The Economic Impact of Commercial Space Transportation on the U.S. Economy: 2002 Results and Outlook for 2010

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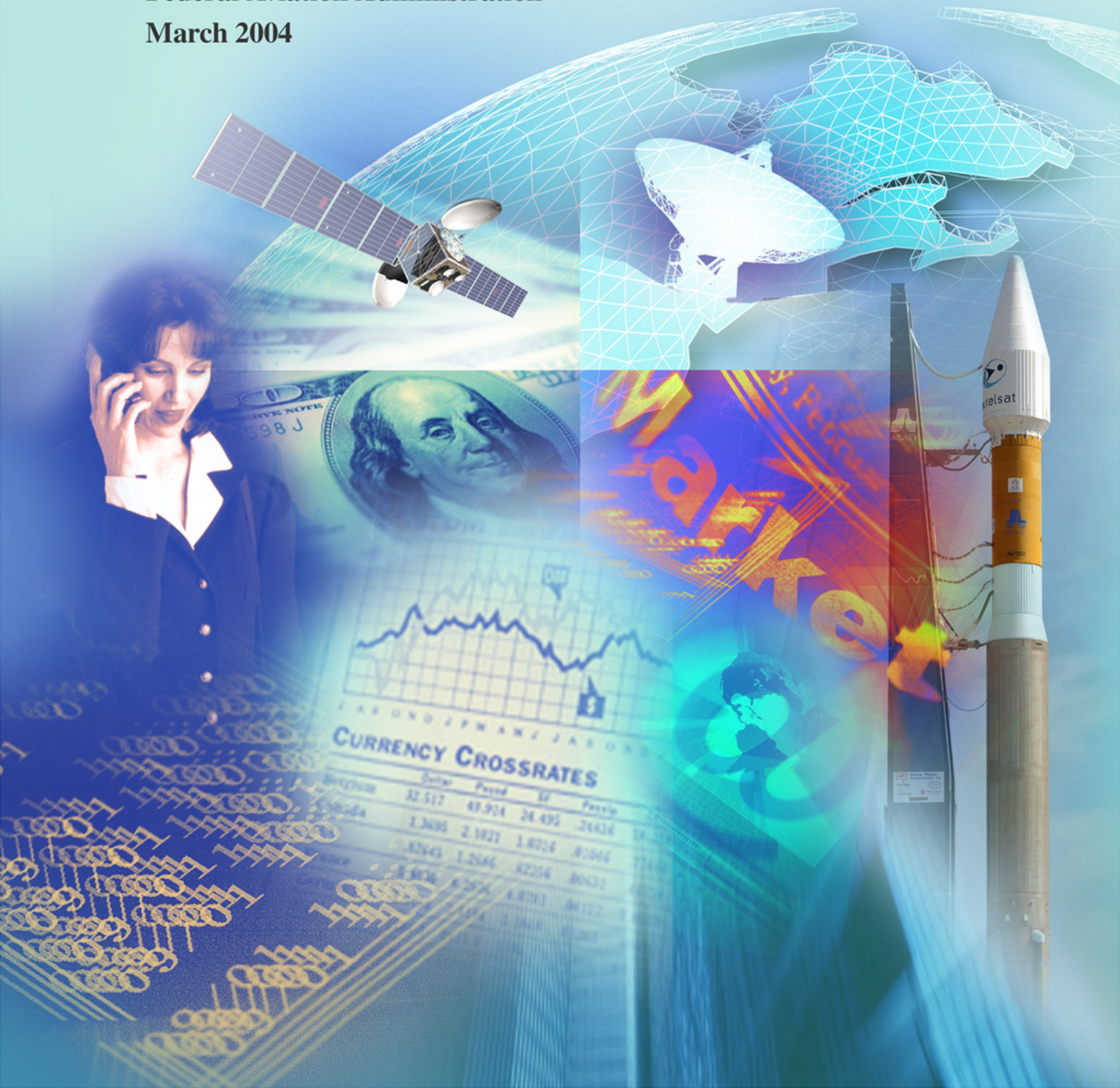

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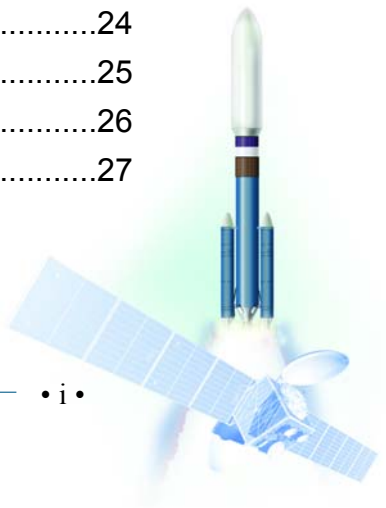

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Executive Summary

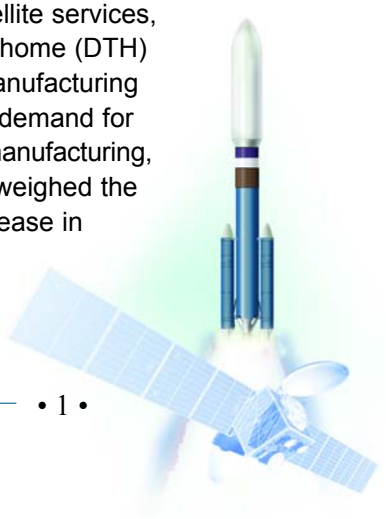
The Economic Impact of Commercial Space Transportation on the U.S. Economy: 2002 Results and Outlook for 2010 report features a quantitative analysis of the extent to which the manufacture and sale of commercial launch vehicles, as well as the conduct of commercial space activities enabled by the launch industry, are responsible for contributing to production and generating jobs in a variety of space- and non-space-related industries in the United States.

This report examines the U.S. commercial space transportation industry and the launch-enabled industries together to assess the full economic impact of commercial space transportation on the U.S. economy. Those industries include launch vehicle manufacturing and services, satellite manufacturing, ground equipment manufacturing, satellite services, remote sensing, and distribution industries. The report highlights how those industries affected the economic activity, employee earnings, and number of jobs in all major U.S. industry sectors, as defined by the U.S. Department of Commerce's RIMS II economic model.

This is the Federal Aviation Administration Associate Administrator for Commercial Space Transportation's (FAA/AST) second study of the commercial launch industry's effect on the nation's economy. The first study, released in 2001, determined that in 1999 commercial space transportation and enabled industries were directly and indirectly responsible for $61.3 billion in economic activity, $16.4 billion in employee earnings, and 497,000 jobs in the United States.

The impacts quantified in this report are based on data for the year 2002 and reveal that U.S. economic activity linked to the commercial space industry totaled over $95.0 billion and contributed to $23.5 billion in employee earnings throughout the United States. Over 576,000 people were employed in the United States as a result of the demand for commercial space transportation and enabled industries' products and services. A summary of the economic impacts of commercial space transportation and enabled industries on the U.S. economy is shown on the next page.

While this study shows that the overall economic impact of commercial space activities has grown significantly in the last three years, the various industry segments performed differently. Launch vehicle and satellite manufacturing impacts declined since 1999, primarily due to a sharp decrease in the manufacture and launch of commercial spacecraft. Satellite services, on the other hand, recorded a major increase in economic impact as direct-to-home (DTH) television and other services attracted more customers. Ground equipment manufacturing also showed an increase in economic impact, largely related to the increased demand for satellite services. The gains made by satellite services and ground equipment manufacturing, as well as smaller increases in remote sensing and distribution industries, outweighed the decreases in launch vehicle and satellite manufacturing, resulting in a net increase in economic impact from 1999 to 2002.



Total Impacts on the U.S. Economy Generated by Commercial Space Transportation and Enabled Industries, 1999 and 2002[1]

Industry	Economic Activity ($000) 1999	Economic Activity ($000) 2002	Earnings ($000) 1999	Earnings ($000) 2002	Employment (Jobs) 1999	Employment (Jobs) 2002
Launch vehicle manufacturing and services	$ 3,515,978	$ 791,759	$ 1,071,722	$ 206,328	28,617	4,828
Satellite manufacturing	6,839,132	4,937,867	1,964,415	1,379,491	57,372	31,262
Ground equipment manufacturing	24,030,337	37,934,507	6,893,878	10,134,674	213,076	247,160
Satellite services	25,818,414	49,560,450	6,150,105	11,239,634	186,954	278,287
Remote sensing	235,879	555,282	85,292	192,702	2,820	5,108
Distribution industries	873,971	1,245,881	265,780	374,916	8,506	9,803
Total Impacts	**$61,313,711**	**$95,025,746**	**$16,431,192**	**$23,527,745**	**497,345**	**576,448**

Section 2 of this study explores the potential future economic impact of the U.S. launch vehicle manufacturing and services sector by exploring two scenarios for the industry in 2010. Under a constrained scenario the U.S. would have only a 10% share of the commercial orbital and suborbital launch markets forecast for 2010, while under a robust scenario the U.S. would have 60% of the orbital and 75% of the suborbital markets for that year. The constrained scenario shows that the launch vehicle manufacturing and services sector would generate markedly lower economic impact than in 2002, while the robust scenario puts the sector at approximately the same levels as in 1999. A summary of the economic impacts of the two 2010 scenarios is provided below.

Projected Total Impacts on the U.S. Economy Generated by the Commercial Launch Vehicle Manufacturing and Services Sector in 2010

	Constrained	Robust
Economic Activity ($000)	$ 496,755	$ 3,559,395
Earnings ($000)	$ 129,452	$ 927,560
Employment (Jobs)	3,029	21,704

[1] Values are in current dollars, not adjusted for inflation.

Section 1

Economic Impact of Commercial Space Transportation and Enabled Industries on the U.S. Economy in 2002

Introduction

Since the 1950s, the U.S. Government has invested billions of dollars in the development of launch vehicles. These vehicles were originally developed solely to place military and civil government satellites into orbit. In January 1958, the first successful U.S. Government launch occurred when a Jupiter C rocket placed the Explorer 1 satellite into orbit. The private sector soon realized the potential commercial benefits of the ability to place spacecraft into orbit, primarily for space-based communications. The first commercial spacecraft was AT&T's Telstar 1, launched on a Thor-Delta booster in July 1962, with the National Aeronautics & Space Administration (NASA) conducting the launch for AT&T on a cost-reimbursable basis. The Government also launched the subsequent few commercial payloads of the early space age.

Over time, a U.S. commercial launch industry began to develop as commercial satellite operators started to work more closely with the manufacturers of launch vehicles. By the late 1980s, the U.S. commercial launch industry developed into its present form due to the emergence of overseas competitors, the passage of the Commercial Space Launch Act, and an executive order forbidding the use of the government-operated Space Shuttle to launch commercial payloads. The first U.S. commercial orbital launch licensed by the U.S. Government took place in August 1989 when a Delta 4925 carried the Sirius 1 communications satellite into orbit. Since that time, there have been more than 150 launches licensed by the U.S. Government. Today, four nations and one multinational entity regularly perform commercial launches.

The development of a commercial space transportation industry has aided the growth of other industries. In addition to enabling technological advancements, the launch industry has enabled economic growth by contributing to the evolution of new commercial markets. The communications industry has gradually transformed its use of communications satellites from simple infrastructure applications such as telephone trunking and television transmission to more complex, value-added services including direct-to-home television (DTH), data services, very small aperture terminal (VSAT) services, and most recently, digital audio radio services (DARS). Commercial space transportation has also supported the growth of the commercial remote sensing industry. The growth of these satellite applications has, in turn, sustained markets for satellites and ground equipment.

Indeed, the launch industry has technologically enabled satellite manufacturing, satellite communications services, remote sensing, and satellite ground equipment manufacturing. By producing reliable, more capable launch vehicles that successfully place satellites into orbit, the commercial space transportation industry has enabled the growth of markets for satellites, satellite services and ground equipment.

