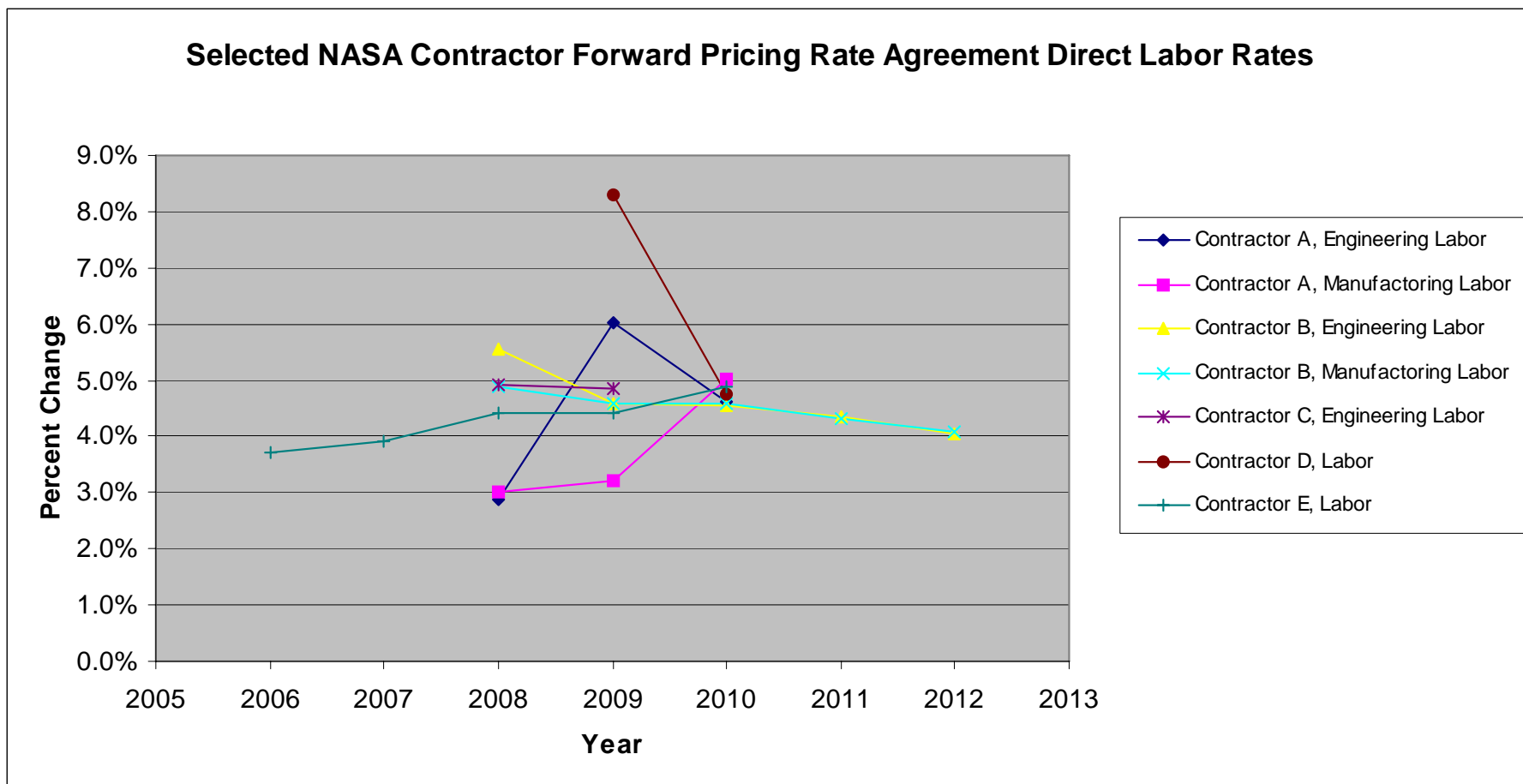
Brian.Welsh@ngc.com June 2008

Observations

- Current NASA New Start Index has several areas for possible improvement

    - NASA indices measure predominantly manufacturing type labor and product manufacturing but engineers and scientists are likely a significant percentage of labor

