# The Economics of Space Tourism: NASA and the Entrepreneur[1]

By Christopher Carr

## Abstract

During the perceived recent stagnation of NASA activity, there have been several successful efforts by private manned spacecraft to penetrate the Earth's atmosphere. Affluent citizens and celebrities have vacationed in space; yet it will be a long time before space tourism is both profitable for suppliers and affordable for middle class society. In order to ensure growth, two problems must be solved: the first is prohibitive fixed production and insurance costs; and the second is poor dissemination of information to the public. This paper investigates how best to facilitate this industry's expansion, whether through private markets, government legislation, or public-private cooperation.

## Introduction

In the poorly understood contemporary international climate, tensions between former space superpowers have eased, concerns about space-based warfare or missile attacks are relatively non-existent, and technologies previously limited to military usage have been handed down to the eager public. Without competition from the Soviets, NASA has seemingly stagnated. Young, gregarious entrepreneurs have taken hold of private opportunities in space and have gradually encroached upon areas previously limited to NASA Astronauts and Soviet Cosmonauts. In May of 1996, in the spirit of private growth, the Ansari X Prize Foundation announced it would award ten million dollars to the first team that privately financed, built, and launched a spaceship able to carry three people to 100 kilometers, return safely to Earth, and successfully repeat the launch within two weeks. On October 4, 2004, SpaceShipOne accomplished this feat and received the X Prize, bankrolled entirely by Microsoft co-founder Paul Allen. Virgin Atlantic CEO Sir Richard Branson immediately announced plans to develop Virgin

[1] Christopher Carr is currently a senior at Duke University. He can be reached at cjc12@duke.edu.

Galactic using the SpaceShipOne model, which he estimates could fly 3,000 people into space within five years at a cost of $200,000 per person. Since the well-publicized success of SpaceShipOne one year ago, countless entrepreneurs have invested in private space applications. With each passing day, with each subsequent ship that promises to break new altitude records or to send vacationers to the moon and back, with each billionaire that throws money into the mix, the importance of SpaceShipOne's accomplishment reaches new ears, and more and more scenarios become feasible. But as with all great scientific leaps, it is economics that determines commercial success or failure. In order to be successful, the space tourism industry needs to reach an efficient level of production to reduce costs and increase clientele. With a projected minimum price tag of $200,000, the industry does not seem to possess the type of staying power needed to offset inherently high fixed production costs, expensive liability insurance, and long firm incubation periods. The appropriate question to ask then should not be whether *technology* can get us there but whether *economic* trends support Virgin Galactic and other attempts to privatize the space tourism market and what sort of industry environment should be developed now to maintain steady growth.

In the debate over how best to handle space operations in the near future, there are three predominant voices. The first seeks total deregulation. Proponents of the first voice point to the success of the deregulated telecommunications industry and to the market mechanism itself. This group calls space the "final free-market frontier" and sees the private sector, spurred forth by competition, as the ultimate appropriate agent of space commerce. The second voice sees the current NASA-dominated system as the ideal. Proponents of the second voice point to the historical diffusion of technology from

government to the private sector and to the prohibitive costs associated with space that only government can finance comfortably. This group argues that private firms are not large enough to weather the years of deficit certain in such a high-cost industry and are therefore destined for failure. The third voice seeks to loosen regulation. Proponents of the third voice argue for cooperation between NASA and the private sector and for government assistance in assuring that barriers to entry for private firms be conquered. This group sees a strong role for NASA in the future, albeit not quite so monopolistic, and treats each specific issue differently depending on circumstance. Within this voice, prescriptions of how NASA and the private sector should cooperate vary considerably, but they generally advocate government assistance in breaking barriers-to-entry.

How groups tend to conform to these paradigms is difficult to discern at times. Due to the nature of the space debate as futurist, spurious methodology appears even in the most defined fields of study. However, the modern core of the economics discipline, government, and popular culture are the three segments of society with the most consistency to them, and shall be treated separately. Within this paper, the modern core of the economics discipline is discussed first so as to frame the argument. Next, think tanks, public opinion, special interests, and the media are divided into parties in favor of deregulation, parties in favor of regulation, and parties in favor of cooperation. Within the first viewpoint, that in favor of deregulation, the special interests of Virgin Galactic are discussed, followed by the libertarian views of the think tank The Cato Institute, examples of the media's demonization of NASA, and public opinion data supporting deregulation of the space economy. Within the second viewpoint, that in favor of regulation, the special interests of NASA are discussed, followed by examples of the

media's defense of NASA and public opinion data in favor of NASA's continued role as leader of space applications. Finally, within the third viewpoint, that which seeks cooperation between NASA and the private sector, the institutionalist views of the think tank Resources for the Future are discussed, followed by the views of Duke University Professor of History Alex Roland, and public opinion data gauging perceptions of experimental cooperative programs. After this, there is a section summarizing conclusions on these less consistent segments as they relate to the styles of economics. Government and popular culture are last, as their treatment depends on the reader having appropriate background. This structure emphasizes the differences between professional economic modeling and other methodologies.

Before undertaking analysis, it is important to describe exactly what this paper is about. First, this paper focuses only on space *tourism*, which is a small part of the highly-developed space commerce sector. Second, it seems as though man's mastery of the solar system is inevitable. Nevertheless, when this mastery will occur or begin to occur shall not be treated, but rather how it *should* be fostered in the *near future*. In recent years, there has been a wide deregulation movement, from telecommunications to personal computers, that has resulted in incredible economic booms and improvements in quality of life. Doubtless, space commerce packs such potential. But, as the reader shall see, there are significant barriers to entry and high fixed costs associated with space applications and important safety concerns within the inherently dangerous space tourism industry. Furthermore, technological limitations dictate that near-future space tourism will be restricted to adventure tourism for the upper class until new, more efficient technology or means of production can be developed. Finally, due to a small intellectual

elite, scholarship, and therefore information diffusion through government to popular culture has been lacking. Without a way for the public to hold its lawmakers accountable, lawmakers are open to the influence of special interests. Also, if the public is not aware of space tourism, it cannot consume its services. It seems that in the long-run, a fully private space economy will greatly benefit society, but the development of private space tourism can occur only with the help of government or a corresponding agent already in a financial position to afford the high costs and heavy risk of the space tourism industry.

**The Modern Core Economic Analysis of Space Commerce**

Unfortunately for the purposes of discussing this issue scientifically, the economic analysis is problematic. How does one model the future using a neo-classical approach without simply drawing out current trends like Neuromancer and other works of science fiction? The answer is to consider a variety of different scenarios and to model them using a markets-based approach such as a 2004 extensive report from the Organisation for Economic Co-operation and Development does. The report essentially models space tourism as a potentially explosive industry suffering from a stunting market failure. The report also concludes that additional variables such as the development of essential technologies and the global political landscape strongly influence the analysis of this potential market.

According to the OECD report "In the medium term, public markets (will) be the (space) industry's main engine of growth, because the strategic value of space is increasingly recognized in the OECD area as well as in Russia and in a number of

emerging space-faring countries, such as China, India, and Brazil" (p. 27). The OECD report further states that

> "Because developing space assets is a lengthy and costly process, it requires long-term financing. Private financiers are naturally reluctant to fulfill this need, as space orders are small and production runs typically very short, so that the manufacture of space assets must often rely on public support. Moreover because the life of space assets is quite long once they are deployed…, it is not possible to adjust supply quickly to changing demand conditions…The problem of oversupply is exacerbated when space-faring nations attempt to keep national champions in operation…" (p. 30).

The report illustrates that the private space economy in general and especially the inevitable expansion of space tourism suffers from market failure. According to the introduction to Part III of the textbook Microeconomic Theory by Andreu Mas-Colell, Michael D. Whinston, and Jerry R. Green, a market failure is a situation where "market equilibria fail to be Pareto optimal" (p. 308). In that case, the Second Fundamental Welfare Theorem must be applied. It states

> "If household preferences and firm production sets are convex, there is a complete set of markets with publicly known prices, and every agent acts as a price taker, then *any Pareto optimal outcome can be achieved as a competitive equilibrium if appropriate lump-sum transfers of wealth are arranged*" (p. 308).

In this sense, the OECD report suggests that government support for national champions is responsible for the current lack of private space markets, such as space tourism, and that the success of SpaceShipOne is merely the result of an appropriate "lump-sum transfer of wealth" in the form of the ten million dollar prize, enough to provide an incentive to the developers of SpaceShipOne. In essence, the fixed costs to enter the space market are too large for existing firms and must be offset by a government or wealthy third party.

So how can the problems of overcompensation for national champions and a corresponding suppressed private space market be corrected? According to the OECD report, "(under globalisation there will be) high economic growth (in the space sector), owing to further liberalisation of trade" (p. 78). And that "(worldwide economic liberalisation) trends have given a greater role to the private sector (and) opened new market opportunities. Given the ubiquity of space services, space solutions have benefited considerably from market liberalisation" (p. 35).