The Economic Impact of Commercial Space Transportation on the U.S. Economy: 2002 Results and Outlook for 2010 is FAA/AST's latest study on the commercial launch industry's influence on the nation's economy. The commercial launch industry has promoted the development of businesses that build satellites, sell satellite communications services and satellite imagery, and manufacture ground equipment necessary to operate satellites and use satellite services. In this report, commercial space industries that depend on commercial space transportation are referred to as enabled industries. Responsible for billions of dollars of U.S. production each year, these industries are examined here in tandem with the commercial launch industry to assess the full impact of commercial space transportation on the U.S. economy.

This report is a quantitative analysis of the extent to which commercial space transportation and enabled industries together are responsible directly and indirectly for supporting a variety of space- and non-space-related industries, thereby contributing to production and generating jobs in the United States. The figures in this report do not simply present the revenues and employment statistics for the commercial launch industry and enabled industries. Rather, estimates derived from the data included in the report quantify the economic impact of the commercial launch industry and the industries it enables.

Study Objectives

Commercial space transportation and its enabled industries impact the economy continuously. This year's study aims to describe that impact by showing the economic impact of commercial space transportation[2] and the industries it enables on the nation's economy in 2002 and by placing it in context with past and predicted economic environments.

To meet the first objective, the study highlights other industry sectors that profit from commercial space transportation activity and the extent to which these industries are affected. By measuring economic impacts, the study quantifies how much economic activity is stimulated, how much income is earned, and how many jobs are created in other industry groups as a result of the activities in commercial space transportation and enabled industries.

The second objective is to provide an outlook for commercial space transportation and the potential economic impacts of varying future scenarios.

In 2001, FAA/AST published a study of the U.S. commercial launch industry's effect on the nation's economy for the year 1999. This report provides a comparison of the economic impacts of the commercial launch industry on the nation's economy in 2002 with the results from 1999. It also compares the economic impacts of commercial space transportation and enabled industries to the impacts of other industry sectors on the U.S. economy. Using that analysis and projections for future launch revenues, the study provides an outlook of two scenarios in which launch activity and U.S. market share change and the subsequent economic impact of each scenario. The outlook portion of the study is intended to demonstrate how different space industry trends affect the economic impact of commercial space transportation on the U.S. economy.

[2] This study classifies commercial launches as one or more of the following:

- Internationally competed launch events (i.e., launch opportunities considered available in principle to competitors in the international launch services market)
- Any launches licensed by FAA/AST under the Commercial Space Launch Act as amended, codified at U.S. Title 49, Section 701, Subsection 9.

In some instances, commercial launches may include the launch of government payloads on commercial vehicles.

Industries Included in Analysis

The industries included in the calculation of economic impacts are outlined below. The list comprises the commercial launch industry as well as the industries that commercial space transportation enables.

- **Launch vehicle manufacturing and services** includes the construction of U.S. commercial launch vehicles and the provision of U.S. commercial launch services.[3]
- **Satellite manufacturing** includes the sale of all commercial satellites constructed by U.S. commercial satellite manufacturers.
- **Satellite services** include both end-user services and transponder leasing. End-user services include satellite telephony, VSAT services, satellite data services, and DTH. Satellite data services include mobile data services, such as asset tracking and high-speed Internet services. Transponder leasing includes services offered by companies that operate satellites and lease or sell satellite transponder capacity on a full-time or occasional-use basis.
- **Remote sensing** includes the provision of raw satellite data and satellite imagery services. It does not account for sales by firms that digitally process imagery and combine it with additional information to create maps, databases, or other value-added products.
- **Ground equipment manufacturing** includes satellite-related hardware, such as gateways and satellite control stations; mobile uplink equipment; VSAT terminals; and consumer electronics used with satellite services, such as direct broadcast satellite dishes, phone booths, and handheld phones.
- **Distribution industries** represent wholesale and retail trade margins and transit costs incurred as components are moved to manufacturing sites. Distribution industries are positively affected by commercial space transportation because truck, air, and rail transportation services are required to move parts to the manufacturing sites and to move launch vehicles and satellites to launch sites.

Approach

This study follows FAA-recommended procedures for economic impact analysis, including the use of the Regional Input-Output Modeling System (RIMS II) developed by the Department of Commerce, Bureau of Economic Analysis. The study uses FAA-accepted methods to quantify the economic values of financial transactions associated directly or indirectly with commercial

[3] International Launch Services' Proton launches are not included in the impacts assessed herein. However, Sea Launch launches are included because Sea Launch is considered a U.S. company whose launches are both commercial and licensed by the FAA.

space transportation and enabled industries. Financial transactions are traced through the economy in order to identify which industry types benefit, and by how much.

RIMS II is used to quantify the *full economic impact* of the commercial launch industry and the industries it enables; the figures herein do not simply present the revenues and employment statistics for the commercial launch industry and enabled industries. Economic impacts are measured in terms of economic activity, earnings of employees, and jobs generated not only within these industries but also within the industries they support directly and indirectly.

Commercial space transportation and enabled industries impact the national economy as well as regional and local economies across the country. In this report, commercial space transportation and enabled industries impacts are shown only for the national economy, with the understanding that the national economy is an aggregation of the regional economies throughout the United States.

RIMS II

RIMS II is an economic input-output model developed by the Department of Commerce, Bureau of Economic Analysis to map the flow of goods and services within the U.S. economy and to illustrate the interconnection of producers and consumers. The model is used to measure individual industries' contributions to the economy. Appendix A explains how RIMS II was used to generate the data for this study. Appendix B elaborates on the translation of the aforementioned industries into applicable categories for use with RIMS II.

Source Data

Economic impact analysis using RIMS II is dependent on the revenue data for each industry analyzed. The revenue information used to derive the impacts shown in this report is based on the results of the Satellite Industry Association's (SIA) *2002 Satellite Industry Annual Indicators Survey.*[4] SIA has conducted an annual survey of hundreds of companies within the global space industry for the last six years. The survey output is the total revenue of the commercial space industry, including the launch, satellite manufacturing, satellite services, remote sensing, and ground equipment sectors broken into U.S. and world revenue numbers.

This report considers only U.S. revenues and impacts of commercial launches and the industries that commercial space transportation enables. The data do not account for impacts on the economy of industries and activities enabled by Space Shuttle launches or non-commercial expendable vehicle launches, such as revenues from the launch of Global Positioning System (GPS) satellites and sales of handheld GPS navigation devices.

[4] The data collected from the SIA survey have been recategorized to accommodate industry definitions determined to be appropriate for this report. Revenue data may differ from that reported by SIA.

Measuring Economic Impacts

The demand for commercial space transportation and enabled industries' goods and services impacts all other industry sectors. For purposes of this study, economic impacts are measured in terms of increases in economic activity (revenues), earnings, and jobs that occur throughout all industries in the national economy as a result of a change in final demand for products or services offered by commercial space transportation and the enabled industries.[5] Following are the definitions for each type of impact:

- **Economic activity** is the value of goods and services produced in an economy. In this study, economic activity includes the goods and services produced by commercial space transportation and enabled industries plus the goods and services produced by all other industry groups to support the above industries.

- **Earnings** refer to the sum of all the wages and salaries (including employee benefits) paid to employees in an economy. In this study, earnings include wages and salaries paid to all persons employed by commercial space transportation and enabled industries, plus those employed by all other industry groups to support the above industries.

- **Jobs** refer to the number of workers employed to produce goods and services in an economy. In this study, jobs include all workers employed by commercial space transportation and enabled industries, plus those employed by all other industry groups to support the above industries.

The total economic impact of commercial space transportation and enabled industries in 2002 is summarized in Figure 1. Commercial space transportation was responsible for $95.0 billion in economic activity in 2002, including $792 million from launch vehicle manufacturing and services, $4.9 billion generated by the manufacture of satellites, and $37.9 billion from the manufacture of ground equipment. Satellite services generated a total of $49.6 billion in economic activity. Direct-to-Home (DTH) television was by far the largest contributor, accounting for about 80 percent of the economic activity impacts attributable to all satellite service industries. Distribution industries were responsible for economic activity of over $1.2 billion because of commercial space transportation and other enabled industries.

As a result of economic activity in the commercial space transportation and enabled industries, employees in all industry groups earned a total of $23.5 billion in salaries and wages. Commercial space transportation and enabled industries stimulated over 576,000 total jobs throughout the country.

[5] The same economic impact is measured in three ways, which are differently denominated (some in dollars, some in number of jobs). Therefore, the impacts cannot be added together.

Figure 1: Total Impacts on the U.S. Economy Generated by Commercial Space Transportation and Enabled Industries, 2002

Industry	Economic Activity ($000)	Earnings ($000)	Employment (Jobs)
Launch vehicle manufacturing	$ 791,759	$ 206,328	4,828
Satellite manufacturing	4,937,867	1,379,491	31,262
Ground equipment manufacturing	37,934,507	10,134,674	247,160
VSAT services	2,371,500	624,060	14,467
Satellite data services	2,635,000	693,400	16,075
Transponder leasing	4,321,400	1,137,176	26,363
Mobile satellite telephony	447,950	117,878	2,733
DTH	39,784,600	8,667,120	218,649
Remote sensing	555,282	192,702	5,108
Distribution industries	$ 1,245,881	$ 374,916	9,803
Total Impacts	**$ 95,025,746**	**$ 23,527,745**	**576,448**

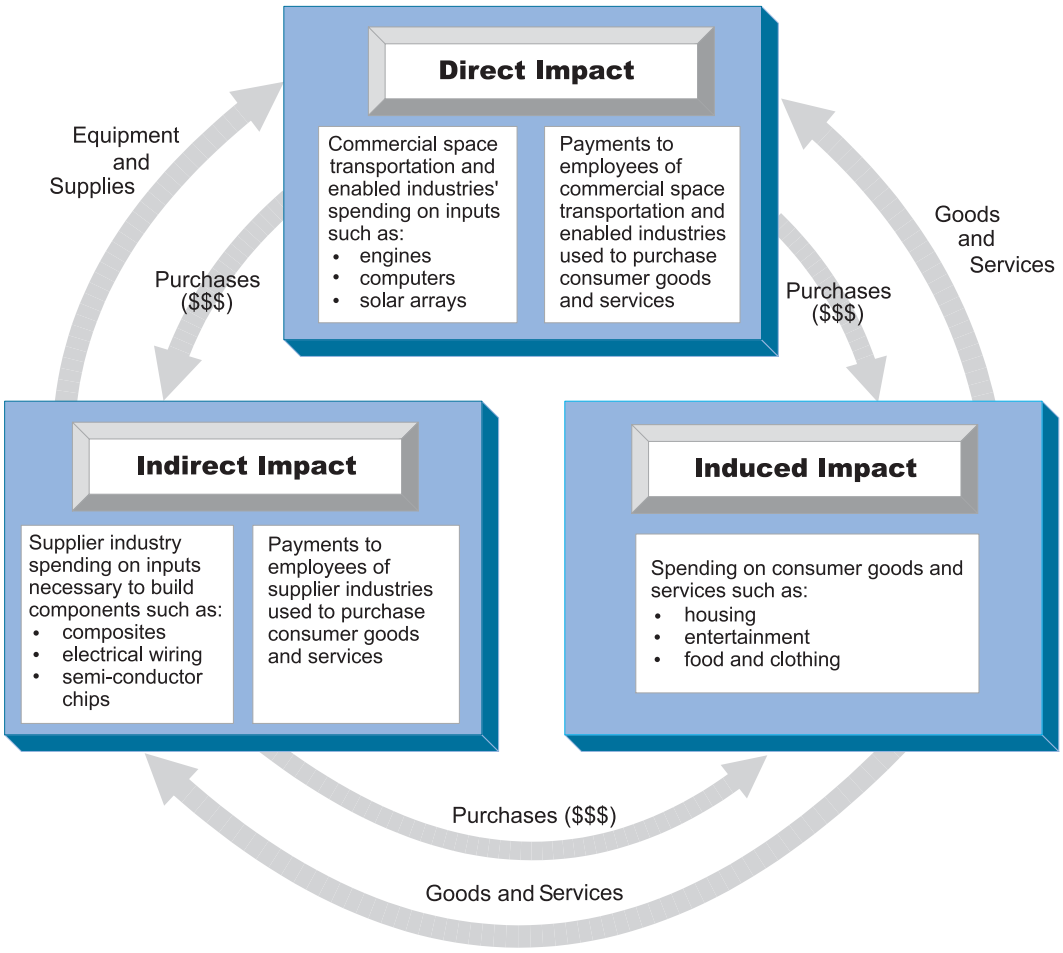
Each measure of economic impact described above is comprised of three components:[6]

- **Direct impacts** are the expenditures on inputs and labor involved in the provision of any final good or service relating to the industries analyzed herein.
- **Indirect impacts** involve the purchases (e.g., silicon, copper wire) made by and labor supplied by the industries that provide inputs to the launch and enabled industries. This impact quantifies the inter-industry trading and production necessary to provide the final goods and services.
- **Induced impacts** are the successive rounds of increased household spending that result from the direct and indirect impacts (e.g., a launch vehicle engineer's increased spending on household goods and services).