    - The CPI used includes measures of food and energy

    - There are no specific material measures in the current index, it would be helpful to better define the materials used in product manufacturing

    - Consider investigating outlay profiles or spend plans to provide insight for NASA New Start Inflation Index users

Scrutiny by outside observers would reveal current shortfalls

Brian.Welsh@ngc.com June 2008

Methodology – Analysis

NORTHROP GRUMMAN

- Selected Forward Pricing Rate Agreements (FPRA) are used to specify a future labor rate or a percent increase in labor rates for future years

Selected NASA Contractor Forward Pricing Rate Agreement Direct Labor Rates

Legend:
- Contractor A, Engineering Labor
- Contractor A, Manufactoring Labor
- Contractor B, Engineering Labor
- Contractor B, Manufactoring Labor
- Contractor C, Engineering Labor
- Contractor D, Labor
- Contractor E, Labor

Methodology – Results and Analysis

**NORTHROP GRUMMAN**

- The Forward Pricing Rate Agreements for five separate contractors show that inflation will be about 4.5% for years 2008 through 2012

- Engineering labor is slightly higher than Manufacturing labor

- Specific types of labor varies between contractors but most of the contractors include System Design, Program Management, Science, and Finance

NASA Contractor Forward Pricing Rate Agreement Direct Labor Rates								
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Geometric Mean**
Contractor A, Engineering Labor			2.88%	6.03%	4.62%			4.31%
Contractor A, Manufactoring Labor			3.02%	3.22%	5.03%			3.66%
Contractor B, Engineering Labor			5.56%	4.58%	4.56%	4.34%	4.06%	4.59%
Contractor B, Manufactoring Labor			4.87%	4.57%	4.58%	4.31%	4.07%	4.47%
Contractor C, Engineering Labor			4.91%	4.85%				4.88%
Contractor D, Labor				8.30%	4.75%			6.28%
Contractor E, Labor	3.70%	3.90%	4.40%	4.40%	4.90%			4.24%

FPRAs suggest inflation is approximately 4.5 %

13

Comparison of NNSI to AF 3600, CPI, and FPRA
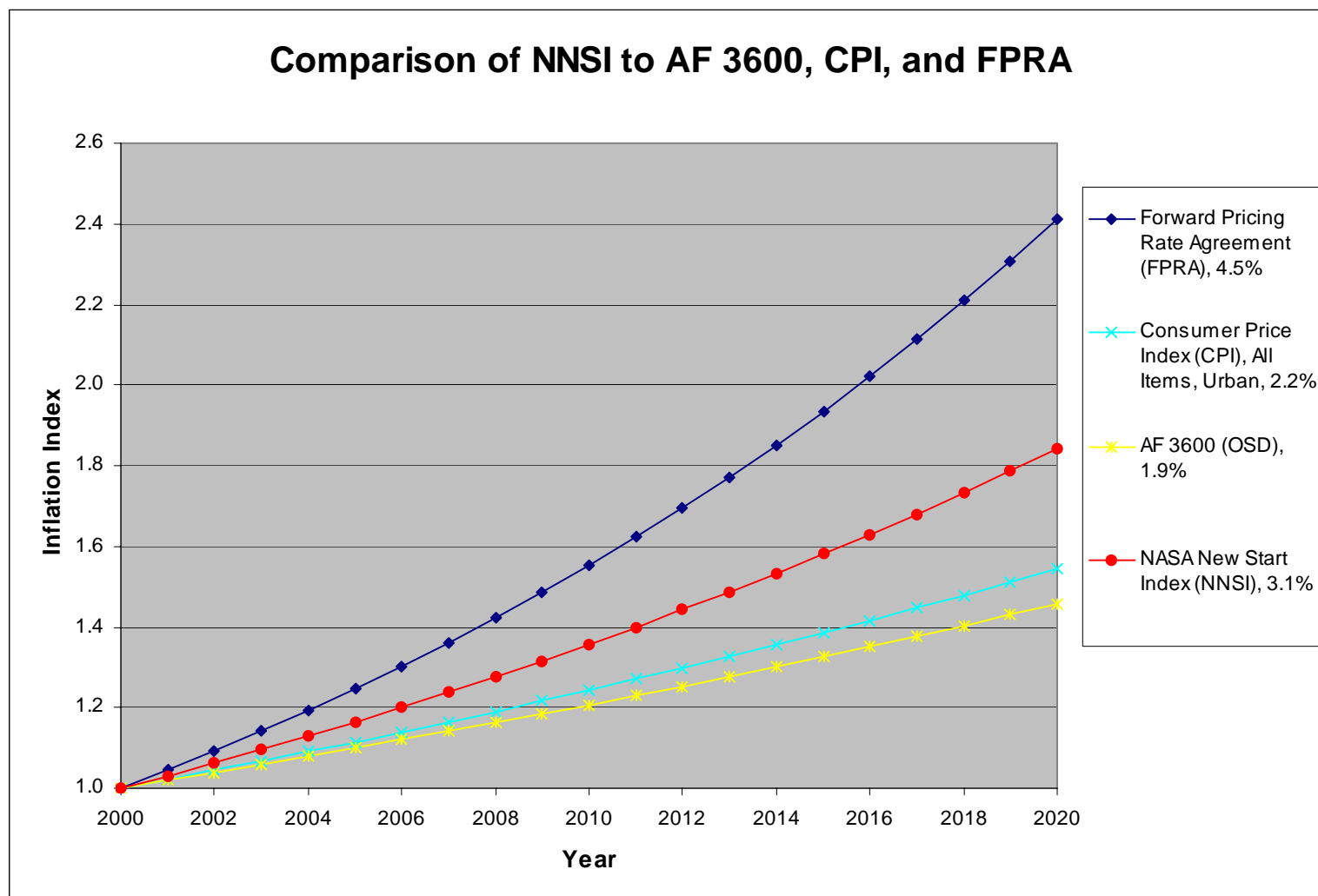
Inflation compounds over time, especially for long term programs