Nevertheless, the OECD reports more potential for market failure in the future, since the volatile space tourism industry requires a corresponding development of linked technologies and a cooperative international climate. As the report states "Space tourism may become the next step in adventure tourism, even if the possibilities are limited at first (such as is the case with SpaceShipOne)…but the demand foresees differs, as it depends significantly on international tensions, security imperatives, and development of space transport" (p. 122). This statement echoes the uncertainty and highlights the departures from conventional methodology required to answer such a question as this paper poses.

The OECD report admits that in order to answer the question using a proper economic market-building construction, a variety of potential situations must be contemplated. The first of these, it dubs "Smooth Sailing" and defines as "a global world order under the benevolent guidance of international organisations in which free markets and democracy gradually become the accepted universal model for national institutions" (p. 92). The report states that "major contributing factors include the growth of global trade as well as the internationalization of production worldwide" (p. 92) and that under

this scenario "as one of the fastest growing industries in the world, (space) tourism expands significantly despite concerns about security" (p. 123). It is only under this scenario that a private space sector is possible. The others, which suggest non-cooperation and global protectionism, do not support space tourism for national security reasons. As the report states "the general environment of distrust…strongly limit(s) space tourism's commercial responsibilities…the main driver is the military. As countries co-operate more for civil goals, the development of space tourism is facilitated" (p. 123).

The OECD report stresses the dependence that the space tourism industry places on other up-and-coming fields. The report concludes that "based on social and commercial demand but highly dependent on the development of space transport and security, (both suborbital tourism and orbital tourism) may be promising in the next thirty years" (p. 124). The technologies that the report cites as being integral to the development of such transport and security include nanotechnology, which "will provide lighter and stronger materials for the spacecraft and the equipment of space tourists" (p. 130), embedded sensors and actuators, which will "offer a way to track the health status of space tourists" (p. 130), artificial intelligence, which will "(allow) space tourists…to train for the mission in a virtual reality environment very close to real space conditions" and "monitor and control important phases of the mission" (p. 130), and robotics, which "could be used to assemble space hotels" (p. 130). The report further states that

> "The development of space tourism/adventure is highly dependent on the development of an RLV (a reusable launch vehicle like SpaceShipOne) which depends in turn on progress in propulsion technologies. Possible candidates include advanced rocket engine designs that enable a great number of reuses (and/or) the development of air-breathing engines (e.g. scramjets) which accelerate space transport vehicles to Mach 10-15 at an

> altitude of 60 km…During this period, a four to fivefold reduction in the cost of expendable launch vehicles could also help to lower construction costs for space hotels. Autonomous robots could be used to construct space hotels to accommodate space tourists. Progress in fuel cell technology could enhance the production of energy and water in space hotels accommodating space tourists" (p. 132).

Because of the multitude of variables involved in determining the future of the space tourism industry, even an analysis corresponding to the modern economic core is left guessing. As the OECD report itself admits, "for (this application), the cost of access to space is an important consideration, and the future evolution of costs is a major unknown. It is assumed here, on the basis of expert advice, that costs could decline fivefold by 2030" (p. 133). The report groups space tourism with a category it calls "outsiders", that is "applications that have less a chance of realisation over the period (from 2005 – 2030)" (p. 133). Nevertheless, it concludes, as it did at the beginning that "demand conditions appear favorable" (p. 133).

According to the modern core analysis of the space industry, there are too many uncertainties to make a prediction. The only way to model the future space tourism market is to look at current market trends in both the industry itself and in corresponding technologies and attempt to posit a variety of situations and policies which could correct an inherent market failure via the Second Fundamental Welfare Theorem. It seems as though this is illustrated by the transfer of wealth embodied in the ten million dollar cash prize awarded to SpaceShipOne. But as the OECD report illustrates, this is only one potential problem to overcome in the long journey toward satisfying public demand for space tourism. With this approach in mind, let us now explore arguments for deregulation.

**Arguments for Deregulation**

One of the principle proponents of deregulation is Sir Richard Branson himself, founder of Virgin Galactic. Virgin Galactic's arguments in favor of private enterprise's handling of commercial space flight tend to appeal to a sense of egalitarianism among citizens, safety concerns, and to world harmony while simultaneously indicting NASA as preventing those things. As the organization states on its webpage:

> "Previously it has been thought impossible to design an affordable, robust man-rated rocket ship. Existing spaceships have been very complicated and not robust enough to carry commercial passengers. By using a space craft with adjustable wings for easy re-entry and powered by an inert nitrous oxide (laughing gas) and rubber fuel, (Scaled Composites CEO Burt) Rutan has brought to an abrupt end the government monopoly on rocketship space travel" (p. 1).

In essence, this argument criticizes NASA for designing expensive, weak spacecraft and for preventing all but the elite from traveling in space. Furthermore, with this statement, Virgin Galactic seeks to redefine how the public views space travel. Space travel has always been thought of as a natural public good. But, as the neoclassical analysis points out, a simple transfer of funds in the form of a prize is enough to correct for barriers to entry.

Virgin Galactic further emphasizes safety, stating that "the most important factor that brings us to the precipice of mass space exploration is safety. Burt (Rutan) has utilised a much safer fuel than ever before – nitrous oxide…This is much safer than liquid propulsion systems or solid fuel rockets" (p. 1). In light of the recent Space Shuttle Columbia accident, this argument is sure to resonate with potential clientele and with policy makers.

Finally, Branson is directly quoted as stating;

> "We hope to create thousands of astronauts over the next few years and bring alive their dream [sic] of seeing the majestic beauty of our planet from above, the stars in all their glory and the amazing sensations of weightlessness and space flight. The development will also allow every country in the world to have their own astronauts rather than the privileged few" (p. 1).

Here, Branson's target audience is especially prevalent. He hopes to sway those social democrat lawmakers such as Congressman Oberstar that see regulation as necessary to protect the common man through promises of even class distribution and peaceful international relations, as space crews will not longer represent a specific nation, as they did during the cold war, but rather humanity in general through private business.

It is notable that there is little overt mercantilism in the statements of Virgin Galactic, but that there is an outwardly social democratic concern for safety and equity. Perhaps this is an attempt on the part of the company to paint NASA as self-interested enemy to those things. Nevertheless, Virgin Galactic is not alone is casting NASA as an enemy.

In the Essay "Toward a Theory of the Press", Michael C. Jenson defines the term "romantic" as:

> "1: consisting of or resembling a romance 2: having no basis in fact; imaginary 3: impractical in conception or plan; visionary 4: marked by the imagination or emotional appeal of the heroic, adventurous, remote, mysterious or idealized…" (p. 1).

This description accurately describes media coverage of the imminent privatization of the commercial space market. Instead of treating the issue within an economic or political framework, the media has largely portrayed it in a fictionalized way, as a conflict of man vs. nature familiar to readers of adventure stories and survival narratives. The commercial space debate seems to conform to Michael C. Jensen's Devil Theory, that

"The media…seldom present controversy in terms of the conflict between opposing ideas or theories but often go out of the way to convert such controversy into confrontations between people. One side is usually portrayed as self-interested (evil) and the other as altruistic (good)" (p. 9). Due to the unique nature of the particular issue of commercial space flight as one in which only one man or party may be involved, for the purpose of this essay it will be necessary sometimes to modify the theory to apply to man vs. nature dichotomies as well, as this is in keeping with the romantic simplification Jensen outlines as the primary activity of the media. Nevertheless, it is most interesting to note that with space commerce, when there is a polarization of two representative entities, a reversal of traditional roles generally occurs, with private industry acting as the hero and the government serving as the villain.

In an October 29, 2004 article from CNN.com in response to the successful flight of SpaceShipOne entitled "The Race for Flights into Space", this is indeed the case. The article champions the ordinary man, whose childlike dreams of going into space are no longer constrained by the government. It states in its first line "After years of capturing the imagination of wide-eyed daredevils, dreamers and would-be entrepreneurs, space travel for ordinary people may finally be taking flight" (p. 1). This statement champions the common man despite the fact that civilian travel to space carries a multi-million dollar price tag. It further quotes SpaceShipOne designer Burt Rutan as stating "We think the most significant thing was to show that a private company without any NASA help, without any government help at all, can actually go out and fly a manned space flight" (p. 1). Here we see government and NASA specifically criticized in their capacity for inaction. Later in the article, Burt's brother, Dick Rutan states "The space domain for

manned spaceflight is no longer the domain of a huge bureaucracy spending billions of dollars. We can do it privately" (p. 1). The government is even more clearly criticized in this statement as free-spending and wasteful. On the next page, the article states "Rutan's design reached space for $25 million dollars—about a twentieth the cost of a NASA space shuttle flight" (p. 2). A bit later in the article Microsoft co-founder Paul Allen states "A few years down the road, when space tourism is available for everyone, it's going to be amazing and it's going to make that momentum increase more and more" (p. 2). In the sense that space exploration represents a romantic goal for all of humanity, with private industry being heralded as helping meet that goal, NASA and the government are cast as Jensen's devil, while the heroes are the common man and the indomitable human spirit. Through this casting, the private sector is actively trying to destroy the view of space as natural public good.