The output of the commercial space transportation and enabled industries yields direct impacts, which in turn result in indirect and finally induced impacts. As shown in Figure 2, demand for commercial space transportation results in payments to workers, including personnel working for launch service providers, steelworkers that provide materials for launch vehicles and satellites, and food service employees that feed all of these workers. Workers then re-spend these payments in local economies.

[6] The direct, indirect, and induced components are computed only for economic activity in this report. The economic model used in this analysis does not make these distinctions for earnings and jobs.

Figure 2: Relationship of Impact Types



Economic Activity

This section of the report includes the economic activity impacts of commercial space transportation and enabled industries in 2002. Figure 3 illustrates the total economic impacts generated by commercial space transportation and enabled industries. The table details the direct, indirect, and induced impacts of economic activity. Added together, the direct, indirect, and induced impacts yield the total impact on the U.S. economy.

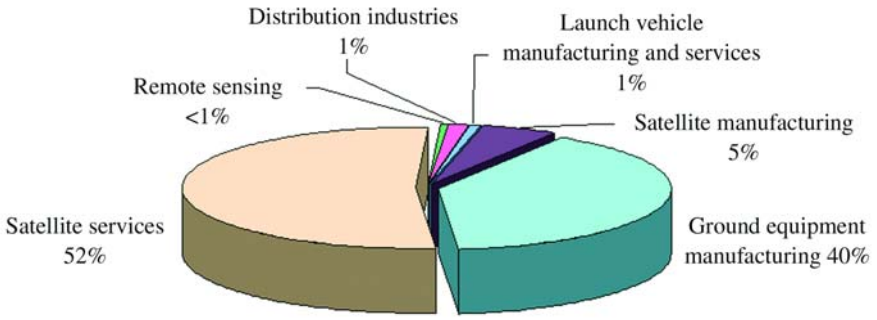
Figure 3: Economic Activity Impacts of Commercial Space Transportation and Enabled Industries, 2002 ($000)

Industry	Direct	Indirect	Induced	Total Impacts
Launch vehicle manufacturing and services	$ 149,273	$ 367,530	$ 274,956	$ 791,759
Satellite manufacturing	697,655	2,401,889	1,838,322	4,937,867
Ground equipment manufacturing	6,244,034	18,185,014	13,505,460	37,934,507
Satellite services	9,631,761	24,954,611	14,974,078	49,560,450
Remote sensing	75,503	223,087	256,693	555,282
Distribution industries	$ 161,633	$ 583,786	$ 500,462	$ 1,245,881
Total Impacts	**$ 16,959,859**	**$ 46,715,917**	**$ 31,349,971**	**$ 95,025,746**

Purchases of inputs from supplier industries are captured in the indirect impact and employees' household spending is captured in the induced impact. The indirect and induced impacts of an industry tend to be larger than the direct economic impact, because the value of the components is often greater than the value added in the production of the final goods and services. For the service industries, the largest investment is often in the salaries of the workers needed to provide the service.

Figure 4 shows the relative proportion that each of the six industry groups analyzed contributed to total economic activity impacts in 2002. Satellite services and ground equipment manufacturing contributed the largest portions of this activity, comprising 52 percent and 40 percent, respectively, of the total impact.

Figure 4: Distribution of Total Economic Activity Impacts Resulting from Commercial Space Transportation and Enabled Industries, 2002



The results suggest that the launch vehicle manufacturing and services industry primarily functions in the economy as an enabler of other industries. Over time, commercial launches have placed many satellites in orbit that have allowed operators to offer a range of satellite services and have spurred the growth of ground equipment production to support these satellite services. Therefore, although the impacts of launch vehicle manufacturing and services in 2002 were small, the industry has successfully fueled the continuous expansion of other industries. Commercial launch is essential for the maintenance of existing satellite services markets and is invaluable for future emerging space markets.

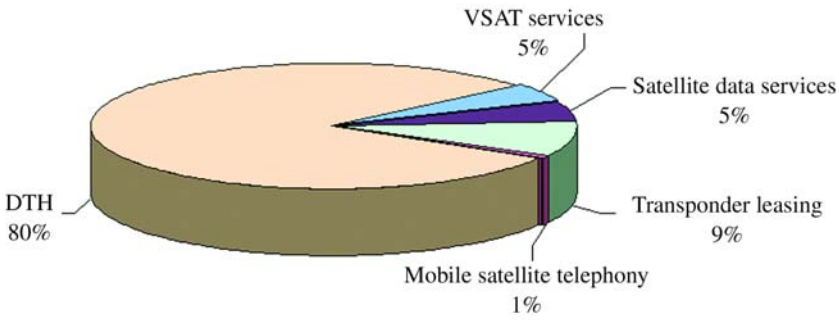
Role of Government In Space Transportation

The federal government continues to play a critical role supporting the U.S. commercial space transportation industry as both a customer and an investor. In 2002, seven of the 12 launches of U.S.-built expendable launch vehicles (ELVs) carried government payloads: five satellites for NASA and one each for NOAA and the Department of Defense (DoD). The total estimated value of those launches was $720 million. That trend continued into 2003: 17 of the 22 launches of U.S.-built ELVs during this period carried government payloads, seven for NASA and ten for the DoD. The total estimated value of those launches was $1.53 billion. Most of these launches took place using launch vehicles that are also available for commercial launches. Thus, government purchases of launch services provide a key source of revenue for launch vehicle companies, particularly during a time of depressed commercial demand for launch services.

The government has also helped develop the current generation of commercial launch vehicles. The U.S. Air Force's Evolved Expendable Launch Vehicle (EELV) program led to the development of two launch vehicles, the Delta 4 and Atlas 5, which could be used for both commercial and military customers. To aid in the initial development of these vehicles, the Air Force provided $500 million to each company when it awarded the initial EELV launch contracts in 1998. More recently the Air Force is providing additional money to support EELV engineering and vehicle reliability projects at the two companies to help compensate for the lack of commercial launch revenue. The government also supports the launch industry by building and maintaining launch facilities, including the Cape Canaveral Air Force Station in Florida and Vandenberg Air Force Base in California, that are used for both government and commercial launches.

A further breakout of the satellite services portion of economic activity impact is shown in Figure 5. DTH was by far the leading satellite service, accounting for 80 percent of the economic activity generated in 2002. Transponder leasing was the next largest contributor, with nine percent of the total satellite services impact. VSAT services and satellite data services contributed equal amounts, with five percent each, to the total economic activity impact due to satellite services.

Figure 5: Distribution of Economic Activity Impacts Resulting from Satellite Services Industry Segments, 2002



Most Affected Industries

All major U.S. industry sectors are affected by the activities of the commercial space transportation and enabled industries to some extent.[7] Figure 6 shows how each of the industry groups was impacted in terms of economic activity, earnings and jobs as a result of the commercial space transportation and enabled industries in 2002. The industry groups are ranked by the extent of impact on economic activity. Although some of these industry types seem unrelated to commercial space transportation, they appear because they provide goods and services, directly or indirectly, to the commercial space industry, or they benefit from the re-spending of money on consumer goods, such as household items and leisure activities.

In 2002, the *communications* and *electronic and other electric equipment* industry sectors were the two most affected sectors in terms of additional economic activity, earnings, and jobs, generating over $43 billion of revenues, more than $8 billion in earnings, and creating nearly 135,000 jobs combined. The communications sector includes the sale of satellite services in addition to telephone communications, including cellular service; operation of satellite earth stations; telemetry and tracking services; and terrestrial Internet, email, and facsimile services. The electronic and other electric equipment sector includes a wide range of products, including electrical industrial equipment, such as power transformers, motors, and generators; electrical wiring equipment; communications equipment; electronic components, such as electron tubes, electron beams, and semiconductors; and other miscellaneous electrical supplies, such as microprocessors, integrated circuits, and silicon wafers.

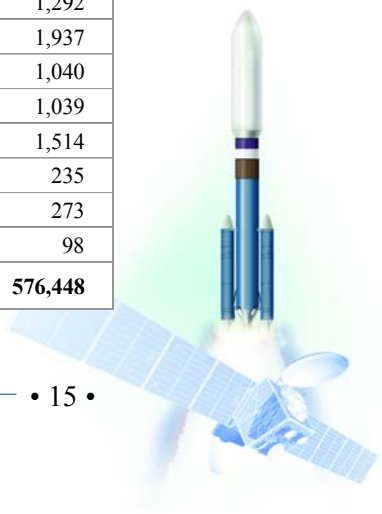
Business services was the third most affected industry sector with an increase of $6 billion in economic activity and over 70,000 jobs. Some business services related directly or indirectly to commercial space transportation and enabled industries may include companies that offer management and consulting services; testing and research labs; computer programming, data processing, and other computer related services; and business brokers.

The *forestry and fishing products* and *metal mining and nonmetallic minerals* were the least affected industry sectors. Nonetheless, due to commercial space transportation and the enabled industries, they benefited from an additional $84 million of economic activity and about 370 new jobs combined.

[7] RIMS II defines the "major" U.S. industry sectors, all of which appear in Figure 6.

