White Paper

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Thinking About Martian Economics by Edward L. Hudgins

Why, four decades after men first ventured into space are there no regularly scheduled commercial flights into orbit? Some 35 years after the Wright brothers' 1903 flight the commercially viable DC-3 was flying. But today the cost of placing payloads into orbit on the Shuttle is perhaps a magnitude more than on Apollo. By contrast, in the past twenty years the cost of airline tickets per passenger mile have dropped by 30 percent, with twice as many people now flying. The costs of other goods and services have declined as well. The cost of shipping oil, for example, has dropped 80 percent.

For too long space enthusiasts have ignored economics at the peril of their passion. If men are to journey to Mars, markets are the means.

The Goal.

In this discussion I shall address two questions. The first is "Can a mission to Mars be privately funded?" My answer will be "Yes." The second question is "Can development and exploitation of Mars be sustained beyond the initial landings?" Here I answer is unclear.

Private vs. government suppliers.

It is useful first to review some economic truths that should be obvious to most people today. The first is that the free market system is the only known way that, on a large scale, resources can be used in the most efficient manner to satisfy the needs of individuals.

What constitutes a market? First, individuals own property and, especially, the means of production. Second, individuals are free to exchange their property or services with others. Third, all exchanges are based on mutual consent. This means that the prices of all goods, services and labor are based on contract. Fourth, the purpose of government is to protect private property and enforce contracts.

The market system results in the following:

First, each individual has a strong incentive to act in an entrepreneurial manner, offer the goods and services that will bring the greatest return or profits or wages for one's efforts.

Second, in a market system division of labor occurs. Individuals who are most efficient at performing some task or producing some good or service will prosper and those who are less efficient some particular area will have to find work elsewhere.

Third, the market is a discovery process. No individual or group of individuals can know for certain what goods or services, produced in what manner, by what individuals or enterprises, will best serve consumers. It is only in market exchanges that the system "discovers" who is best at what. This is why central planning does not work.

And fourth, the market process allows for the creation of new wealth, the invention of new products and services.

By contrast, governments generally do a poor job of allocating resources and delivering goods and services. To begin with, there is little incentive for governments to do so. After all, revenue is not does not result from satisfying customers; it comes from taxes.

The Space Station, for example, originally was expected to cost $8 billion. The price through the 1980s escalated to $16 billion then to $32 billion. When it reached $39 billion in the early 1990s, a stripped down version was offered that was suppose to cost only $29 billion. But the cost continues to rise. We saw, for example, that when asked how much it would cost to go to Mars, NASA's "90 day Report" in 1991 put the price at $450 billion. Remember, it is governments that give us $900 toilet seats and hammers, and $700,000 outhouses.

A second reason why governments cannot deliver goods and services efficiently is that they are subject to political pressures. Indeed, if decisions are not made on a basis of market demand, then politics is the other alternative. In the case of government spending on technology, businesses compete for corporate pork. For example, recipients of taxpayers' money through the Department of Commerce's Advanced Technology Program include Xerox, IBM, and Dupont, all no doubt fine companies but hardly poor, struggling newcomers. Political pull is their to the federal pocketbook.

Better government approaches.

The most economically and politically viable approach to a Mars mission, based on market principles, is the Mars Prize approach, supported by House Speaker Gingrich. A version of this approach was considered in 1988 by a Commerce Department led group looking at ways to return to the Moon. For a Mars mission a $20 billion prize, with an actual mission cost of only $5 billion, indeed creates an incentive for the private sector to find the best way to the Red Planet.

But these funds still will prove difficult to secure. Thus Mars enthusiasts might support a radical approach: A way to make such a prize-based approach politically and economically practical might be for advocates of a Mars mission to back the elimination of the planned Space Station and privatization of the Shuttle as a means to turn over civilian space activities to the private, civilian sector where it belongs. Some of the savings could be used for the Mars Prize.

The General Accounting Office estimates that the actual cost of building the station will be around $48 billion with a cost of $49 billion to operate it between 2002 and 2012. The station will never pay for itself by selling space to the private sector. Space on the station will continue to be given away for below cost.

Further, the is little useful science that will be performed on the station that could not be done with unmanned, expendable launch vehicles. In 1991 a special Presidential Advisory Commission, chaired by Martin Marietta Corporation CEO Norman Augustine, stated that "We do not believe that the space station ... can be justified solely on the basis of the (non-biological) science it can perform, much of which can be

conducted on Earth or by unmanned robots."

Has part of the transition, some of the savings from NASA's $13 billion annual budget could be set aside for a Mars price. Two billion dollars per year would produce a $20 billion prize over a decade.

Private approaches.

But a better approach would be for the Mars mission to be totally financed by the private sector. There is certainly historical precedent for such an approach.

For example, between 1903 and 1919 the Carnegie Foundation spent $2.38 million to build the Mount Wilson Observatory. That would be $32 million in current dollars. But a better comparison is to the federal budget. Between 1903 and 1919 Washington spent $11.1 billion (adjusting for World War I expenditures). This might seem a small amount. But the same portion of the cumulative federal budgets for the seventeen year period between from 1982 through 1998 Carnegie would be $4.45 billion, an amount that could put a entrepreneurial company well on its way to a trip to Mars.