In the msnbc.msn.com article "SpaceShipOne wins $10 million X-Prize", there is a notion of America itself as the hero and nature as that which the hero contends against. The article states "President Bush phoned the (X-Prize) winning team to offer his congratulations…The President said (pilot Brian) Binnie and fellow pilot Mike Melville…ranked among the heroes of the new space age" (p. 2). The article further stresses the American spirit of enterprise and the fact that the date chosen for SpaceShipOne's first flight corresponded to the 100$^{th}$ anniversary of the Wright Brothers' first successful flight and that the date on which it finally broke orbit was the same date that Sputnik went into space. In this sense it lauds the American spirit of competition as it embodies the free market.

The Cato Institute suggests that government leave the development of the space

sector to private industry and wealthy financiers. As far back as 1986, Cato Institute member Alan Pell Crawford wrote:

> "government efforts to stimulate industrial motivation (in the space sector) have been dismal indeed…recent studies of the differences in productivity growth among countries suggest that…the countries with the highest ration of R & D spending to gross national product—the United States and Great Britain—had among the lowest rates of productivity growth" (p. 10).

The institute has contributed a significant body of scholarship to the issue and on March 15, 2001 hosted a conference entitled "Space: The Free-Market Frontier". Edward L. Hudgins in his capacity as Director of Regulatory Studies for the institute has been the primary author of recent free-market advocates.

Hudgins' analysis appeals to a broad audience of policy-makers. In his introduction to "The Coming Commercial Frontier in Space" he outlines an economic history of aeronautics followed by a brief synopsis of current private space-based projects, and he provides a philosophical justification of his argument for deregulation. In his articles "X-Prize Proves the Power of Entrepreneurship" and "Move Aside NASA", he employs similar styles to argue for deregulation. In the article "Hayek vs. Asimov: Spontaneous Order or Failed Foundation", Hudgins presents a general philosophical framework to apply to future industrial expansion based on Nobel Prize winning Austrian economist F.A. Hayek's postulate that the future is uncertain. Finally, in his statement before the Subcommittee on Space & Aeronautics, he employs the same methodology as in his introduction to "The Coming Commercial Frontier in Space" but in reverse, starting with a philosophical justification, followed by a synopsis of current private space projects, and concluding with a history of the failures of regulation.

In his introduction to "The Coming Commercial Frontier in Space", Hudgins

outlines the content of his argument:

> "The cause of the problems and source of the answers (to the problem of humankind's delayed full exploration of space) are found in public policy and private markets. There has been too much of the former and too little of the latter. Civilian Space efforts have been dominated by (NASA), a government agency that for all its good intentions has retarded as much as facilitated activities in space. By contrast, during that same period entrepreneurs in the commercial market gave birth to the computer, telecommunications, and internet revolutions" (p. ix).

Hudgins then goes on to discuss the Wright Brothers in their capacity as private financiers of their own innovation, the deregulation of the airline industry's leading to lower prices for consumers, the important roles played by the Carnegie Institution and the Rockefeller foundation in developing the Mt. Wilson observatory and the Mount Palomar Observatory respectively, and the successes of the telecommunications and information technology industries under deregulation. He finally concludes that "A market-based growth strategy would benefit any party that could benefit from low-cost access to space" (p. xiv).

Hudgins then highlights current projects, including a RadioShack/LunaCorp joint venture designed to take pop group 'N Sync member Lance Bass to space, the X-Prize (eventually awarded to SpaceShipOne), a lightweight Kevlar space station, and finally a project designed to beam solar energy to Earth. Hudgins eventual recommendation to NASA is to "back out of civilian space activities and let the private sector do what it does so well in other areas of the economy: reduce costs and develop new, innovative projects and services" (p. xxi).

Finally, Hudgins closes his discussion with a philosophical argument, stating "At the basis of all economic prosperity on Earth is the right to private property, that is, the exclusive freedom of individuals to utilize material and intellectual assets as they see fit,

without the need to seek approval from political authorities" (p. xxiv). On the next page, he states

> "Aristotle opens his *Metaphysics* with the observation that 'all men by nature desire to know.'…In the past patriots fought to establish political and economic conditions of free exchange and private property rights. These conditions opened commercial frontiers on Earth and allowed us to create material wealth and technical capacities never dreamed of. By establishing these conditions throughout the solar system, we will open boundless new commercial frontiers" (p. xxv).

In Hudgins' analysis, there is a fusion on three elements: the neoclassical notion of free enterprise, historicism, and a philosophical basis for argument.

In Hudgins' article "X-Prize Proves the Power of Entrepreneurship", he employs a Kuhnian argument familiar to philosophers of science, stating of SpaceShipOne, the vehicle which captured the X-Prize:

> "SpaceShipOne marks a paradigm shift. For nearly five decades, most people thought of space as a government program and believed that travel beyond the atmosphere simply was too costly for the private sector to provide. Of course, it was because the government was providing the service that the cost stayed high, and government regulations helped to discourage private entrepreneurs from trying to create their own space businesses. But Peter Diamandis, president of the X-Prize Foundation, sought to create a revolution not only by sparking entrepreneurial competition but by changing the way people think about space—it can be a place to which private providers can take you to private facilities for your own private edification" (p. 1).

Hudgins' analysis again points out what the Cato Institute sees as the constrictive nature of government regulation and advocates a philosophical framework in support of the free market. Likewise, in "Move Aside, NASA" Hudgins concludes, "If we're true to our nature, we will explore and settle planets. But only individuals with vision, acting in a free market, will make us a truly space-faring civilization" (p. 2).

In "Hayek vs. Asimov: Spontaneous Order or Failed Foundation", Hudgins uses

the principles of F.A. Hayek, that "the actor and unit of analysis for any study of human history, society, or institutions is the individual" (p. 1) and that "spontaneous order…arises from human action (and) is not specifically planned by men" (p. 1) to argue against the "socialist and statist (belief) that all-wise, caring bureaucrats can plan and benevolently guide economies to prosperity" (p. 1). Hudgins suggests that "(Isaac) Asimov's fiction reflected two fundamental premises of 1950's liberalism: (1) social and economic sciences can predict the future of a society; and (2) philosopher-kings with knowledge of how societies can or should work should rule. Hayek calls such premises fatal conceits" (p. 2). Hudgins then uses this philosophical framework to argue that "knowledge is always uncertain. Experimentation best facilitates progress. Predictions about the unintended consequences of particular discoveries are impossible, (thus) advances usually come as individuals, doing their best in the face of uncertainty, (try) to solve a particular challenge facing them" (p. 4). This philosophical base is applied to Cato's analysis of space commerce.

There are a variety of public opinion polls which suggest that there is indeed a strong drive to deregulate the space economy. On questions related to financing, private-sector development of products for government use, and joint government-private industry ventures, the public seems to support the expansion of the private space market. In a 1986 poll which mentions the first Challenger disaster, the public is asked "If it were decided… to build a replacement to the shuttle Challenger, which of the following alternatives do you think would be the best way to pay for the new shuttle?" to which "Let the private sector raise the funds" was the most popular response. Perhaps this reflects a general frustration with NASA on the part of the public or perhaps it reflects

individual desires to pay less in taxes. In another 1986 poll, the public is asked "(Should) we encourage private industry, rather than government, to provide space services such as navigation satellites, weather satellites, and launching services, wherever possible?" 83% of the public agreed, with 58% saying they strongly agree. . In a 2003 poll, the public was asked "Do you feel that civilian astronauts, such as journalists, politicians and school teachers, should or should not participate in any future space shuttle flights?" 56% said they should participate and 38% said no. When asked in 1985 whether they would personally like to fly in the space shuttle, 27% said yes. Nevertheless, while this number may look small, it scored higher than eight out of the eleven other options, some notables being a supersonic military aircraft, a hang glider, and a World War II plane. This might indicate a niche market for thrill seekers that might attract some mainstream consumers too.

When given to subgroup analysis, specifically by polling wealthy Americans, a seminal 2002 Futron Corp. study found that "…space tourism could generate more than $1 billion per year by 2021… Suborbital tourism would have the largest demand, with a potential for 15,000 passengers and $700 million in revenues per year by 2021. Growing less slowly, orbital space tourism will have about 60 passengers and $300 million in revenues per year by 2021" (p. 2).

It would seem from these arguments that deregulation is the only solution. It offers endless possibilities for average citizens to fly in space and promises of general economic prosperity. Nevertheless, is it realistic to think that a free space sector will really deliver on all of these promises, and, if so, how long will it take?

**Arguments for the Status-Quo of Regulation**

NASA, to its own credit, seems to recognize the realities of the increasing popularity of the deregulation movement and argues an approach to business called "competitive sourcing", which pits government developers against private enterprise as opposed to leaving the matter up to an unregulated market.

Throughout a variety of budget reports, policy briefs, and press releases, the organization attempts to illustrate some of the advantages of this approach to outsourcing or complete privatization. At the root of this strategy is NASA's own recognition of emerging markets for private enterprise in space. In its policy brief "A Renewed Spirit of Discovery: The President's Vision for U.S. Space Exploration", NASA states "As we move outward into the solar system, (we) will rely more heavily on private sector space capabilities to support activities in Earth orbit and future exploration activities" (p. 17).