Figure 6: Distribution of Economic Activity, Earnings, and Jobs throughout Major U.S. Industry Sectors Generated by Commercial Space Transportation and Enabled Industries, 2002

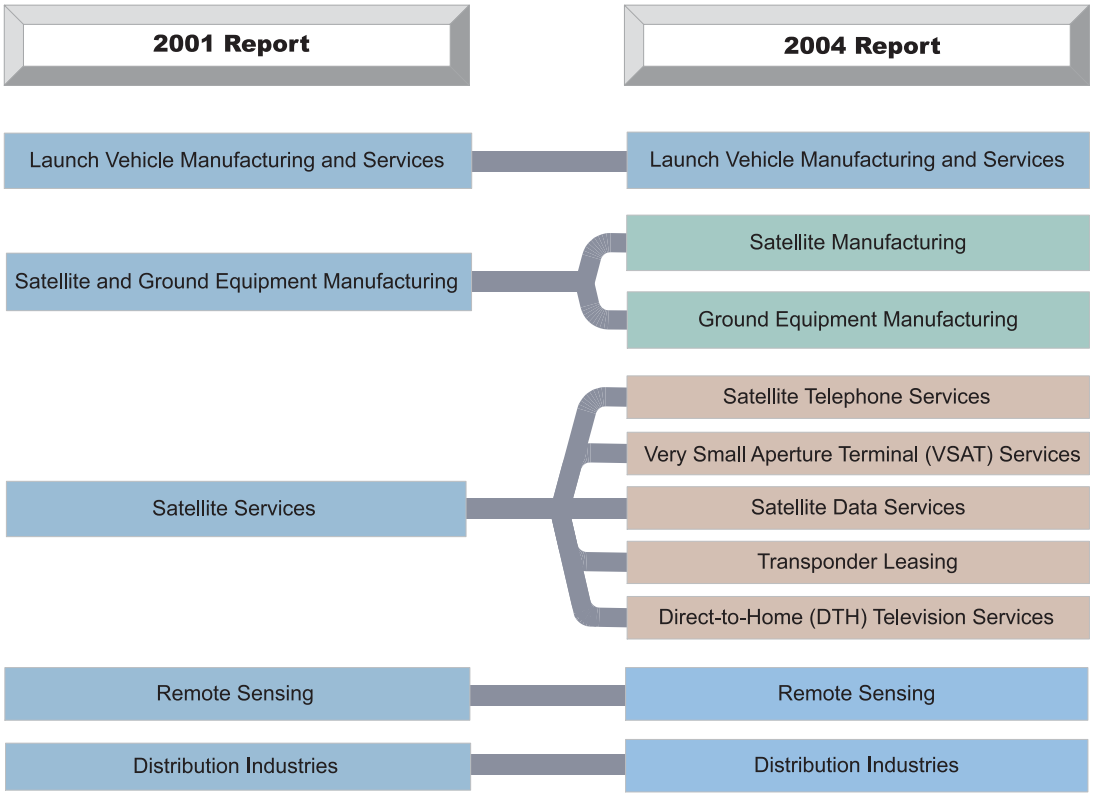
Industry Group	Economic Activity ($000)	Earnings ($000)	Jobs
Communications	$ 23,904,287	$ 3,587,617	55,465
Electronic and other electric equipment	$ 19,407,938	$ 4,739,384	79,487
Business services	$ 6,352,940	$ 2,811,196	73,522
Real estate	$ 5,722,463	$ 236,329	9,692
Wholesale trade	$ 3,999,461	$ 1,304,134	26,986
Hotels and other lodging places, amusement and recreation services, and motion pictures	$ 3,506,159	$ 1,251,642	38,285
Depository and nondepository institutions & security & commodity brokers	$ 3,013,769	$ 1,027,440	19,238
Health services	$ 2,846,998	$ 1,330,529	34,061
Retail trade	$ 2,780,160	$ 1,003,029	47,091
Miscellaneous services	$ 2,380,062	$ 783,694	33,206
Transportation	$ 2,204,847	$ 789,850	21,571
Construction	$ 2,004,413	$ 677,842	18,104
Chemicals and allied products and petroleum and coal products	$ 1,626,372	$ 261,283	3,171
Food and kindred products and tobacco products	$ 1,558,981	$ 186,990	4,992
Fabricated metal products	$ 1,416,256	$ 438,325	11,611
Insurance	$ 1,286,692	$ 428,097	9,370
Electric, gas, and sanitary services	$ 1,252,636	$ 205,268	2,510
Eating and drinking places	$ 1,169,572	$ 404,024	29,500
Printing and publishing	$ 1,139,969	$ 356,515	8,553
Primary metal industries	$ 984,118	$ 183,004	3,646
Industrial machinery and equipment	$ 899,680	$ 215,453	4,163
Rubber and miscellaneous plastic products and leather & leather products	$ 789,545	$ 178,824	4,882
Farm products and agricultural, forestry, and fishing services	$ 746,102	$ 195,139	9,906
Paper and allied products	$ 636,540	$ 122,617	2,601
Motor vehicles and equipment	$ 574,429	$ 77,535	1,236
Personal services	$ 492,690	$ 212,182	11,373
Other transportation equipment	$ 409,776	$ 94,281	1,551
Lumber and wood products and furniture and fixtures	$ 388,580	$ 83,693	2,712
Oil and gas extraction	$ 338,791	$ 47,365	535
Instruments and related products	$ 308,475	$ 83,848	1,292
Apparel and other textile products	$ 205,943	$ 47,486	1,937
Stone, clay, and glass products	$ 187,423	$ 46,347	1,040
Textile and mill products	$ 176,875	$ 32,659	1,039
Miscellaneous manufacturing industries	$ 153,497	$ 47,619	1,514
Coal mining	$ 75,238	$ 19,611	235
Metal mining and nonmetallic minerals, except fuels	$ 54,211	$ 13,564	273
Forestry and fishing products	$ 29,857	$ 3,327	98
Total	**$ 95,025,746**	**$ 23,527,744**	**576,448**



Study Comparisons

There are some minor differences in the industry segmentation between the 2001 and 2004 reports. Figure 7 illustrates the industry sectors analyzed in the *Economic Impact of Commercial Space Transportation on the U.S. Economy* report published in 2001, and how some of the industries have been divided into more detailed sectors for the 2004 edition. The key differences are the separation of satellite manufacturing from ground equipment manufacturing and the additional segmentation of satellite services.

Figure 7: Industry Segmentation: 2001 Report vs. 2004 Report



Comparison of Impact Results

Figure 8 shows that the economic activity impact of commercial space transportation and enabled industries increased about 55 percent from 1999 to 2002 while the earnings impact grew about 43 percent and the number of jobs created increased about 16 percent. However, as the figure illustrates, the gains were not uniform among the various industry segments: while some industries posted major increases in economic impact, others, notably launch vehicle and satellite manufacturing, declined between 1999 and 2002.

The declines in the economic impact caused by the launch vehicle and satellite manufacturing industries are linked to a decrease in activity and a corresponding decline in revenue. In 2002, there were six FAA-licensed orbital launches, compared to 17 FAA-licensed orbital launches in 1999. In 2002, 31 U.S.-manufactured satellites were launched, compared to 89 in 1999; the deployments of Globalstar, Iridium, and ORBCOMM satellites in 1999 accounts for most of the difference. This reduced activity and revenue caused the overall economic impact of these industries to decline significantly.

Figure 8 also shows the change in economic impacts in terms of jobs. It should be noted that the employment data represent the total number of jobs in all affected industries, not just the industry itself. Similar to economic activity, the overall number of jobs increased from 1999 to 2002 as a result of business activity in the commercial space transportation and enabled industries. However, the launch vehicle and satellite manufacturing sectors experienced a decline in employment. Some companies directly involved in these industries saw significant job losses: for example, Boeing Satellite Systems has cut 5,000 jobs, half its workforce, in the last two years. However, the far larger share of the employment changes come from affected industries. These changes include layoffs, attrition, and transfers, as well as jobs that still exist in those industries but are no longer associated with launch vehicle or satellite manufacturing, such as companies that previously sold components to vehicle manufacturers but now have other customers for their products.

Despite diminished impacts from the commercial launch and satellite manufacturing segments, most of the industries enabled by launch continued to generate considerable impacts on the U.S. economy. The industry segment that experienced the greatest growth was the satellite services industry, with economic activity impacts over 90 percent higher in 2002 than in 1999. As previously mentioned, this was due in large part to the surge in DTH subscribers. The commercial remote sensing industry also experienced significant expansion, more than doubling over the time period. The ground equipment industry created 58 percent more economic activity impacts in 2002 over 1999. The changes in the amount of earnings and number of jobs were commensurate with changes in economic activity.

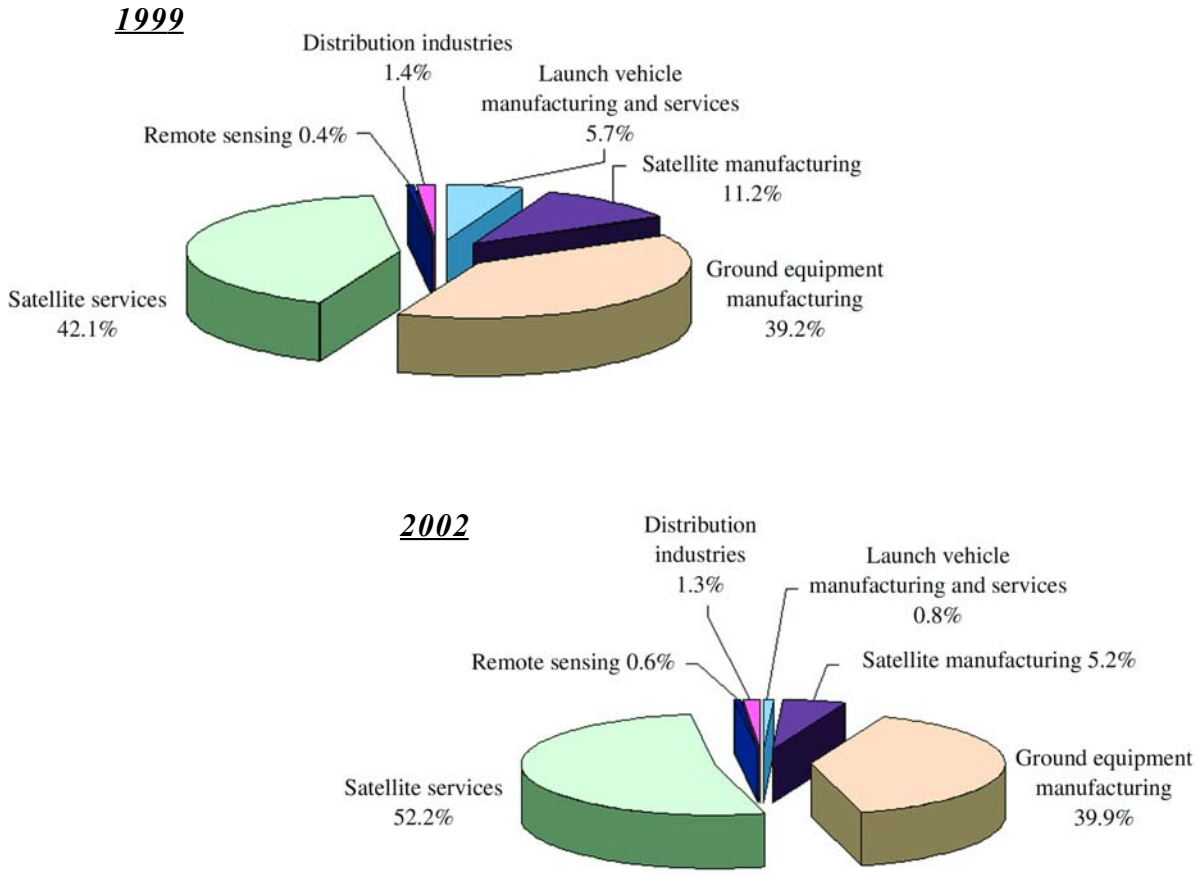
Figure 8: Total Impacts on the U.S. Economy Generated by Commercial Space Transportation and Enabled Industries, 1999 and 2002[8]

Industry	Economic Activity ($000)		Earnings ($000)		Employment (Jobs)	
	1999	2002	1999	2002	1999	2002
Launch vehicle manufacturing and services	$ 3,515,978	$ 791,759	$ 1,071,722	$ 206,328	28,617	4,828
Satellite manufacturing	6,839,132	4,937,867	1,964,415	1,379,491	57,372	31,262
Ground equipment manufacturing	24,030,337	37,934,507	6,893,878	10,134,674	213,076	247,160
Satellite services	25,818,414	49,560,450	6,150,105	11,239,634	186,954	278,287
Remote sensing	235,879	555,282	85,292	192,702	2,820	5,108
Distribution industries	873,971	1,245,881	265,780	374,916	8,506	9,803
Total Impacts	**$61,313,711**	**$95,025,746**	**$16,431,192**	**$23,527,745**	**497,345**	**576,448**

[8] Values are in current dollars, not adjusted for inflation.