Carnegie spent $2.29 billion between 1920 and 1929 on Mt. Wilson ($20.4 million in 1996 dollars), $2.38 million from 1930 to 1939 ($26.37 million in current dollars), and $2.15 million between 1940 and 1949 ($18 million in current dollars).

The Rockefeller Foundation spent, starting in 1929, paid out $6 million to build the Mount Palomar Observatory, which saw first light in 1948. That's about $60 million in 1996 dollars.

Between 1925 and 1929 the Guggenheim Foundation operated a $3 million Fund for the Promotion of Aeronautics. That's $26 million in 1996 dollars. (Total federal expenditures during that period were $14.8 billion.) And in the 1930s the Guggenheim Foundation paid about $100,000 to finance Robert Goddard's pioneering rocket work.

If the actual cost of a Mars mission is between $5 billion and $10 billion, a consortium of enterprises and educational institutions could fund a Mars mission. Yet without taxpayers funds, what would be the incentive to go? Many institutes and foundations no doubt would invest in a Mars mission for the scientific knowledge that it would yield. For example, the National Geographic Society took in $401 million in 1996, and spent $4.7 million in research grants. It would no doubt be part of such a consortium.

The prospect of property rights and owning Martian assets would be a strong incentive. Also a consortium might earn money and develop technology for a Mars mission by taking on other tasks for profit. If NASA stops subsidizing cargo on the shuttle, their would be a larger market for launch services and companies that might provide such services and use part of the profits to fund a Mars mission.

The entertainment industry no doubt would have an incentive to be part of a Mars consortium. Consider the Disney Company. It might put up several hundred million dollars to put camera-equipped rovers on the Moon to provide holodeck-type virtual reality entertainment on Earth. It might use some of the profit to fund similar activities on Mars. Disney, by the way, took in $22.47 billion in revenue in 1997. Its pre-tax net revenue was $3.387 billion. With a tax bill of $1.42 billion, the after tax profit was $1.966 billion. If Disney were given a tax credit for money used to finance a Mars mission, it alone could pay for that mission in 14 years. The road to Mars does not have to go through government territory.

Is the Time Economically Right?

Mars enthusiasts must also ask the question "Are the economic conditions right for sustained development of

Mars?" Many correctly worry that initial landing on Mars will be followed by decades in which the Red Planet sees no human visits, as happened with the Moon after Apollo. The promise of profits for investors on Earth who finance missions to Mars could cover some of the costs. This is why the initial consortium contracts will be important.

But it is often the case that what is technologically possible at a given time is economically impossible. An analogy might be made here with technology itself. Leonardo diVinci designed a flying machine 500 years ago. Let us assume that he actually designed a model that could work. Of course, without materials with certain properties, electric motors, fuels, etc., while the design might work in theory, it would not in practice.

Or consider computers. In the 1950s it might have been possible to string together enough Univacs or early IBMs to do what a good desktop can do today to perform certain functions. But would that be the best way to perform certain tasks? For example, much of the special effects work in the movie *Jurassic Park* was done on desktop computers. in the 1950s it might have been possible to create such effects on a series of mainframes. But it would have cost a substantial portion of the country's GDP. It only became both technologically and economically practical to produce such a movie, or, for example, design an aircraft such as the Boeing 777, on computers in the past decade.

Let us assume that the first Mars landing will cost around $20 billion. And let us take the optimistic view that the cost of each flight will drop after the first landing. Based on a flight every year and a half, the costs will drop by 80 percent over twenty years, the same as the drop in the costs of shipping oil over the past two decades. That's fourteen flights with the first $20 billion and the last $4 billion. That still means that 14 flights will cost a total of $168 billion. And let's assume that by the eighth flight, a crew of eight can be sent to Mars than just four, but for the same cost. That means that the cost of sending 84 individuals to Mars, with 14 flight, over 20 years, is $2 billion each. That's a hefty airfare!

Sustaining activities on Mars will require considerable capital. In his enjoyable book *Red Mars*, Kim Stanley Robinson fails to appreciate the costs of the capital equipment needed for decades to bring that planet to self-sufficiency. A lot a material will have to be paid for and transported to Mars. This will add to the total costs.

But there is still cause for hope for sustainable settlement of Mars. First, the costs of technology needed for a Mars mission would fall much faster than, say, the 80 percent figure that I used. This has certainly happened with the costs of computers.

Second, strong GDP growth could carry us to Mars. Between 1982 and 1989 the economy grew at a real rate of about 4 percent annually. Today the GDP is over $8 trillion, with inflation very low, though growth rates are not as high as in the 1980s. If deregulation and tax cuts spur 4 percent annual growth, a $8 trillion economy will double its size in about 18 years. That means that $168 billion is less of a price.

Conclusion.

The lunar landing were great human and engineering achievements, but they unfortunately created the mistaken impression that the government must take the lead in such projects. The exploration of Mars will also manifest humans fulfilling their destiny but also will show that free men and women working without government can achieve great things as well.