Nevertheless, NASA argues that it has a necessary role in any private sector activities, specifically in breaking technological barriers and in national security interests. In terms of the former, an historical style is largely utilized. In describing the success of SpaceShipOne, NASA administrator Sean O'Keefe states in "The Business of Risk", an article appearing in NASA magazine The X-Press "…the flight marked what the end result of NASA research should be: the transfer of knowledge to the private sector, where federally funded research can be explored and made available to the public" (p. 1). O'Keefe essentially argues that since it worked that way in the particular case of SpaceShipOne that is how it will work in every case. A neoclassical economist would dismiss this argument, stating that competitive markets would have accomplished the same feat in less time. The article repeats O'Keefe's point four more times.

The NASA article further differentiates the role of NASA from the private sector in terms of ensuring national security, specifically highlighting NASA's role in the cold war. As it states:

> "The innovative approach to space flight developed by…Scaled Composites…made use of…a different approach to reaching space than those used by others who have conquered it. The flight also had different goals than those of the flights made by the US and the Soviet Union in the 1960s" (p. 12).

A similar point is made in "A Renewed Spirit of Discovery: The President's Vision for U.S. Space Exploration" which also calls to mind both NASA's aforementioned argument of the transfer of technology from itself to the private sector and the role of NASA in ensuring national security. The brief states:

> "The space missions in (the President's) plan require advanced systems and capabilities that will accelerate the development of many critical technologies…These technologies underpin and advance the U.S. economy and help ensure national security…The accomplishments of U.S. space explorers are also a particularly potent symbol of American democracy, a reminder of what the human spirit can achieve in a free society. However, space exploration also encourages international cooperation, where spacecraft and explorer come to represent our world as well as our nation" (p. 21).

It is interesting to compare this point with Virgin Galactic's view that national government space exploration causes international *competition* and that only in handing over the reins to private enterprise can peace be obtained.

Not surprisingly, NASA's reframing of its role in light of its acknowledgment of the burgeoning private sector has caused a shift in the organization's budget allocations. The success of recent private reusable launch vehicles and the momentum they seem to be gaining in the public sector and in the media have caused the organization to plan to phase out the shuttle program completely by fiscal year 2012 in favor of the new Crew

Exploration Vehicle, which is still too early in development to speculate upon. The reason for this can be found in NASA's own doctrine. As NASA administrator O'Keefe states in the "Business of Risk" article "had NASA sponsored a flight similar to SpaceShipOne, an investigation would inevitably have been launched. I'd be called in as the first witness. A senator would start the questioning by saying 'Mr. O'Keefe, how is it that you could possible [sic] put a guy without a (pressurized) flight suit into a plastic airplane fueled by laughing gas…'" (p. 1).

It is with this redefined role and subsequent phasing out of the Space Shuttle and SpaceShipOne, that NASA makes its managerial attempt to represent its own special interests. Its budget through fiscal year 2009 increases at a rate of five percent per year for three years, despite the phasing out of the costly shuttle program. This has mostly to do with the nationalist role the organization seems to see for itself, with space exploration missions scheduled to account for approximately 65% of the budget by 2020, up from a paltry 20% today. It is of further note that the terminology that NASA administrator O' Keefe uses directly indicts SpaceShipOne as highly risky. Instead of describing the vehicle as constructed of composite materials and powered by nitrous oxide, he calls to mind images of childhood toys and the gas that anaesthetizes patients at the dentist.

Media treatment of pro-regulation material is similar to media treatment of pro-deregulation material. A similar casting of good and evil figures is present in the article "NASA Follows X Prize Footsteps" which appeared on March 23, 2005 on wired.com. The article evokes romantic notions of burgeoning technology such as one might find in science fiction, stating "High-tech tethers could play an important role in space missions if a proposal to build a so-called space elevator ever gets off the ground. The elevator

would lift vehicles thousands of miles into space by whisking them along an electromagnetic cable" (p. 1). In this article, however, NASA is cast as the hero, with the devil figure being played by congress. The article states "Congress currently limits NASA to awarding prizes of $250,000 or less. The space agency is lobbying lawmakers for the authority to increase the limit to as much as $40 million. That would allow the Centennial Challenges program to set up competitions for more-advanced projects, like a human orbital flight" (p. 2). Here, NASA is associated with the romantic ideal of humanity's valiant struggle against nature in that it seeks to encourage human orbital flight, yet it is constrained by Congress, which seemingly does not want to pay for such a prize.

There is a good amount of public opinion data that seems to support the pro-regulation view as well. In 1963, when space's future as a public good was still questionable, 89% of Americans said "government should develop rockets that send Americans to the moon". When asked in 1988 whether we should "shift a large part of the US civilian space program from NASA to private American companies because private enterprise is more effective than government", only 42% responded positively, with 52% saying no. When asked whether "the civilian space program is too big an activity to turn over to private companies", 61% agreed, with 38% strongly agreeing. When faced with the statement "Because NASA has a good overall record of managing the civilian space program, proposals to shift some of NASA's responsibilities to private industry are a bad idea", 58% answered in the affirmative, with 32% strongly agreeing.

When it comes to gauging public interest on *commercial* space travel, there is a similar dichotomy. Nevertheless, when asked in 1999 "Would you, yourself, like to go to

the moon?" 73% of the respondents said no. When asked in 2000 "Would you like to travel in space one day?" only 37% of Americans said yes. And when asked in 2003 "Would you, yourself, like to be a passenger on a space shuttle flight sometime in the future?" 69% said no. These surprising responses could be for a variety of reasons. Perhaps the public is anticipating the exorbitant costs that would go with such a privilege, or perhaps it is overly cautious due to security concerns.

As far as the former concern goes, the public was asked in 2000, "If you could travel in space what is the most you would pay for the trip?" 72% selected the lowest bracket, which was 1000 to 10,000 dollars. 14% said "10,000 to 100,000 dollars and only 3% said they would be willing to pay more than 100,000 dollars. This data would seem to support the status quo of only trained, elite astronauts in space.

Perhaps it is security concerns that cause the public to be seemingly uninterested to opportunities to travel in space. When asked in 2004 whether "a new treaty banning all weapons in space would be a good idea or a bad idea", 65% said it would be a good idea. In another sample of the same question, 74% said yes. When asked whether the recent "loss of the Space Shuttle (Columbia) was a terrorist act" 12% said yes despite there being absolutely no evidence of that being the case.

It seems as though nationalist concerns play a large role in public opinion on space travel. When asked in 2004 "How important do you think it is for the United States to be the leading country in the world in the exploration of space?" 73% said it is important, with 29% saying it is very important. When asked "When the space shuttle Columbia was lost yesterday, did you personally feel (upset)?" 94% of respondents said they did, with 58% saying they were deeply upset. Perhaps these nationalist concerns

inhibit public support for a private space market.

Nevertheless, this support for government involvement in space commerce contradicts the aforementioned public sector support for privatization. These inconsistencies seem to be in finding with Henry Aaron's conclusions in his Distinguished Lecture on Economics in Government, when he says:

> "…If behavior shapes preferences, then any estimated micro behavior that does not take explicit account of the consequences of the behavior on the underlying preferences is, by definition, reduced form and incapable of serving as a suitable guide to future action. The behavior that the model predicts would change the preference structure and thereby render the model invalid…This problem is similar to that bedeviling forecasts of responses to policy that induce technological change. Thus forecasts of the consequences of deregulation failed to encompass the full range of benefits because they failed to foresee induced technical changes…" (Aaron 52).

The public anticipates both exorbitant costs and safety concerns with space travel. Furthermore, little serious data exists besides forecasts, and this is often in the form of a loaded or misleading question taken out of historical context. Finally, the sheer nature of the space tourism market as one of an expanding technology makes the situation nearly impossible to model. And for this very reason, it is impossible to classify public opinion on this emerging market into any particular style of economic thought. Any such modeling or classification would fail to "encompass the full range of benefits" as espoused by Aaron above. These inconsistencies and failures lead one to conclude that public opinion on commercial space flight is largely inconclusive but that the potential for an explosive industry could exist.

**Other Solutions**

The issue is not so simple as to be one of deregulation versus regulation. There

are a variety of other solutions which involve loosening regulation in the short run and fostering cooperation between government and the private sector.

Molly K. Macauley in her capacity as a Senior Fellow of the think tank Resources for the Future has contributed a great deal of scholarship to the commercial space debate. She, like The Cato Institute's Edward L. Hudgins, advocates deregulation, but still sees government as playing a strong role in the development of the private space sector. She suggests in her 1996 "Testimony Prepared for Presentation to Committee on Science", addressed to the House of Representatives that "perhaps the challenge of commercial space lies not with the supply side addressed in many of the proposed provisions, but with the demand side (namely, what are the useful things to do in space, and why might taxpayers want to subsidize them)" (p. 7). This is quite a different approach to that taken by the Cato Institute, which allows for no government role at all. As Macauley's statement is an address to Congress, it conforms to Robert H. Nelson's view of government, that "A recurrent theme of (my) argument…is the influence of progressive-era conceptions…many of the institutions most important to the (economics) profession are founded on the political theories and general outlook of the progressive movement…" (p. 51). Thus, Macauley conforms to the role that economists have been consigned to play in government that is primarily based in the institutionalist thinking of the Progressive Era.