Figure 9 compares the percentage of economic activity attributable to the different industry segments in 1999 and 2002. The U.S. satellite service industries grew the fastest in absolute terms and therefore experienced the most growth relative to the other industries. Satellite services' economic activity impacts increased ten percentage points, the share of ground equipment manufacturing impacts remained about the same, and satellite manufacturing economic activity impacts declined by six percentage points. The remote sensing industry experienced the greatest percentage growth of any industry sector, growing about 50 percent since 1999. However, its share of overall economic activity remained about the same due to the relative size of that industry compared to all of the other commercial space transportation and enabled industry segments.

Figure 9: Distribution of Economic Activity Resulting from Commercial Space Transportation and Enabled Industries, 1999 and 2002



Digital Audio Radio Services (DARS)

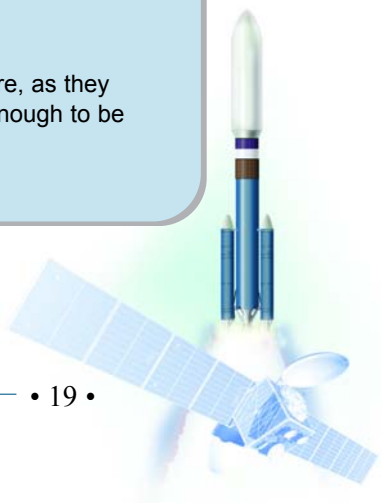
	Sirius	XM	Total
Number of subscribers (2003)	261,061	1,360,228	1,621,289
Number of subscribers (2002)	29,947	347,159	377,106
Revenues (2003)	$12,900,000	$91,800,000	$104,700,000
Revenues (2002)	$805,000	$20,181,000	$20,986,000
Net loss (2003)	$437,500,000	$584,500,000	$1,022,000,000
Total investment to date	$2,400,000,000	$2,100,000,000	$4,500,000,000

Digital Audio Radio Services (DARS) is not included with other communications services in the overall analysis of the economic impact of commercial space transportation. The economic models used in the preparation of this analysis are dependent on the revenue recorded by the various industries enabled by commercial space transportation. This tends to underestimate the effect caused by the two companies providing DARS in the United States, XM Satellite Radio and Sirius Satellite Radio, since these companies are still in the early phases of providing their services to consumers and remain highly dependent on outside investment rather than revenue to maintain their operations. In 2003 XM reported a net loss of $584.5 million on $91.8 million in revenue, while Sirius reported a net loss of $437.5 million on $12.9 million in revenue in the same period.

While the DARS industry has generated only limited revenues to date, the companies involved have made considerable progress. By the end of 2003, XM reported that it had 1.36 million subscribers, four times the number one year earlier; the company's revenue increased by a corresponding factor as well. XM has offered commercial service since November 2001 using two satellites, XM-1 and 2 (also known as "Rock" and "Roll") launched earlier in 2001. The company has a third satellite, XM-3, scheduled for launch in the fourth quarter of 2004 and ordered a fourth, XM-4, for launch later in the decade. These two satellites will replace XM-1 and 2, which are experiencing gradual losses in power because of a solar panel system defect. Through mid-2003 the company had raised a total of $2.1 billion, and does not anticipate needing to raise additional funds before it reaches cash flow breakeven in late 2004, the point at which revenues alone will be sufficient to cover operating expenses. The company had 425 employees as of the end of 2003.

Sirius Satellite Radio launched its satellites earlier than XM—three Proton rockets placed the company's three satellites into highly elliptical orbits in late 2000—but did not begin commercial service until July 2002 because of technical issues. As a result, the service has fewer subscribers than XM: the company reported having 261,061 subscribers by the end of 2003. That was still nearly nine times the number of subscribers Sirius had at the end of 2002. The company has raised a total of $2.4 billion since its inception, including $357 million raised in the second quarter of 2003. As of the end of June 2003, the company had $560 million in cash on hand, sufficient to take it through the cash-flow breakeven point in 2005, when the company forecasts having approximately two million subscribers. The company had 375 employees as of December 2003.

Should XM and Sirius continue to grow and achieve cash flow breakeven in the near future, as they currently plan, then these companies, and the DARS industry in general, will be mature enough to be included in future economic analyses.



Industry Comparisons

Commercial space transportation and its enabled industries made significant contributions to the U.S. economy during the last several years. This section is intended to put into perspective the relative size of the economic impacts of the commercial space transportation and enabled industries by comparing them to the economic impacts of other industry sectors in the economy. Two economic impact studies of other transportation industries were selected for comparison: In April 2003, the FAA completed a study, *The Economic Impact of Civil Aviation on the U.S. Economy, Update 2000,* which used the RIMS II input/output model to quantify the impacts of the civil aviation industry in 2000; in April 2002 LECG, LLC produced a study, *The Economic Contributions of the U.S. Commercial Shipbuilding Industry,* for the Shipbuilders Council of America. The study also used the RIMS II input/output model to quantify the economic impacts of commercial shipbuilding activities on the U.S. economy in 2001. Figure 10 shows that the economic impact of the civil aviation industry is over 10 times larger than the impact of commercial space transportation and enabled industries while the impact of the shipbuilding industry is more than eight times smaller.

Figure 10 also shows how the economic impact of commercial space transportation and enabled industries compares with other high-tech industries. For purposes of comparison, national economic impact studies between 1999 and 2002 were selected. All of the studies referenced in the figure used the RIMS II model except the biotechnology study, for which the IMPLAN economic input-output model was used. IMPLAN is a regional economic modeling system, similar to the RIMS II model, that is used for economic impact analyses. The IMPLAN model is maintained and sold by a private company. The figure shows that commercial space transportation has a greater impact on the U.S. economy than other high-tech industries such as biotechnology and computer gaming.

Figure 10: Comparison of Economic Impacts of Commercial Space Transportation and Enabled Industries and Other Industry Sectors

Industry (year of impacts)	Economic Activity ($billion)	Earnings ($billion)	Jobs
Civil Aviation (2000)[9]	$1,000.0	$310.1	10,000,000
Recreational Fishing (2001)[10]	$116.0	$30.1	1,068,000
Commercial Space Transportation and Enabled Industries (2002)	**$95.0**	**$23.5**	**576,000**
Commercial Space Transportation and Enabled Industries (1999)	$61.3	$16.4	497,000
Biotechnology (1999)[11]	$47.0	N/A	437,400
Commercial Shipbuilding (2001)[12]	$11.0	$9.4	147,230
Computer and Video Games (2000)[13]	$10.5	$7.2	219,000

[9] *The Economic Impact of Civil Aviation on the U.S. Economy, Update 2000*, published by Wilbur Smith Associates in April 2003 for the Federal Aviation Administration.
[10] *Sportfishing in America: Values of Our Traditional Pastime*, http://www.asafishing.org/content/statistics/economic/.
[11] *The Economic Contributions of the Biotechnology Industry to the U.S. Economy*, http://www.bio.org/news/ernstyoung.pdf.
[12] *The Economic Contributions of the U.S. Commercial Shipbuilding Industry*, http://www.shipbuilders.org/publications/econcontr_shipbuilding.pdf.
[13] *Economic Impacts of the Demand for Playing Interactive Entertainment Software*, http://www.idsa.com/pressroom.html.

Emerging Markets for Future Consideration

Commercial space transportation has technologically enabled the existence and continued growth of the industries highlighted in this report that at one time were considered science fiction. Now, these same industries, in aggregate, create a multi-billion-dollar impact on the U.S. economy annually. In the coming years, commercial space transportation will enable the emergence of new industries that will impact the U.S. economy. Both existing and emerging industries will help sustain a robust U.S. launch market. Examples of some of these emerging industries are discussed below.

Public Space Travel

Public space travel has the potential to become a major growth industry. Two people—Dennis Tito in 2001 and Mark Shuttleworth one year later—have already paid an estimated $20 million each for weeklong trips to the International Space Station. While such trips are currently on hold in the wake of the Space Shuttle Columbia accident, plans are already in the works to resume tourist flights once the Shuttle returns to flight. As the orbital tourism market develops, commercial space transportation could play a key role in providing flights as well as providing a competitive marketplace that could lead to lower ticket prices. Potential space tourists who lack the time or wealth to afford an orbital trip may opt for a suborbital alternative: a 15-minute trip to the edge of space and back. More than two-dozen teams are competing for the XPRIZE™, a $10 million award for flying a three-person spacecraft to an altitude of 100 kilometers twice in two weeks. Several teams are likely to make a serious attempt to win the prize by the end of 2004. Recent market studies have shown that public space travel has the potential to become a billion-dollar industry within 20 years. Moreover, public space travel may provide the initial market for suborbital vehicles that can also serve other markets, including microgravity research, remote sensing, and fast package delivery. On June 13, 2003, Sen. John McCain and Sen. Sam Brownback introduced the Commercial Space Transportation Act of 2003, S. 1260, which promotes the development of the commercial space transportation industry, authorizes appropriations for the Office of the Associate Administrator for Commercial Space Transportation, and directs the Secretary of Transportation to report to Congress on the need for a distinct regulatory regime for suborbital vehicles. On March 4, 2004, the House of Representatives passed H.R. 3752, the Commercial Space Launch Amendments Act, designed to enable the development of public space travel.

Real-time Remote Sensing Applications

Remote sensing from space has provided the world with powerful data and tools for tracking environmental change, disease control, crop management, and areas of military interest. Later this decade, new commercial remote sensing satellites with higher resolution are expected to replace existing systems. One potential application that could require an increase in launches is real-time remote sensing for intelligence, disaster monitoring, and crop management, but only if revenue from the current and follow-on systems is sufficient to enable development.

Commercial space transportation will play an integral role in ensuring the continued data flow of today's remote sensing satellite systems as well as the data from next-generation systems.

Broadband Data Services

Demand for broadband Internet access continues to grow, both in the U.S. and worldwide. However, for some people it is difficult to obtain service from terrestrial broadband providers, particularly in rural areas with limited infrastructure. A new generation of broadband communications satellites scheduled for launch in the next several years promises to solve this "last mile" problem and provide broadband Internet access to all potential users, in much the same way as DTH provided an alternative to cable television a decade ago. If these ventures are successful it may prompt the development of additional systems, further supporting the commercial space transportation industry.

S e c t i o n 2

Industry Outlook: Projected Economic Impact of the Commercial Launch Industry on the U.S. Economy in 2010

Introduction

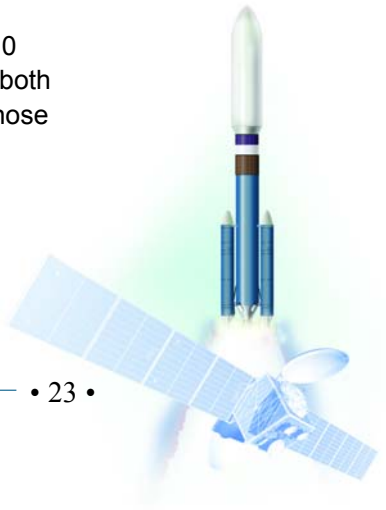
Section 1 of this report describes the impact of commercial space transportation and enabled industries on the U.S. economy in 2002. It is also important to consider the potential impact of various industry trends, including the development of the emerging markets described in Section 1, on the U.S. economy in the future. An approach somewhat different than that in Section 1 is required to estimate the future impact of the commercial space transportation industry on the economy.