Brian.Welsh@ngc.com June 2008

Future Research

NORTHROP GRUMMAN

- Examine trends for extended period of time

- Outlay profiles

- Specific labor mixture used by contractors and the government
  - Specific type of labor (example – engineers, scientists, manufactures, etc.)
  - Percent of each type of labor

- Mixture of materials to labor
  - Types of materials (example – gold, steel, silicon, and other exotic materials)
  - Percent of each type of material
  - Percent of materials to labor

Brian.Welsh@ngc.com June 2008

Conclusions

NORTHROP GRUMMAN

- The OSD Air Force 3600 inflation index recommends using an average of 1.9%, while the previous NRO inflation study suggests space craft inflation will be 3.4 % between the years 2000 – 2013

- The NASA New Start Index is experiencing inflation of 3.1% between the years 2000 – 2013 which is substantially lower than contractor FPRA inflation of ~ 4.5% between the years 2008 - 2012

- The current NASA New Start Index is comprised of approximately 86% Labor and 14% CPI which is most likely not representative of the NASA market basket of goods

Questions?

Space inflation needs further investigation and may be higher than originally expected as shown by FPRA inflation at ~ 4.5%

References

NORTHROP GRUMMAN

- [1] "The Reality of Tomorrow." American Astronautical Society Goddard Symposium. NASA Administrator Michael Griffin. 5 March 2008.

- [2] "Congressional Budget Office." 21 February 2008. http://www.cbo.gov/ftpdoc.cfm?index=5772&type=0&sequence=4

- [3] "Bureau of Labor Statistics Data." 6 December 2008. www.bls.gov.

- [4] "Bureau of Labor Statistics Producer Price Index." 28 March 2008. http://www.bls.gov/ppi/ppinaics.htm

- [5] "Global Insight". 12 November 2007. www.globalinsight.com.

- [6] Dalton, Greenlees, and Stewart. "Incorporating a geometric mean formula into the CPI." *Monthly Labor Review.* October 1998. http://www.bls.gov/opub/mlr/1998/10/art1full.pdf

- [7] "Pythagorean Means." 5 September 2007.http://en.wikipedia.org/wiki/Pythagorean_means