In similar testimony given in 2004, Macauley states:

> "The history of prizes is attractive enough to warrant experimenting with their use in NASA activities. Further review of the structure of previous contests…would provide helpful 'lessons learned' as plans proceed. But prizes cannot fully substitute for peer-reviewed grants and procurement contracts…Taken together…these forms of financial support make up a portfolio of tools for encouraging innovation" (p. 10).

Again, there is a similar mentality of correcting for problems through the construction of various special government institutions, in this case a mixture of prizes and research grants.

Like Hudgins, Macauley also uses a philosophical foundation with which to frame her argument. In a 1997 address to congress, Macauley paraphrases Thorstein Veblen, the father of American Institutionalism:

> "(Researchers) distinguish between the 'dynamic forces of technology' and the 'conservative forces of ceremony and ritual'. Perhaps (a blend of the two) characterizes the desirable relationship between a space program historically dominated by government and the emergence of commercial activity—NASA and the Department of Defense bring much expertise but are the 'conservative forces of ceremony and ritual' that must blend with the dynamic forces of technology" (p. 12).

Duke University history professor Alex Roland believes that the launch vehicle issue should be modeled after the Comsat projects: that the government and private sector should cooperate with each other. This essentially is how the telecommunications industry developed. He believes that prizes won't work because there are no long-term benefits to space tourism, that only government can lead the process due to inevitable exorbitant insurance costs. Roland also believes that manned missions are unnecessarily risky and expensive and that the robotics revolution will change the entire scope and trajectory of space travel. Essentially the excessively high costs of the space shuttle are due to the labor that goes into maintaining life support systems. From an efficiency standpoint, it does not make sense to send human beings into orbit in spacecrafts. Space tourism will remain a vanity for the rich, but the ultimate way to explore space and the ultimate mode for space applications will be to have government direct a process involving robotic missions with the assistance of the private sector.

Polling data exists in a number of sub-categories related to commercial space flight. There are data that question whether government or private corporations should be in charge of the commercial space flight industry, data gauging public interest in private space travel, questions relating to safety, and questions regarding America's role in the future of space.

In 1997, registered voters were asked "The Mars Pathfinder program was a joint venture between the US government and private corporations. Given the program's apparent success, do you think more government programs should involve private corporations?" 71% of the respondents said yes, and only 20% said no. In 1988, registered voters were asked "(Should we establish) a private or semi private space development corporation supported by the sale of the corporations' stock to the public, like the Comsat corporation which was used to build the communications satellite network(?)" 73% agreed, with 33% strongly agreeing.

**General Conclusions about Public Opinion, Think Tanks, and the Media**

Public opinion fluctuates significantly when it comes to commercial space travel. "The people" have been asked similar questions multiple times, and they respond quite differently each time depending on the way the question is phrased and the state of recent events. If the question calls to mind a recent success, the public is likely to applaud that success. If a recent failure is noted, the public is more likely to be concerned and cautious. If the question is phrased within the context of a broad public-private debate, people tend to fall in along ideological lines. Perhaps the public sector is quite incapable of making up its own mind when it comes to public polling over commercial space travel

and space tourism.

Perhaps this has to do with public ignorance. It is likely that a large proportion has not heard of the Ansari X Prize or SpaceShipOne, two vital components of the burgeoning commercial space travel industry akin to the Raymond Orteig Prize and the Spirit of St. Louis. Furthermore, due to the rapidly shifting preferences as a result of this sweeping technological change, public perception has been increasingly difficult to model. Uncertainty seems to be the only conclusion one might be able to draw from the public. Nevertheless, the role of the public in the space tourism debate will be further developed in the section on popular culture.

Both think tanks, the Cato Institute and Resources for the Future, advocate the development of the private sector in space, yet they differ in the ways in which they recommend building such an industry. The libertarian Cato Institute focuses on near-total privatization of the space sector, while Resources for the Future has focused on ways in which the government can expedite the space sector's development, through a mixture of government prizes and research grants. Both organizations see deregulation as key to developing the private space industry and have made their arguments using as foundation an historical style of economic thought, although the Cato Institute has relied heavily on a philosophical base for its neo-classical ideas, and Resources for the Future has incorporated a strong institutionalist element.

Of course, both institutions' outlooks can be attributed to their nature as think tanks. In the Cato Institute's capacity as "(a think tank) designed to spell out policy options from an ideological perspective" (Goodwin 16), it is no surprise that such a philosophical basis is used and a government-less free-market solution is advocated. To

give such solutions to problems is what the Cato Institute was founded for. Likewise, Resources for the Future was founded through the failed creation of a government committee "in response to an upwelling concern over…depletion of renewable resources" (Goodwin 16). Furthermore, as concerns Resources for the Future "the nucleus of its staff was comprised of 'refugees' from a short-lived natural resource unit within the Department of the Interior" (Goodwin 17). The organization may offer its institutionalist perspective on the development of a commercial space market out of its institutionalist foundation.

Overall, both the Cato Institute and Resources for the Future follow a consistent methodology and give appropriate responses as they relate to the overall nature of their organizations, yet they do this from an *a priori* perspective. The Cato Institute is strongly ideological and keeps with its ideology, developing a philosophical basis for its viewpoint and advocating a free-market solution to the development of the commercial space sector. Resources for the Future, in similar fashion, conforms to its unique ideology in advocating an institutionalist solution.

The styles seen in media coverage of the X-Prize and commercial space flight in general are hard to pinpoint much due to the polarizing effect of the media as it conforms to Jensen's Devil Theory. Nevertheless, certain styles are indeed capable of being noted, namely the historical style and the mercantilist style, in that many leading figures of big business are intimately involved in the expansion of the industry, including Richard Branson and Paul Allen. The CNN.com article states of X-Prize chairman Peter Diamandis, "He got the idea for the prize after reading Charles' Lindbergh's autobiography, 'The Spirit of St. Louis'. He realized that there were two things that

spurred innovation in aviation: Warfare—and cash prizes…" (p. 2). The wired.com article states "The (NASA) competitions are under the space agency's new Centennial Challenges program. The program seeks to spark technical innovations by following the model of historical challenges like the 1919 Orteig Prize that inspired Charles Lindbergh to make the first nonstop flight between Paris and New York" (p. 1). Finally, in the msnbc.msn.com article, Diamandis is quoted as stating "Over the course of the last two weeks we have had companies approaching us, we have had wealthy individuals approaching us, about investing in this marketplace. The same thing happened when Lindbergh flew, the same thing happened when Netscape went public, the same thing's going to happen here" (p. 7).

Overall, it seems as though the media does indeed follow Jensen's model of idealizing the romantic nature of a particular news story. As the idea of future space exploration by private citizens is likely to elicit a romantic response, it is an easy mold for the topic to fit into. The issue of the commercialization of space also seems to correspond to Jensen's Devil theory, with the usual parties representing good and evil sometimes reversed and sometimes represented by man and nature respectively. Overall the media fosters the imagination of the reader when it comes to the commercialization of space, that he can someday travel there and personally play a role in man's continual quest to understand and explore the world around him.

Ultimately, the two segments of society that are most important in this debate are the government itself, which determines if a potentially growing free market can be allowed to thrive and determines the legal framework within which this debate must occur, and popular culture, which serves as an image of truth.

**Approaches within Government**

Shortly after SpaceShipOne's success on October 10th, legislative action occurred, resulting in the Commercial Space Launch Amendments Act of 2004, which became law on December 23rd. The key economic provisions of the bill are as follows:

> "(1) the goal of safely opening space to the American people and their private commercial enterprises should guide Federal space investments, policies, and regulations…(3) greater private investment in these efforts will stimulate the commercial space transportation industry...and (5) the regulatory standards governing human space flight must evolve as the industry matures so that regulations neither stifle technological development nor expose crew or space flight participants to avoidable risks…" (p. 1).

While there have been few policy makers who have denied the economic and social advantages of such a private market, the question remains as to how and with what restrictions its development might be facilitated. Essentially the debate concerns the degree and type of regulation incurred upon such a high-risk industry as space tourism as per provision five above.

Despite the unique nature of the space tourism industry and its particular status as one of both exploration and danger, the debate generally conforms to the normal pattern of economics' role in government as described by Robert H. Nelson in his "The Economics Profession and the Making of Public Policy". To refresh the reader, Nelson states "A recurrent theme of (my) argument…is the influence of progressive-era conceptions…many of the institutions most important to the (economics) profession are founded on the political theories and general outlook of the progressive movement…" (p. 51). This is true in that the main opposition to provision five of the Commercial Space Launch Amendments Act of 2004 exists in the form of "ideological combatants"

representative of the social democrat style of economics. As Nelson states "economists encounter many advocates of social policies based on asserted absolute "rights" or values: protecting the environment from all harm, protecting human life from all risk…" (p. 58). In the case of the commercial space industry, the "ideological combatant" takes the latter form in the personage of Congressman James L. Oberstar (D-Minnesota).