Section 2 of *The Economic Impact of Commercial Space Transportation on the U.S. Economy* presents the first attempt by FAA/AST to assess the future economic impact of the commercial launch industry in the United States. This forecast is intended to illustrate two possible directions the industry may take through the remainder of the decade and their resulting impacts on the U.S. economy. This report is not intended to describe what *will* happen, but rather what *could likely* happen, illustrating the effects that both industry trends and government policies could have on the economy. This analysis should serve as a tool to guide discussion of the policies, plans, and investments that may shape the launch industry of 2010.

Given the many uncertainties involved with forecasting, the economic impact analysis in Section 2 is more limited than the one presented in Section 1. Unlike Section 1, which includes commercial space transportation and enabled industries, Section 2 focuses exclusively on the launch vehicle manufacturing and services industry segment. Adding enabled industries, such as satellite services and ground equipment manufacturing, introduces many additional variables that would affect the forecast, many of which are not directly related to commercial space transportation. Also, this analysis limits a calculation of economic impact to a single year, 2010. This date is far enough in the future to forecast significant change from the current environment, while still being within the range of existing commercial launch forecasts (see the Methodology section). Two different scenarios will illustrate the range of potential economic impacts the industry could have in 2010.

Methodology

Estimating the economic impact of the U.S. commercial launch industry in 2010 requires knowledge of three key factors: the number of commercial launches, both orbital and suborbital, that will take place that year worldwide; the fraction of those launches that will be captured by American launch providers; and the revenue generated from those launches.

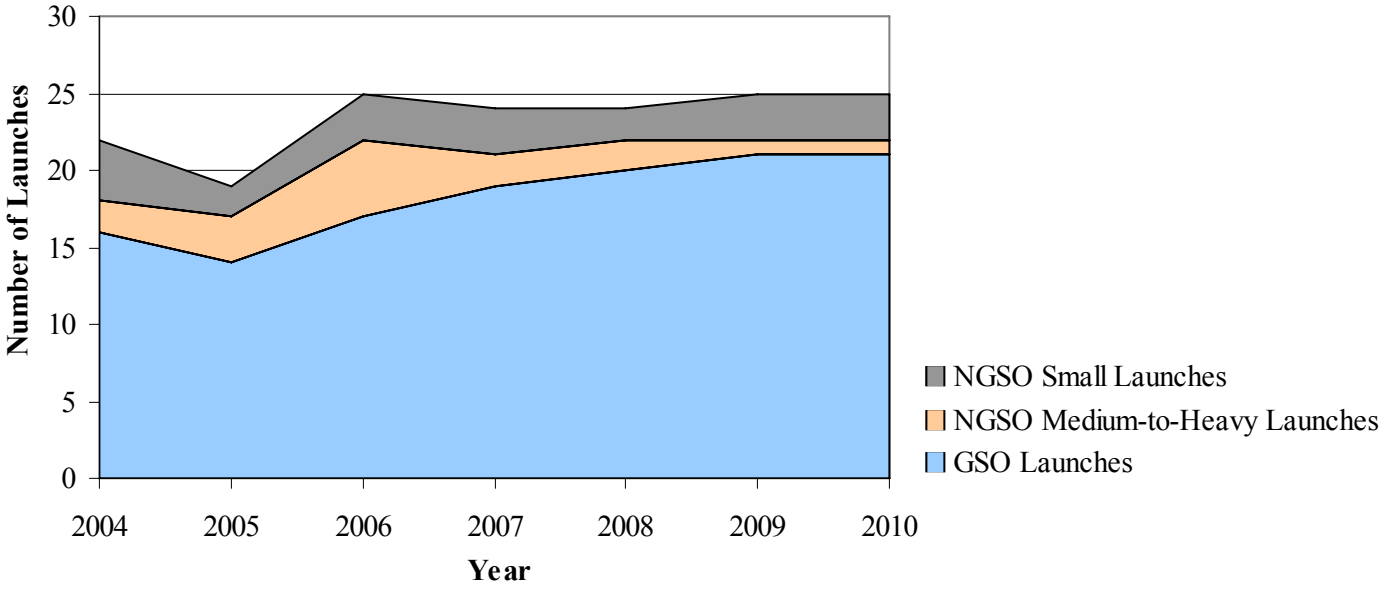


Launch Activity

Commercial launch activity in 2010 is divided into three segments: launches of payloads to geosynchronous orbit (GSO), launches of payloads to non-geosynchronous orbits (NGSO), and suborbital launches. The last category includes both launches of expendable sounding rockets as well as flights of suborbital reusable launch vehicles (SRLVs) expected to enter commercial service later this decade, serving the public space travel market.

For commercial GSO launches, this analysis uses the 2003 10-year forecast for launch activity compiled by the Commercial Space Transportation Advisory Committee (COMSTAC). Commercial NGSO launch activity comes from the 2003 forecast by FAA/AST. Both forecasts were published in the *2003 Commercial Space Transportation Forecasts* report by FAA/AST in May 2003. These forecasts for the period 2004-2010 are shown in Figure 11.

Figure 11: Commercial GSO and NGSO Launch Forecasts, 2004-2010



	2004	2005	2006	2007	2008	2009	2010
GSO Launches	16	14	17	19	20	21	21
NGSO Medium-to-Heavy Launches	2	3	5	2	2	1	1
NGSO Small Launches	4	2	3	3	2	3	3
Total	**22**	**19**	**25**	**24**	**24**	**25**	**25**

For suborbital activity, this analysis assumes that public space travel will be the only market driving commercial SRLV launch activity. Data from the Futron Corporation's study of the demand for suborbital public space travel was used to compute suborbital launch activity for the period 2006-2010. Annual numbers of passengers from the Futron study are converted into launches by assuming an average of two passengers per flight. Added to this is an average of one commercial expendable sounding rocket flight every other year, based on historical trends. These results are shown in Figure 12. While these numbers are quite large, the price per launch of these suborbital flights is far lower than for an orbital GSO or NGSO mission.

Figure 12: Suborbital Launch Forecasts, 2004-2010

	2004	2005	2006	2007	2008	2009	2010
Public Space Travel	0	0	252	321	410	522	665
Sounding Rocket Launches	1	0	1	0	1	0	1
Total	**1**	**0**	**253**	**321**	**411**	**522**	**666**

Launch Prices

There is no common methodology or strategy that allows for accurate prediction of future prices in the commercial launch services market. A variety of factors can affect price, including supply and demand, mission requirements, regional and global economics, availability, contract terms and conditions, reliability and insurance. The launch business has a unique structure in part because of the high technical risk coupled with financial support in various forms by governments for the purposes of independent access to space or other reasons. Even in the near term similar payloads may pay widely varying launch prices. Moreover, most price and contractual information is proprietary.

For the purposes of this report, a price range is estimated based on current conditions with the expectation that prices will increase somewhat from their current low levels through the remainder of the decade unless there is a dramatic breakthrough in cost by a new technology or the emergence of an efficient orbital RLV.

In the GSO launch market, which remains the most competitive today, prices during 2001-2003 ranged from about $50 million to $85 million for a single satellite with some high and low variance, based on open sources. Through the remainder of the decade it is estimated prices will gradually increase to a range of $60 to $95 million. Large NGSO payloads will incur similar launch costs because they use similar launch vehicles as GSO payloads. For small NGSO payloads, current international prices range from $3 million to $25 million depending on size of the payload, launch vehicle, and other factors. Future prices could drop based on the entrance of new vehicles and availability of surplus excess ballistic missiles.

The emerging suborbital market will likely have launch prices ranging from $200,000 to $1 million per launch depending on the vehicle as well as the number of payloads or passengers per mission. Prices should drop as more vehicles enter the market and the public space travel market matures.

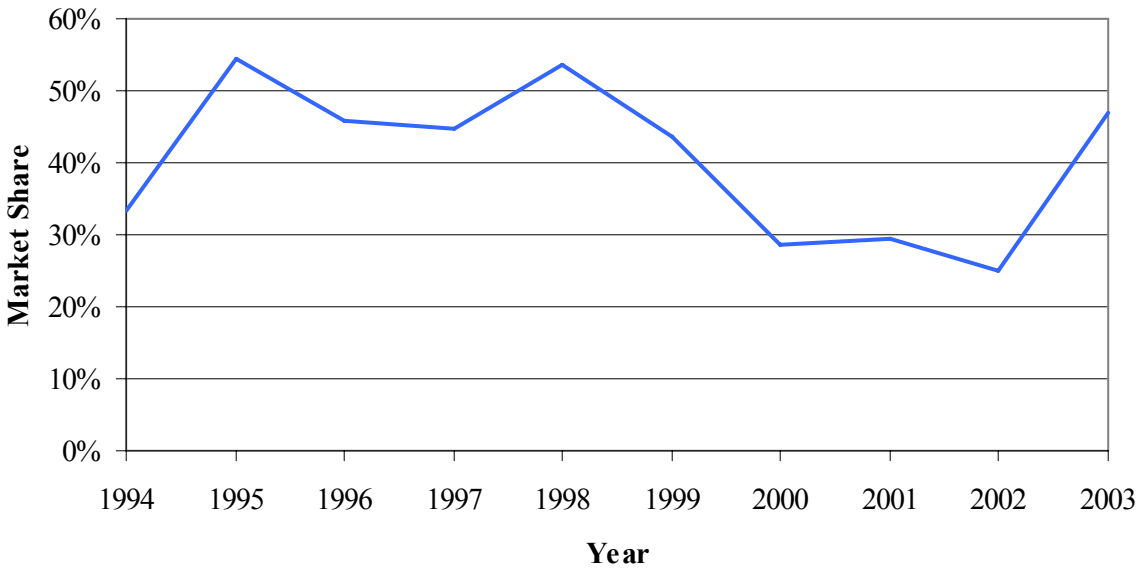
Market Share

The launch forecast described above provides an estimate of the number of commercial launches worldwide in 2010, but does not estimate what fraction of those will be carried out by U.S. companies.[14] Because satellite and launch vehicle contracts are usually announced no more than two to three years prior to the launch itself, it is not possible to reliably estimate which companies will win contracts for launches several years in the future, or even who the customers of those launches will be.

To address this limitation, this analysis uses two scenarios designed to provide low- and high-end estimates of the conceivable market share of launches U.S. companies could conduct in 2010. In the "constrained" scenario, U.S. companies capture only a 10% market share for both orbital and suborbital launches. Such a scenario represents a significant decline from current market shares, and would likely imply the existence of a single American commercial launch services provider. It also assumes that the suborbital market will primarily be served by vehicles already under development outside the U.S. The "robust" scenario gives U.S. companies a 60% market share for commercial orbital launches and a 75% market share for commercial suborbital launches. The orbital market share is slightly higher than the peak U.S. commercial launch market share in the last decade, as shown in Figure 13. Both scenarios are applied in the following section to launch forecasts after 2004 (announced commercial launches are used for 2004), although the economic impact is calculated only for 2010.

[14] As in Section 1 of this report, Sea Launch is considered a U.S. company.

Figure 13: U.S. Commercial Launch Market Share, 1994-2003



Economic Model

This study uses the same RIMS II model described in Section 1 of this report. One assumption used in this analysis is that the multipliers used to compute economic activity, earnings, and employment remain unchanged from 2002. In practice these multipliers do change from year to year, although by minimal amounts. Because the changes in these multipliers cannot be reliably forecast, the 2002 multipliers are used to compute economic impact in 2010.

Results

U.S. Launch Forecasts

In the constrained scenario U.S. commercial launch activity drops off significantly after 2004, with an average of only two commercial orbital launches per year—nearly all to GSO—between 2005 and 2010. (See Figure 14). The constrained scenario also greatly reduces the potential number of suborbital public space travel flights later in the decade. (See Figure 15).

