Accounting for Inflation in the Cost of Space Projects
By Howard E. McCurdy

How do we account for inflation in assessing the cost of space projects?

The easy answer is this: use the latest figures from NASA New Start Inflation Index (NNSI). The index is available on the Internet. Go to the web site for NASA's Cost Analysis Division (CAD) and click on CAD publications – the latest URL is http://www.nasa.gov/offices/ooe/cad/publications/#.VC10YxawT2o (accessed October 2, 2014). Open the NASA New Start Inflation Indices. The table appears as an Excel spreadsheet with a handy calculator.

Be careful not to use archived indexes that you might find on the Internet. These typically do not contain actual inflation figures for the most recent years. Instead, use the most current NNSI.

Figure 1: A picture of the Saturn V rocket on the launch pad at Cape Canaveral in Florida. Source: NASA History Office

How is the NNSI calculated?

Cost analysts in NASA prepare the index by measuring price changes in the market basket of goods and services that go into a space activity. Appropriately, the index is weighted heavily to account for shifts in the labor costs of aerospace workers. Most of the money that project managers spend on space expeditions consists of salaries paid to professional, scientific, and technical employees. Accordingly, cost analysts allocate 81 percent of the index to changes in that area. Elements of that allocation trace changes in labor costs for mission design, manufacturing, computer programming, and flight operations. Analysts reserve a sizeable allocation for changes in the benefit packages that workers in the private sector receive. When labor costs rise, so does the NNSI.

The remaining 19 percent follows changes in the cost of materials, energy, and similar factors. Cost analysts incorporate movements in the prices of nonferrous metals, semiconductors, electronic equipment, and guidance systems. They trace shifts in the price of energy and insert a small allotment that measures the Consumer Price Index omitting food and energy.