Congressman Oberstar specifically objects to the provision in the act that states that "regulation governing launch vehicle design or operation…shall…be limited to restricting or prohibiting design features or operating practices that have resulted in a serious or fatal injury to crew…(This act) authorizes…eight years after (its) enactment…regulations without regard (to the information above)" (p. 2). Oberstar describes this in his "Bill to Enhance the Safety of Commercial Space Flight" as "The Tombstone Mentality" (p. 1). His final argument is that "we can and should protect the safety of passengers on space flights in this new and emerging industry, without placing unreasonable limitations on industry development" (p. 2). This seems to parallel the general tone of social democrat Hillary Clinton's "It Takes a Village", that while pragmatic concerns certainly do matter, social and humanitarian concerns should come first. As Clinton says when discussing the future of America's children:

> "Government has to do its part to reverse the crisis affecting our children, and to do so it cannot retreat from its historic obligations to the poor and vulnerable. Yes, we must work to balance the national budget, but we can not afford, in the long run—or for much longer in the short run—to balance it on the backs of children" (p. 315).

Nevertheless, here is where the similarities between Nelson's modeling of economics and government and the economics behind the space tourism debate end. There is a significant and quite mainstream group of historical government officials that

seek to parallel space exploration with such diverse historical events as the colonization of the Americas and the voyage of Lewis and Clark. Although quite pertinent, this is slightly problematic, as the historical group does not often seem to treat space tourism or the private space market specifically, but rather makes general arguments for increased government space-based funding. This is most likely due to the very newness of the particular issue under discussion. This group fails to distinguish between the two very different paradigms.

The historical style that characterizes this second group dominates the government literature and is especially prevalent in "a joint resolution adopted by the assembly of the State of California relative to space exploration to the Senate Committee on commerce, Science, and Transportation", "a Senate Concurrent Resolution adopted by the General Assembly of the State of Ohio relative to the funding of the National Aeronautics and Space Administration's Vision for Space Exploration Program to the Senate Committee on Commerce, Science, and Transportation, and a White House fact sheet titled "A Renewed Spirit of Discovery".

The first document in this group, "a joint resolution adopted by the assembly of the State of California relative to space exploration to the Senate Committee on commerce, Science, and Transportation" begins its argument by stating "…the United States is a nation of explorers…exploration and discovery have been especially important to the American experience, providing vision, hope, and economic stimulus…" (p. 1). The resolution further states:

> "…the desire to explore is part of our character, and history has shown that space exploration benefits all humankind through new technologies for everyday application, new jobs across the entire economic enterprise, economic contributions through new markets and commercial

> products…United States leadership…and a legacy for future generations" (p. 1).

The resolution goes on to list the new technologies mentioned, which include but are not limited to MRI technology, insulin pumps, and pacemakers. The report continues that "our nation's new vision for space exploration…allows our nation to remain competitive in the new industry of space commerce" (p. 2), and concludes that "…Congress and the President of the United States is [sic] requested to enact and fully fund the proposed budget for space exploration…to enable the United States and California, in particular, to remain a leader in the exploration and development of space" (p. 2). This historical argument coincides with economist Friedrich List's notion in Part I of his "National System of Political Economy" that:

> "history teaches us how nations which have been endowed by Nature with all resources which are requisite for the attainment of the highest grade of wealth and power, may and must—without on that account forfeiting the end in view—modify their systems according to the measure of their own progress" (p. 66).

In light of its particular history and the peculiarities of the industry, one can see how the United States has abandoned a more conventional approach to government when it comes to the space economy.

The Ohio resolution has both mirrored structure and content to the California report. The document states "the expansion of America's exploration boundaries from the original 13 states to the lunar surface in the relatively short period of 200 years has led to immeasurable benefits to all humankind…" (p. 1). This fits with List's notion in Part II of his "National System of Political Economy" that one state's domination benefits every other state. As he states in 1885 of the British Empire "it must be…admitted that England, in striving for…supremacy, has immeasurably increased, and

is still daily increasing, the productive power of the entire human race" (p. 119). This is fitting with the American ideal as embodied by the Ohio General Assembly.

In the White House fact sheet titled "A Renewed Spirit of Discovery" the parallels to historicism are even clearer. As the report states:

> "America's history is built on a desire to open new frontiers and to seek new discoveries. Exploration, like investments in other Federal science and technology activities, is an investment in our future. President Bush is committed to a long-term space exploration program benefiting not only scientific research, but also the lives of all Americans. The exploration vision also has the potential to drive innovation, development, and advancement in the aerospace and other high-technology industries…Our Nation's investment in space is reasonable for a tremendously promising program of discovery and exploration that historically has resulted in concrete benefits as well as inspiring Americans and people throughout the world" (p. 1-2).

Like the resolutions of the general assemblies of California and Ohio respectively, the White House fact sheet uses modelings of past similar, successful industries to shape current and future policy, citing economic benefits such as new markets for innovation and economies of scope.

Proponents of the Commercial Space Launch Amendments Act of 2004, which include the historicist members of the Legislative and Executive branches, seem to be enacting government policy that is conducive to the development of the private space tourism economy. They are doing this in a variety of ways. First, they are recognizing that the industry has the potential to greatly expand the economy in a variety of ways: by opening up the commercial space industry itself and by providing technology boosts to a variety of related industries. Second, they are recognizing that increased investment and funding must be given this industry, as it poses significant barriers to entry. Third, they are willing to forego perhaps appropriate regulation and ignore the excessive risk of the

commercial space industry to provide incentives to entrepreneurs. Opponents of the act, which includes social democrats like Representative Oberstar, seem to agree with the first two points but are unwilling to compromise when it comes to the safety of parties involved. Indicative in the speed with which the market potential was recognized and the Commercial Space Launch Amendments Act of 2004 was passed, but depending on how much of a deterrence increased safety regulations, if enacted, would present, it appears that current government policy trends support attempts to create a private space market. Nevertheless, government simultaneously supports the expansion and increased funding of NASA. This dichotomy perhaps suggests that, similar to NASA, government sees a different role for the private sector in space.

**The Treatment in Popular Culture**

In the debate over whether government or private enterprise should control space travel, science fiction has played a great and diverse, though unheralded role. Isaac Asimov, a leading science fiction author, describes science fiction as "…the only form of literature that consistently considers the nature of the changes that face us, the possible consequences, and the possible solutions." Essentially, science fiction creates a conceivable world by drawing out current trends, a methodological approach that we have already seen with the OECD report. While science fiction authors are not economists, they no doubt take count of economics and their worlds vary according to the types of economics present. Not surprisingly, the debate over whether NASA or private enterprise should control space travel is touched on in a considerable number of science fiction works both directly and indirectly, and various systems of economics are indicted

or lauded throughout.

The Star Wars saga can be read as involving a clash between the "rebels", or private citizens seeking to actualize their own self-interests, and the "empire", a vast governmental conglomerate that seeks ever more power. What the franchise has to say on the government versus private enterprise debate can best be illustrated by plot summary. The conflict that precedes the Clone Wars arises when, as the opening scroll to Star Wars Episode I: The Phantom Menace states "The taxation of trade routes to outlying star systems is in dispute." Essentially, the entire business of the six films originates out of a tax dispute between the social-democratic Republic and the mercantilist Trade Federation, which invades Naboo when its demands are not met. The Trade Federation eventually becomes the Galactic Empire, itself a regulatory organization, when it is used by Senator Palpatine to gain power. As a result of the mercantilist expansion and new regulatory regime, various black markets are created. Han Solo's ship, the Millennium Falcon, has smuggling compartments that he uses to protect his private space commerce from imperial taxation and regulation. Cloud City, a black market outpost run by Lando Calrissian, is eventually overrun by the Galactic Empire. The solution to the lack of economic freedom for the galaxy is embodied in the Force, a philosophy practiced by the Jedi warriors.

It is clear from the good/evil dichotomy of the Star Wars Trilogy, that the philosophical/theological and social democratic styles of economic thought practiced by the Republic and its constituents are preferred to the mercantilism of the Galactic Empire. In its effective transformation from special interest group to government itself, the Trade Federation/Galactic Empire did not drop its style. It merely applied it to a different

function. In this sense, Jenson's Devil Theory applies to popular culture as well. The mercantilist forces of the Galactic Empire are demonized while the social democratic Republic is heralded as the embodiment of a golden age. Perhaps George Lucas was thinking allegorically when he created the original plot for Star Wars. Is Lucas perhaps suggesting that private enterprise should forge space commerce, but beneath the guiding hand of a social democratic regulatory government? Is Lucas also suggesting that special interest groups like trade unions pose threats if given too much power?