Figure 14: U.S. Commercial Orbital Launches, 2004-2010 (Constrained Scenario)

	2004	2005	2006	2007	2008	2009	2010
GSO Launches	9	1	2	2	2	2	2
NGSO Medium-to-Heavy Launches	0	0	1	0	0	0	0
NGSO Small Launches	2	0	0	0	0	0	0
Total	**11**	**1**	**3**	**2**	**2**	**2**	**2**

Figure 15: U.S. Commercial Suborbital Launches, 2004-2010 (Constrained Scenario)

	2004	2005	2006	2007	2008	2009	2010
Public Space Travel	0	0	25	32	41	52	67
Sounding Rocket Launches	1	0	1	0	1	0	1
Total	**1**	**0**	**26**	**32**	**42**	**52**	**68**

The robust scenario, on the other hand, shows orbital launch activity that remains steady or slowly increases through the end of the decade, with an average of over 14 orbital launches per year by the U.S. between 2005 and 2010. (See Figure 16). As with the constrained scenario, the orbital launches are dominated by GSO missions, although there is an average of about three NGSO launches a year during this period. The robust scenario also features a high level of suborbital public space travel during the latter half of the decade as the U.S. captures the majority of this emerging market. (See Figure 17). Figures 18 and 19 show the differences between the two scenarios for orbital and suborbital launches, respectively.

Figure 16: U.S. Commercial Orbital Launches, 2004-2010 (Robust Scenario)

	2004	2005	2006	2007	2008	2009	2010
GSO Launches	9	8	10	11	12	13	13
NGSO Medium-to-Heavy Launches	0	2	3	1	1	1	1
NGSO Small Launches	2	1	2	2	1	2	2
Total	**11**	**11**	**15**	**14**	**14**	**16**	**16**

Figure 17: U.S. Commercial Suborbital Launches, 2004-2010 (Robust Scenario)

	2004	2005	2006	2007	2008	2009	2010
Public Space Travel	0	0	189	241	308	392	499
Sounding Rocket Launches	1	0	1	0	1	0	1
Total	**1**	**0**	**190**	**241**	**309**	**392**	**500**

Figure 18: Comparison of Constrained and Robust Orbital Launch Forecasts

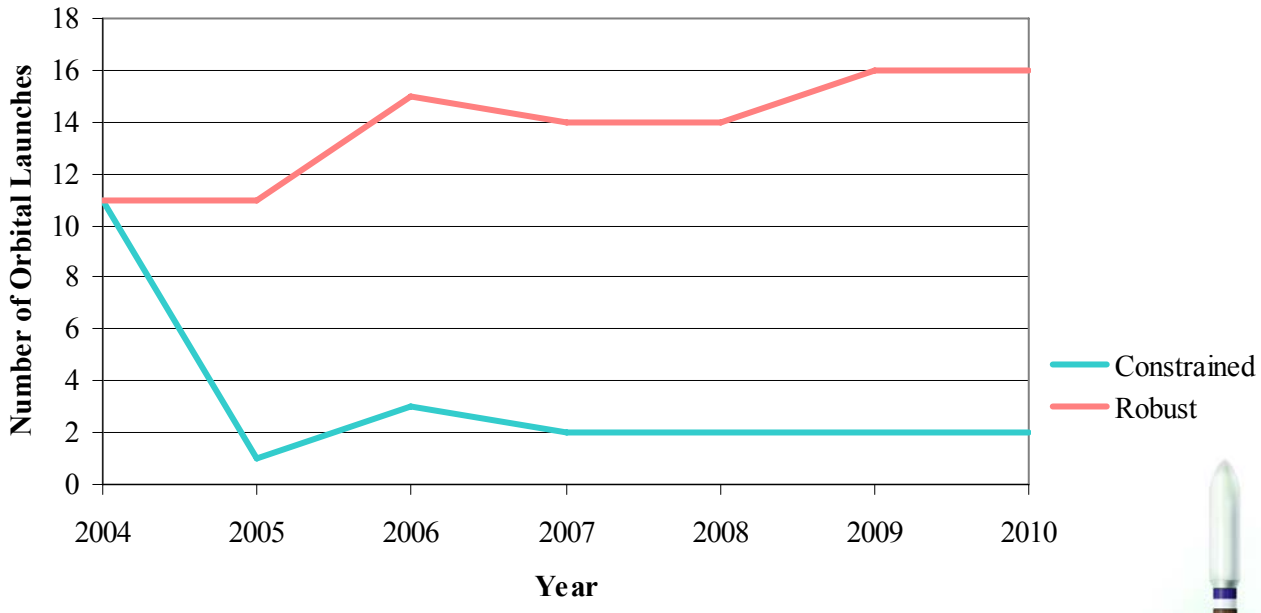
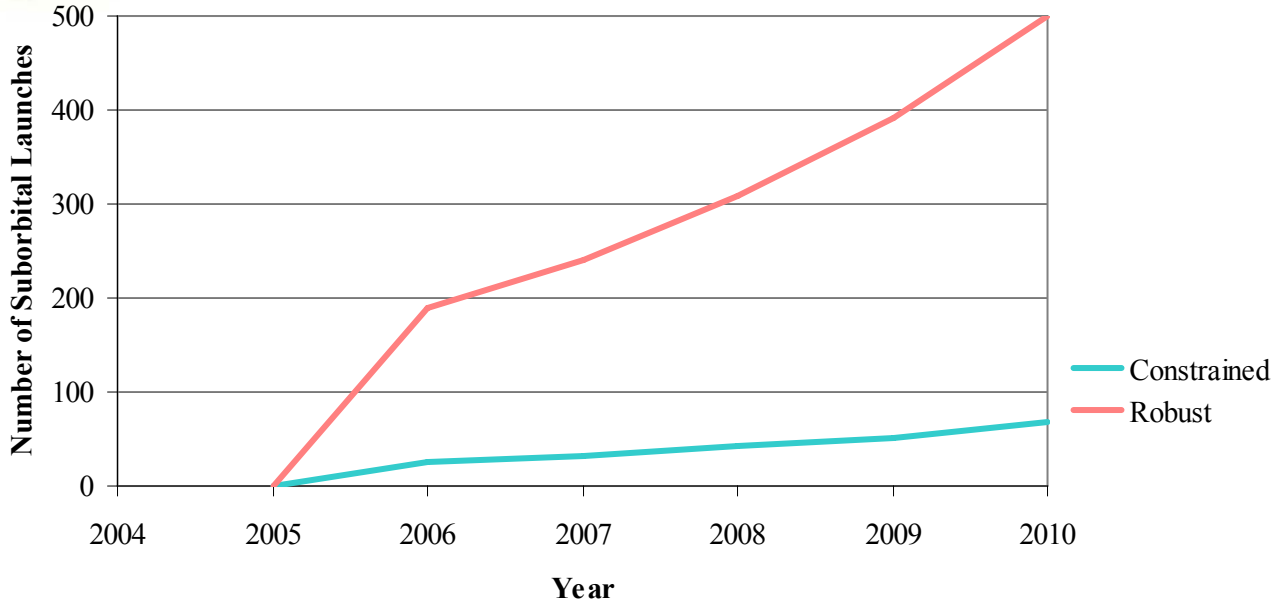


Figure 19: Comparison of Constrained and Robust Suborbital Launch Forecasts



Economic Impact

The sharply different forecasts of these scenarios result in widely varying estimates of revenue for the U.S. commercial launch industry in 2010 and the corresponding economic impact. Figure 20 shows the economic activity, earnings, and employment impacts for the orbital component of the launch vehicle manufacturing and services sector calculated using the RIMS II model described above for both scenarios, while Figure 21 provides the same data for the suborbital sector.

Figure 20: Economic Impact of the Launch Vehicle Manufacturing and Services Sector in 2010 (Orbital Component Only)

	Constrained	Robust
Economic Activity ($000)	$ 454,528	$ 3,263,805
Earnings ($000)	$ 118,448	$ 850,531
Employment (Jobs)	2,772	19,901

Figure 21: Economic Impact of the Launch Vehicle Manufacturing and Services Sector in 2010 (Suborbital Component Only)

	Constrained	Robust
Economic Activity ($000)	$ 42,227	$ 295,590
Earnings ($000)	$ 11,004	$ 77,029
Employment (Jobs)	257	1,802

The constrained scenario generates a total impact that is below the impact of the industry in 2002: less than $500 million in economic activity and under $130 million in earnings, with total employment of just over 3,000, as shown in Figure 22. By contrast, the robust scenario produces results over seven times stronger than the constrained scenario, and 4.5 times higher than the actual 2002 results. The robust results are very similar to the actual 1999 results, when the U.S. commercial launch industry was far more active than it is today. In both scenarios, the suborbital portion of the industry, while rapidly growing, will still contribute only a tiny fraction—less than ten percent—of the economic impact of the orbital segment in 2010.

Figure 22: Economic Impact of the Launch Vehicle Manufacturing and Services Sector in 1999, 2002, and 2010

	1999 Results	2002 Results	2010 Constrained	2010 Robust
Economic Activity ($000)	$ 3,515,978	$ 791,759	$ 496,755	$ 3,559,395
Earnings ($000)	$ 1,071,722	$ 206,328	$ 129,452	$ 927,560
Employment (Jobs)	28,617	4,828	3,029	21,704

Figure 23 breaks down the economic activity for the constrained scenario into its direct, indirect, and induced components. Figure 24 does the same for the robust scenario.

Figure 23: Economic Activity Impacts of the Launch Vehicle Manufacturing and Services Sector in 2010, Constrained Scenario ($000)

	Direct	Indirect	Induced	Total
Orbital	$ 85,694	$ 210,989	$ 157,845	$ 454,528
Suborbital	$ 7,961	$ 19,602	$ 14,664	$ 42,227
Total	**$ 93,655**	**$ 230,591**	**$ 172,509**	**$ 496,755**

Figure 24: Economic Activity Impacts of the Launch Vehicle Manufacturing and Services Sector in 2010, Robust Scenario ($000)

	Direct	Indirect	Induced	Total
Orbital	$ 615,336	$ 1,515,040	$ 1,133,429	$ 3,263,805
Suborbital	$ 55,729	$ 137,211	$ 102,650	$ 295,590
Total	**$ 671,065**	**$ 1,652,251**	**$ 1,236,079**	**$ 3,559,395**

Conclusion

Section 1 of this report showed that, while the overall contribution of enabled industries to the U.S. economy has grown in recent years, the role commercial space transportation itself has played has fallen significantly. This section of the report demonstrates two paths for the future role of commercial space transportation in the U.S. economy. Under the constrained scenario the economic impact of commercial space transportation would continue to decline. The robust scenario projects a return to the vigorous conditions the industry enjoyed in the late 1990s, with a larger number of launches and greater optimism about the future of the industry.

The key difference between 1999 and the robust 2010 scenario, though, is the total number of commercial orbital launches worldwide: 39 in 1999 versus only 25 forecast in 2010. This requires the U.S. commercial space transportation industry to become more competitive and capture a greater fraction of the overall market in order to provide the same level of economic impact that it did in 1999. The emergence of new orbital and suborbital markets, most notably public space travel, will aid this effort, but as noted above will only provide a small fraction of the overall revenue and resulting economic impact of the industry. The major partners in the U.S. commercial space transportation field—business and government—will need to work together to make the robust scenario a reality.