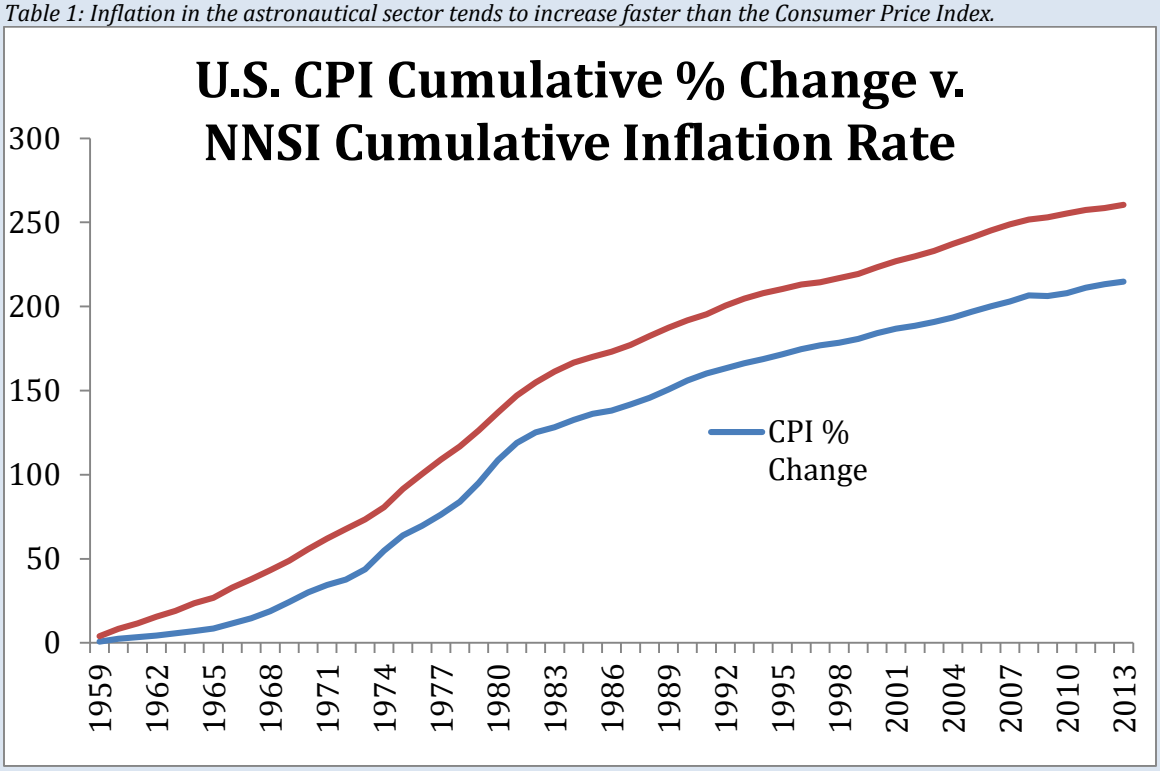
The NNSI and the Consumer Price Index

Because it is based so heavily upon the salaries of well-educated workers, the NNSI tends to rise faster than the U.S. Bureau of Labor Statistics Consumer Price Index (CPI). The CPI measures changes in the prices of items that the average consumer tends to buy: food, housing, energy, automobiles, and so forth. The NSSI measures price changes in the goods and services that space flight managers purchase. For

individual years, the NNSI sometimes jumps ahead of the CPI; other times it lags behind. The overall tendency, nonetheless, is one of acceleration.

Here is a practical example. In the period between the approval of the NASA space shuttle (1972) and the final flight of the space shuttle *Atlantis* (2011), the CPI rose by a factor of 5.38. The goods and services that a consumer bought for one dollar in 1972 cost $5.38 in 2011. In the same period, the NNSI rose 6.426. For a comparison of the NSSI and CPI since the start of the civil space program, see Table 1.

Table 1: Inflation in the astronautical sector tends to increase faster than the Consumer Price Index.



Inflation and innovation

Borrowing a metaphor from aeronautics, NASA cost analysts characterize the acceleration of space price inflation relative to consumer prices as "drag." Americans who are accustomed to spending more for food and housing find themselves being asked to spend a bit more beyond the CPI for space expeditions. Conceptually, this has the effect of reducing demand for spacecraft missions relative to other goods and services.

For the most part, the extra inflation lies beyond the control of NASA contract managers. Extending the metaphor, it is like a stronger headwind into which the pilots of this metaphorical jetliner must fly. The pilots have no control over the headwind. Aerospace workers can make the jetliner fly more efficiently by improving aircraft design and engine technology, improvements that compensate for added drag. This is why innovation is so important to the space effort.

Innovation allows spacecraft managers to fly more efficiently into a stronger headwind by producing articles that work better and cost less relative to inflation. If a new mission can be produced at a level that falls below the acceleration of NSSI relative to the overall cost of living, demand for that activity should rise relative to other options.

Why is all this important?

Consider the challenges involved in producing very large rockets. In 1969, researchers calculated the expense of building the giant Saturn V rocket. They set the "average recurring unit production cost" – essentially the cost of manufacturing each rocket – at $185 million. The old Saturn V delivered 260,000 pounds (118,000 kilograms) to low-Earth orbit (LEO) – enough mass to get each expedition crew to the Moon and back. The cost was $712 per LEO payload pound.

Between 1969 and 2012 (the latest full calendar year for which actual figures are available), the NNSI increased 7.794. The CPI increased 6.26.

a. How much would a Saturn V cost to produce in 2012, should engineers be able to resurrect the old technology?
b. At that cost, is the U.S. Congress likely to resurrect the old Saturn V for 21st century space missions?
c. What is the equivalent cost per pound in 2012 dollars?
d. What would be a good target (cost per pound) at which to aim for a new heavy lift launch vehicle?

The answers appear below. They underlie much of the concern over making space access more affordable. Other technologies have become cheaper as they have matured and rocket scientists want to repeat this experience in space. Knowing how to gauge inflation helps people recognize progress when it occurs.

Answers: (a) $1.4 billion; (b) no; (c) for the Saturn V, $5,500 per pound to LEO; (d) $1000 per pound (Elon Musk in 2011 projected that his Falcon Heavy rocket would be able to lift 117,000 pounds to LEO at a cost of U.S.$1,000 per pound.)

Sources:

NASA, "The National Aeronautics and Space Administration's budget and personnel status history," February 1970. NASA History Office archives, NASA Headquarters, Washington, D.C. (Saturn V unit production cost).*

SpaceX, Press Center, "SpaceX Announces Launch Date for the World's Most Powerful Rocket," April 5, 2011(Falcon Heavy payload and cost estimates).