In Star Trek, economic commentary is even more prevalent. It is widely speculated by Trekkies that the future is Communist. The Proletariat has been victorious, and appropriately, freedom of movement has been denied to the populace. This Marxist interpretation of Star Trek would certainly suggest that government controls space commerce. The series essentially operates on the principle that self-interest is no longer a guiding force of activity. There is no money, no wealth, and nobody seems to mind. This is mentioned in several episodes. Furthermore as evidence of a Marxist view of commercial space travel is that whenever a crisis exists on a particular planet, people do not leave as refugees, since they have no personal ships. They are always waiting for a federal transport vessel to arrive and rescue them. Nevertheless, there is no talk of revolution. The past (future) is marked by a Dark Ages-like violence, where chaos reigns and eventually, after a long struggle, man embraces peace. This provides evidence that perhaps in the world of Star Trek, humankind has accepted an extreme form of the social democratic style or the philosophical/theological style, specifically that they have consciously denounced self-interest and violence as immoral. Of course, whether believing in universal government control or having rejected self-interested competition

through the free market, Star Trek is firmly on NASA's side when it comes to the space debate.

My final example, and the one most pertinent to the topic, is popular author Dan Brown's *Deception Point*. The professional economics literature has said the reason NASA has slowed in terms of progress in recent years is the lack of competition due to its nature as a monopolistic government agency. Due to the fact that the potential payoffs of a privatized space economy is such a long term prospect, private entrepreneurs have been unable to take advantage of NASA's lack of progress. Furthermore, public ignorance and apathy has eliminated the standards of accountability for NASA existing during the Cold War. Nevertheless, in *Deception Point*, one of the principal characters, Senator Sedgwick Sexton, is running against incumbent Zachary Herney is a closely-contested race, on the single issue platform of privatizing space commerce. The justification for Sexton's popularity is that a memo from 1996 is disclosed in which the Clinton Administration is briefed that life outside Earth has been found. Alien enthusiasts around the US flock together in support of Sexton and the privatization of space commerce. Of course, in typical Dan Brown style, it is insisted that all the scenarios in the novel are true.

Nevertheless, while *Deception Point* does indict NASA for being an inefficient bureaucracy and for denying Americans knowledge which they feel they deserve, Brown ultimately takes NASA's side. The private enterprisers in *Deception Point* are the masterminds of a huge conspiracy, which reaches very high up in the chain of government. They are in essence mercantilists, manipulating the public in order to make a profit. With his final conclusion in favor of the government, Brown adheres to a social

democrat style in that he acknowledges the inefficiencies of government but prioritizes safety and concern for all citizens.

Futurist science fiction has been long regarded for its ability to create a believable world through the drawing out of current trends. This naturally includes economic trends. The protagonists in the works examined include Marxists, social democrats, and practitioners of the philosophical/theological style of economic thought (Jedis). This bipolar debate echoes Michael Jenson's Devil Theory that normally applies to the media. Perhaps the fact that the two entities, the mass media and popular culture, have the same audience is what allows for the similarity. According to popular culture, the future contains as many threats to private enterprise as the present. Nevertheless, its treatment is highly futurist and is difficult to take seriously from a scientific standpoint, despite similar methodology to the neoclassical approach. In an issue as romantic as space, popular culture capitalizes on the wildest hopes and dreams of the populace, dreams that perhaps are necessary to drive humanity's quest to explore space and which account for the strong presence of the historical style throughout this debate.

**Conclusions**

As this paper has shown, three dominant paradigms exist within the space tourism debate. The first is that competition among the private sector is the only way to develop space tourism. Within this viewpoint, the neoclassical seeks to model and create a market through lump-sum transfers of wealth. The second paradigm is that only NASA or a corresponding agency can weather the high costs and high risks inherent to the space tourism industry. Within this viewpoint, the social democrat prioritizes safety as a

concern that must be taken care of before a free market can be created. The third viewpoint is that cooperation, not competition, is the key to growth. Within this viewpoint, the institutionalist seeks to loosen regulations but to keep government in direct control. Within each viewpoint self-interested parties provide a strong mercantilist voice; both NASA and Virgin Galactic utilize other rhetorics within their respective viewpoints in formulating their multifaceted arguments.

The styles used by the various segments support manned exploration. An historical style is used in every segment, comparing the current situation to the explorations of Lewis and Clark, the aviation barnstorming of the 1930's, the discovery of the new world, and even man's supposed first foray from caves. Despite this, however, government seems to recognize the importance of the commercial space development issue and has jumped to the forefront in terms of scholarly and intelligent debate. Many leading scholars have testified in front of Congress, and lawmakers have generally enacted well-informed and productive policies. Alex Roland, Edward Hudgins, and Molly Macauley have all testified numerous times. Government is indeed *the* forum for multifaceted and cutting-edge debate on the space tourism development issue. Popular Culture seems to be a good indication of where the rest of society lies: outside the more scholarly realms of the neo-classical economic core, the Cato Institute, Resources for the Future, and academe. Popular Culture embraces a variety of styles, including the Marxian, philosophical-theological, and social democrat. Popular Culture serves as a model for the chaos that is the public sphere in terms of debate on space commerce. In order to ensure a successful and efficient transition to space applications, it is essential that, in addition to providing some closure to the debate itself, a method of more

adequately delivering information to the public be found to replace the oversimplifications present in the media and the inherently speculative nature of science fiction. Without such a method, the space tourism industry will find it difficult to develop new clientele. Also, if the public does not know what goes on in Congress, there is no way for it to hold lawmakers accountable. Congress can easily transform from a place where the opinions of independent scholars such as Roland, Hudgins, and Macauley are well-respected to a competition among special interests such as Virgin Galactic and NASA.

In 2000, the general public was posed the question "Thinking about a child born on January 1, 2000, do you think… the following will or will not happen during that child's lifetime: Average people will be able to travel in space". The public was split, with 47% and 48% answering yes and no respectively. Perhaps someday average people will travel in space, but there are a great number of important puzzles to solve first. The most pressing is how to encourage civilian space activity. Is a free market the solution? From a neoclassical standpoint it is, but there are significant barriers to entry that can be overcome only by government or an extremely wealthy financier willing to tolerate years of loss. If government overcomes these initial fixed costs, we have a situation similar to that which has always described both American and Soviet space exploration programs. If an extremely wealthy financier can afford these costs, as we are seeing with the X Prize and with Richard Branson and Virgin Galactic, the definition of space as a public good is in question. For space tourism entrepreneurs, half the battle consists in redefining space as not a natural public good, and convincing the public that efforts to build private space commerce are feasible. Thus far entrepreneurs have done a good job collaborating

with popular science periodicals, such as Discover Magazine, in efforts to convince the public that ventures are indeed realistic. This is important both as advertising in the traditional sense and to discredit uninformed media or fictional authorities.

There are also important safety issues, as raised by Congress, NASA, the public, and Virgin Galactic itself, that must be solved. For many involved in the creation of a private space market, the safety of passengers is a serious ethical problem. Under the current NASA system, an astronaut represents America and safety is the first concern. When there is a tragedy such as with the explosion of the Space Shuttle Columbia, all of America feels for the victims, since they represent all of America. If such missions were under the control of the private sector, where instead of young men and women sent into space solely for exploratory, military, or scientific purposes, they were motivated by profit or thrill-seeking, there would be no more national mourning. The few citizens that would hear about such an event might feel bad for the people involved and their families, but ultimately, it's no different than if a mountain climber or daredevil were involved in a fatal accident. The individual now represents no one but himself. He has most likely signed a liability release in exchange for this occasion of a lifetime. While such a scenario will doubtless result in both good and bad effects, many lawmakers feel it's unethical to contribute to the creation of such a market, knowing that safety standards will be reduced, if not non-existent.

The creation of a private space tourism market also poses legal liability problems. An elaborate code must be developed to allow smooth development in this industry and to make sure liability insurance does not become a problem, as it has been in the explosive healthcare industries. Furthermore, space commerce hinges on a great number

of other burgeoning technologies, such as robotics, artificial intelligence, and nanotechnology. Finally, information diffusion from the intellectual elite through government to the public has been slow, thus violating the assumption of perfect information. There is no public accountability for lawmakers, and, if the middle class is unaware of your product, you will have to make them aware through advertising, which will only make your product more expensive. From a neoclassical standpoint, the free market is the ultimate *ideal*, nevertheless, it is the purpose of this paper to explore how realistic this is in the near-future, as methodology and conclusions become increasingly spurious as the future trajectory increases. There are significant problems, both on the demand side and the supply side that must be solved to ensure that this industry develops smoothly. Due to the large amounts of problems within the debate, it would appear that, in order to make significant progress, government currently needs to be involved in space commerce. The industry is ripe for overinvestment, poor safety standards resulting in liability problems similar to the health care industry, and, through various companies competing, could run out of clientele rapidly. Otherwise, commercial space applications would be limited to adventure tourism for the extremely wealthy for quite some time.