Section 3

Appendices and Bibliography

Appendix A: Methodology

Methodology Overview

This study utilizes the Regional Input-Output Modeling System (RIMS II) developed by the U.S. Department of Commerce, Bureau of Economic Analysis to quantify the economic value of financial transactions that are associated directly and indirectly with commercial space transportation and enabled industries. The flow of funds is traced through the economy in order to identify which industry types benefit and by how much. The study follows FAA-recommended procedures for economic impact analysis, including the use of RIMS II. The revenue data used to calculate the impacts shown in this report were derived from the results of the Satellite Industry Association's (SIA) *2002 Satellite Industry Annual Indicators Survey*.[15]

Economic Impacts vs. Economic Benefits

Commercial space transportation and enabled industries are responsible for both economic impacts on and economic benefits to the national economies.

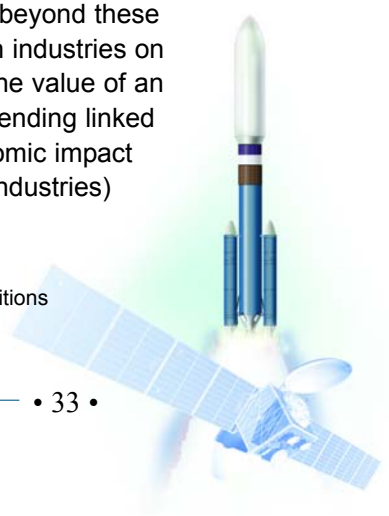
Economic impacts are the quantifiable interactions between consumers and producers that result from a change in final demand for a product or a service. These impacts track the financial transactions that occur throughout the production of a good or service, and they are measured here in terms of increased economic activity, earnings, and jobs.

Economic benefits are wider in scope and generally include the intangible, positive effects that result from the availability of certain goods and services in the U.S. economy. Typically described as advantageous changes in quality of life or quality of business, benefits comprise technological, financial, societal, and environmental improvements. Examples of economic benefits include decreased transaction time, cost savings, cost avoidance, improved productivity, increased efficiency, development of new technologies, technology diffusion, and attraction of new businesses to a region. This study examines the quantifiable economic impacts on the U.S. economy of the commercial space transportation industry and the industries it enables. Only the economic activities that occur during production of a good or the rendering of a service are taken into account.

Measuring Economic Impacts

The base size or annual growth of an industry may be measured in several ways, including revenues, profits, investments in research and development, number of employees, or total number of businesses. The analysis featured in this report, however, extends beyond these basic measures by using multipliers to quantify the economic impact of certain industries on the nation as a whole. Multipliers are mathematical factors used to calculate the value of an initial amount of spending on a good or service plus the value of additional spending linked to the purchase of inputs required to produce that final good or service. Economic impact analyses take into account the multiplier effect that one industry (or group of industries) has on all other industries throughout the economy.

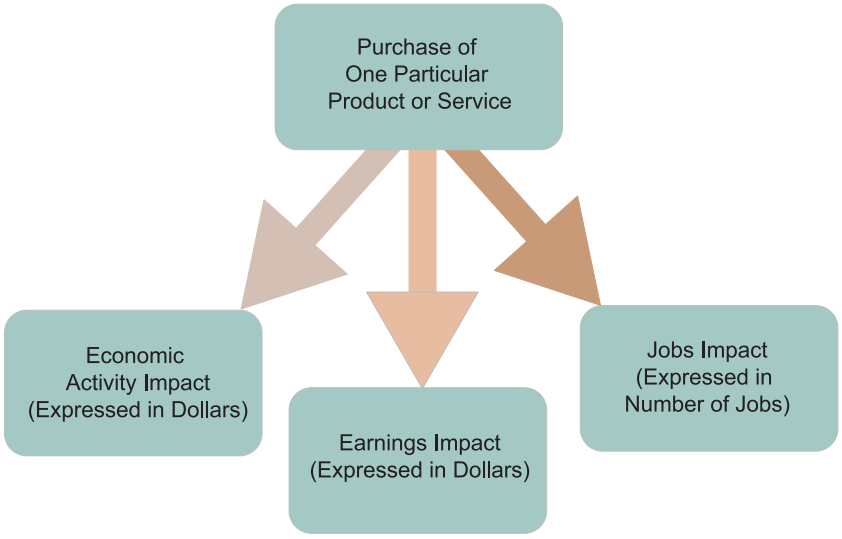
[15] The data collected from the SIA survey have been manipulated to accommodate industry definitions determined to be appropriate for this report. Revenue data may differ from that reported by SIA.



Types of Impacts Measured

Economic impacts are measured here in three ways: economic activity, earnings, and jobs. Economic activity, earnings, and jobs impacts measure the effects of the same change in final demand (for example, the purchase of a launch vehicle), in different ways: some in dollars and others in numbers of jobs (see Figure A1). For example, the purchase of one launch vehicle will stimulate economic activity, increase earnings, and create jobs in other industry groups. However, because all these impacts are based on the same change in final demand, they cannot be added together.

Figure A1: Different Measures of Impact for a Single Change in Final Demand

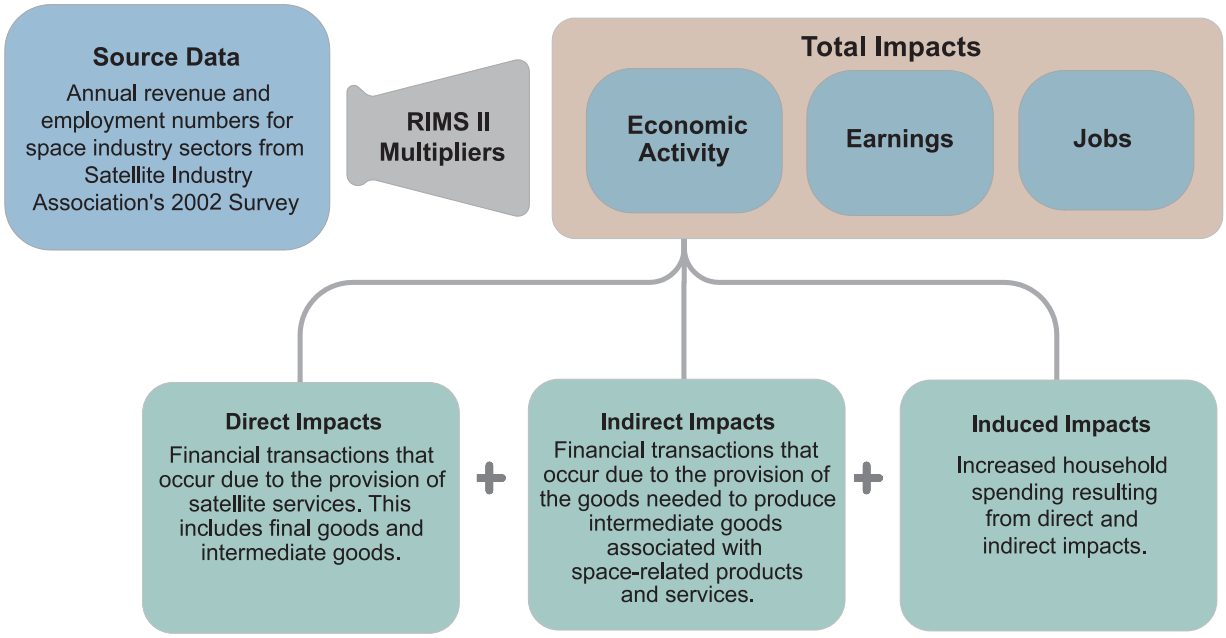


RIMS II

For this study, economic impacts were derived using the Regional Input-Output Modeling System (RIMS II), an economic input-output model developed by the Department of Commerce's Bureau of Economic Analysis. RIMS II maps the flow of goods and services within the U.S. economy and illustrates the interconnection of producers and consumers. RIMS II is comprised of several sets of multipliers that can be used to measure individual industries' contributions to the economy. The multipliers are organized by industry groups. These industry groups are categorized by input-output (I-O) codes, which are based on standard industry classification (SIC) codes. Appendix B describes the translation of the industries studied into applicable RIMS II categories.

The source data from the SIA survey were used with RIMS II to derive the total economic impacts of the selected industries. The total impacts are expressed in terms of economic activity, employment, and earnings. Further calculations were used to derive the direct, indirect, and induced effects of economic activity. Figure A2 illustrates this methodology.

Figure A2: Simplified Methodology for Using RIMS II



Appendix B: Selection of Industries for Analysis

RIMS II input-output (I-O) codes are based on standard industry classification (SIC) codes. The SIC codes selected were those that were most related to commercial space transportation and enabled industries. From the selected SIC codes, I-O codes were assigned to accurately characterize the impact of the commercial space transportation industry. Satellite Industry Association (SIA) source data were then sorted by I-O code. Figure B1 depicts the relationships between the industries selected for study and their appropriate SIC codes, I-O code, and SIA industry segment.

Figure B1: Selected SIC and Input-Output Codes for Industry Segments

SIC Code	SIC Code Description	I-O Code	I-O Description	SIA Industry Segment
3663	*Manufacture of radio & TV broadcasting and communications equipment*. Includes antennas, transmitting and communications; cellular radio telephones; pagers; radio transmitting and communications antennas and ground receivers; satellites, communications; space satellite communications equipment; telemetering equipment; transmitting apparatus, radio and TV.	56.0500	Communication equipment	Satellite manufacturing
3669	*Manufacturing communications and related equipment, not elsewhere classified.* Includes intercommunications equipment, electronic (assumed to include VSATs).	56.0500	Communication equipment	Ground equipment manufacturing (VSATs and other ground equipment)
3679	*Electronic components, not elsewhere classified.* Includes manufacture of antennas, receiving; antennas, satellite: home type (generally includes equipment for receiving signals, rather than transmitting).	57.0300	Other electronic components	Ground equipment manufacturing (manufacture of satellite dishes)
3761	*Guided missiles and space vehicles.* Includes R&D on guided missiles and space vehicles; space vehicles, complete.	13.0100	Guided missiles and space vehicles	Launch vehicle manufacturing
4899	*Communications services, not elsewhere classified*. Includes radar station operation; satellite earth stations; satellite or missile tracking stations, operated on contract basis; tracking missiles by telemetry and photography on contract basis. (assumed data services including VSAT services, internet, and transponder leasing were included)	66.0100	Telephone/telegraph communications and other communications services, not elsewhere classified	VSAT services
4899	*Communications services, not elsewhere classified*. Includes radar station operation; satellite earth stations; satellite or missile tracking stations, operated on contract basis; tracking missiles by telemetry and photography on contract basis. (assumed data services including VSAT services, internet, and transponder leasing were included)	66.0100	Telephone/telegraph communications and other communications services, not elsewhere classified	Data services
4899	*Communications services, not elsewhere classified*. Includes radar station operation; satellite earth stations; satellite or missile tracking stations, operated on contract basis; tracking missiles by telemetry and photography on contract basis. (assumed data services including VSAT services, internet, and transponder leasing were included)	66.0100	Telephone/telegraph communications and other communications services, not elsewhere classified	Transponder leasing
4812	*Radiotelephone communications services.* Includes cellular telephone services and paging services.	66.0100	Telephone/telegraph communications and other communications services, not elsewhere classified	Mobile satellite telephony
4841	*Cable and Other Pay TV Services.* Includes DBS/DTH; SMATV; multipoint distribution systems (MDS) services; subscription TV services.	66.0200	Cable and other pay TV services	Direct-to-Home (DTH) TV services
4841	*Cable and Other Pay TV Services.* Includes DBS/DTH; SMATV; multipoint distribution systems (MDS) services; subscription TV services.	66.0200	Cable and other pay TV services	Satellite radio (DARS)
8713	*Surveying Services*. Includes establishments primarily engaged in providing professional land, water and aerial surveying services; engineering services: photogrammetric; photogrammetric engineering; surveying: land, water, aerial.	73.0302	Engineering, architectural and surveying services	Remote sensing

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