Essentially, the ideal regulatory regime needs to recognize that if it remains too detached, entrepreneurs would still struggle to find prizes worth investment. For many of the development teams that competed for the X Prize, SpaceShipOne's success was their bankruptcy. It's difficult for such an expensive industry as space tourism to depend so much on private investors. Also, the fact that profits are such a long way away for many firms means that there will almost certainly be overinvestment and a market crash similar to that of the internet bubble. Government should assist in any way possible to make sure

that natural business cycle of the space tourism market is not as extreme as that of the dotcom crash. However, if a regulatory regime is too involved, it essentially trades excess costs in the form of liability insurance for excess costs in meeting safety standards, which is an upfront cost and makes development even more difficult. Overall, it is necessary to give some assistance at the beginning, but the crucial step is for government to let go once the industry is developed. It is most important to maintain market integrity, perhaps establish separate roles for NASA and private enterprise. If firms within the space commerce industry attain initial success, they will have more funding to put into more efficient means of production, larger spacecraft to carry more people at cheaper prices, and the capacity to achieve an adequate level of safety in order to attract consumers. The government should be flexible in this initial stage. It should essentially allow the industry to grow, and adjust things like safety standards as they become more economically feasible. The ideal regulatory regime will essentially let the market work, but see and correct for its shortcomings.

**Acknowledgments**

The writer wishes to thank those who contributed to this paper, including Craufurd Goodwin, Alex Roland, Ed Tower, and the students of Economics 150: The Uses of Economics.

**Bibliography**

William Gibson, Neuromancer, chapter 1, pp. 3 – 25 (e-reserves)

Andreu Mas-Colell, Michael D. Whinston, and Jerry R. Green, Microeconomic Theory, introductions to parts of textbook (e-reserves)

Organisation for Economic Co-operation and Development. (2004). Space 2030: Exploring the future of space applications
from http://www.cnn.com/2004/TECH/space/10/04/spaceshipone.attempt.cnn/index.html

Almanac of Policy Issues (2005, January 14). *President Bush Announces New Vision for Space Exploration Program: Fact Sheet: A Renewed Spirit of Discovery*. Retrieved February 22, 2005 from
http://www.policyalmanac.org/economic/archive/nasa)bush_plan.shtml

Ansari X Prize. *What is the Ansari X Prize?* Retrieved February 12, 2004 from
http://www.xprize.org/about/what_is_the_xprize.php

Bill Summary and Status for the 108th Congress (2004, November 18) *Commercial Space Launch Amendments Act of 2004*. Retrieved February 24, 2005 from
http://thomas.loc.gov/cgi-bin/bdquery/z?d108:HR05382:@@@L&summ2=m&

Hillary Rodham Clinton, It Takes and Village (and Other Lessons Children Teach Us), pp. 284 – 315 (e-reserves)

Congressional Record Online (2005, February 8). *Introducing a Bill to Enhance the Safety of Commercial Space Flight by Hon. James L. Oberstar of Minnesota in the House of Representatives*. Retrieved February 22, 2005 from http://wais.access.gpo.gov

Congressional Record Online (2005, February 17). *Petitions and Memorials: POM-8 – A joint resolution adopted by the Assembly of the State of California relative to space exploration; to the Senate Committee on commerce, Science, and Transportation*. Retrieved February 22, 2005 from http://wais.access.gpo.gov

Congressional Record Online (2005, February 17). *Petitions and Memorials: POM-9 – A Senate Concurrent Resolution adopted by the General Assembly of the State of Ohio relative to the funding of the National Aeronautics and Space Administration's Vision for Space Exploration Program; to the Senate Committee on Commerce, Science, and*

*Transportation*. Retrieved February 22, 2005 from http://wais.access.gpo.gov

Congressional Record Online (2005, February 2). *The Shuttle Will Fly by the Hon. Tom DeLay of Texas in the House of Representatives*. Retrieved February 22, 2005 from http://wais.access.gpo.gov

Friedrich List, National System of Political Economy, sections one and two (McMaster Web site)

Robert H. Nelson, "The Economics Profession and the Making of Public Policy," Journal of Economic Literature, vol. 25, March 1987, pp. 49 – 91 (JSTOR)

Henry J. Aaron et al., "Symposium on Economists as Policy Advocates," Journal of Economic Literature, vol. 25, March 1987, pp. 49-91

Commercial Space Launch Amendments Act of 2004 (2004, November 17). *Rohrabacher: Deal Set For Commercial Space Launch Bill* Retrieved March 2, 2005 from http://nationaljournal.com

Space Exploration Polls Retrieved March 2, 2005 from http://poll.orspub.com/poll/lnext.dll/ors/s/spaceexploration

Space Exploration Polls Retrieved March 2, 2005 from http://web.lexis-nexis.com

Henry J. Aaron et al., "Symposium on Economists as Policy Advocates," Journal of Economic Literature, vol. 25, March 1987, pp. 49-91

Craufurd D. Goodwin, "The Fifth Estate: Institutions for Extending Public Policy Debate in Emerging Democracies—Lessons from the American Experience," from Beyond Government (e-reserves)

Edward L. Hudgins, "Introduction: The Coming Commercial Frontier in Space" Retrieved March 23, 2005 from http://www.cato.org

Edward L. Hudgins, *X-Prize Proves the Power of Entrepreneurship* Retrieved March 23, 2005 from http://www.cato.org/pub_display.php?pub_id=2842&print=Y

Edward L. Hudgins, *Move Aside, NASA* Retrieved March 23, 2005 from http://www.cato.org/pub_display.php?pub_id=2514&print=Y

Edward L. Hudgins, *Statement on Space Policy and Space Tourism before the Subcommittee on Science and Aeronautics* Retrieved March 23, 2005 from http://www.cato.org/cgi-bin/scripts/printtech.cgi/testimony/ct-eh062601.html

Edward L. Hudgins, *Hayek vs. Asimov: Spontaneous Order or Failed Foundation* Retrieved March 23, 2005 from http://www.cato.org/cgi-bin/scripts/printtech.cgi/research/articles/hudgins-960101.html

Alan Pell Crawford, *An "Industrial Policy" for Space?* Retrieved March 23, 2005 from http://www.cato.org/pub_display.php?pub_id=935&full=1

Molly K. Macauley, (1996) *Testimony Prepared for Presentation to Committee on Science* Retrieved March 23, 2005 from http://www.rff.org

Molly K. Macauley, (1997) *Testimony Prepared for Presentation to Committee on Science* Retrieved March 23, 2005 from http://www.rff.org

Molly K. Macauley, (2004) *Testimony Prepared for Presentation to Committee on Science* Retrieved March 23, 2005 from http://www.rff.org

CNN (2004, October 4). *SpaceShipOne Captures X Prize*. Retrieved February 12, 2005 from http://www.cnn.com/2004/TECH/space/10/04/spaceshipone.attempt.cnn/index.html

CNN (2004, October 4). *The race for flights into space*. Retrieved March 29, 2005 from http://www.cnn.com/2004/TECH/10/25/spark.spaceage/index.html

Bill Gates, "Compete, Don't Delete," The Economist, June 13, 1998, p. 19 (www.microsoft.com/presspass/features/1998/bill-economist.asp)

MSNBC (2004, October 5). *SpaceShipOne wins $10 million X Prize*. Retrieved March 29, 2005 from http://www.msnbc.msn.com/id/6167761/

Wired News (2005, March 23). *NASA Follows X Prize Footsteps*. Retrieved March 29, 2005 from http://www.wired.com/space/0,2697,67000,00.html?tw=wn_13techhead

De Mandeville, Bernard, "The Fable of the Bees, or Private Vices, Publick Benefits" (e-reserves).

National Aeronautics and Space Administration, "A Renewed Spirit of Discovery: The President's Vision for U.S. Space Exploration", February 2004.

Kraemer, Sylvia Katherine, *NASA, Monopolies, and the Cold War: The Origins and Consequences of NASA Patent Policy, 1958-1996* Retrieved April 6, 2005 from www.nasa.gov.

Levine, Jay, *the Business of Risk: O'Keefe Contrasts Government and Private Industry Roles, Responsibilities* in The NASA X-Press Retrieved April 7, 2005 from http://www.nasa.gov.

Reiff, Mark, *The Space Industry: Apples to Apples*, Retrieved April 7, 2005 from

http://www.freerepublic.com.

Geoffrey F. Segal and Adrian T. Moore in Reason Public Policy Institute, "Frequently Asked Questions about Federal Outsourcing, Competitive Sourcing, and Competition", July 2003.

Wired News (2005, March 23). *NASA Follows X Prize Footsteps*. Retrieved March 29, 2005 from http://www.wired.com/space/0,2697,67000,00.html?tw=wn_13techhead

Michael C. Jensen, "Toward a Theory of the Press" (e-reserves).

Lucas, George. *The Star Wars Trilogy* (1977 – 2005), film.

Roddenberry, Gene. *Star Trek* (1966 – 2005), series

Brown, Dan, *Deception Point*. Pocket, 2002.

Michael Watts and Robert F. Smith, "Economics in Literature and Drama," Journal of Economic Education, Summer 1989 (Business Source Premier).

Karl Marx and Friedrich Engels, "Bourgeois and Proletarians" (www.marxists.org/archive/marx/works/1840/com-man/ch01.htm)

Holmes, Jerry, "The Curious Economics of Star Wars" Retrieved on April 13th from http://wueconb.wustl.edu/~tchecndg/archive/1999/1078.html

"The Economics of Star Trek" Retrieved on April 13th from http://www.stardestroyer.net/Empire/Essays/Trek-Marxism.html