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# FAA AST ECONOMIC IMPACT REPORT RESULTS AND ANALYSIS

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## ABSTRACT

This paper will discuss and analyze the results of a recently completed Economic Impact report produced by the FAA Office of Commercial Space Transportation under contract to The Tauri Group. Components of the U.S. commercial space transportation industry and economic impact are described. Results from the past five reports, dating back ten years, are given and then analyzed specifically for the Launch Vehicle Manufacturing and Service Industry (LVM&SI). The general trends of the Commercial Space Transportation & Enabled Industries (CST&EI) are opposite those of the LVM&SI and are the basis of this paper's discussion. Other points of discussion include a seemingly anomolous data point in the Total Economic Activity metrics, their relationship with the number of launches in a given year, and the leverage ratio each direct LVM&SI dollar spent has on the rest of the LVM&SI economy.

## INTRODUCTION

Approximately every two years, the Federal Aviation Administration (FAA) Office of Commercial Space Transportation (AST) updates a report that provides a study of the U.S. commercial space transportation (CST) industry with the goal of quantifying its economic impact on the rest of the national economy. The previous and current FAA AST Economic Impact (EI) reports provide the data used in this paper and are listed in the table below.

**Table 1. Table 1. List of FAA AST Economic Impact Reports, 1999-Present**

| Data Year | Report Title | Release Date |
|---|---|---|
| 1999 | The Economic Impact of Commercial Space Transportation on the U.S. Economy | February 2001 |
| 2002 | The Economic Impact of Commercial Space Transportation on the U.S. Economy: 2002 Results and Outlook for 2010 | March 2004 |
| 2004 | The Economic Impact of Commercial Space Transportation on the U.S. Economy: 2004 | February 2006 |
| 2006 | The Economic Impact of Commercial Space Transportation on the U.S. Economy | April 2008 |
| 2009 | The Economic Impact of Commercial Space Transportation on the U.S. Economy: 2009 | August 2010 |

All these reports are available in the Reports & Studies section of the FAA AST web site at www.faa.gov/go/ast.

The CST EI reports listed above were conducted between 2001 and 2010 by the Futron Corporation and The Tauri Group, both under contract to AST at different times.

This paper compares the primary EI report metrics for the Launch Vehicle Manufacturing and Service Industry (LVM&SI), namely the economic activity impact metric, including its three component impact metrics: Direct Impact, Indirect Impact, and Induced Impact. Excluded from this paper are discussions of the economic activity metrics for the Commercial Space Transportation and Enabled Industries (CST&EI, defined below), and any analysis of the Earnings and Employment metrics for both the CST&EI and the LVM&SI.

## SPACE TRANSPORTATION INDUSTRY

The commercial space transportation industry is modeled in this study by two categories:

- Launch Vehicle Manufacturing and Services
- Industries Enabled by the Launch Vehicle Manufacturing and Services[1]

Emerging commercial space transportation sectors (including manned and unmanned suborbital transportation as well as manned orbital space transportation sectors) are discussed in the most recent FAA AST EI report, but are not included in the quantitative analysis of the report.

A description of the Launch Vehicle Manufacturing and Services Industry (LVM&SI) is given below. The analysis of the Commercial Space Transportation & Enabled Industries (CST&EI) is covered in the latest FAA AST Economic Impact report.

**Launch Vehicle Manufacturing and Services Industry (LVM&SI)**

The LVM&SI refers to the industrial infrastructure necessary to manufacture, process, and launch orbital and suborbital vehicles and their payloads into space.

For purposes of this paper, the launch industry includes the construction of U.S. commercial launch vehicles and the provision of U.S. commercial launch services, the latter including spaceport facilities and range operations.

The U.S. launch industry is a critical element of the U.S. transportation infrastructure, for without it the nation is unable to send people and satellites into space. Whereas launch revenues are relatively small, the launch industry nevertheless enables other industries, and it is these industries that generate substantial revenues, profits, and employment.

For more on orbital launch activities and trends, consult FAA AST's many publications and reports on the launch industry including: The Year in Review, Semi-Annual Launch Reports, Quarterly Launch Reports, and reports on various special topics, all accessible on the FAA AST website.

1. Enabled Industries are those made directly possible because of the commercial launch industry; those industries related to the manufacture of payloads or the services provided by those payloads. For purposes of this report, these enabled industries include: (1) Satellite Manufacturing, which covers the sale of all commercial satellites constructed by U.S. commercial satellite manufacturers; (2) Satellite Services, which include direct-to-home television (DTH TV), Very Small Aperture Terminal (VSAT) services, satellite data services, transponder leasing, satellite digital audio radio services (DARS), and mobile satellite telephony; (3) Ground Equipment Manufacturing which encompasses satellite-related hardware, like gateways and satellite control stations. It also includes mobile uplink equipment, VSAT terminals, and consumer electronics used with satellite services, such as direct broadcasting satellite antennas and receivers, phone booths, and handheld satellite phones; (4) Satellite Remote Sensing covers the provision of raw satellite imagery, but does not include value added services such as geographic information systems (GIS); and (5) Distribution Services which represent wholesale, retail trade, and transit costs incurred as components are delivered to manufacturing sites. Distribution industries are considered enabled by the commercial launch industry because truck, air, and rail transportation services are required to move parts to manufacturing sites and to move launch vehicles and satellites to launch sites.

## ECONOMIC IMPACTS

Three economic impact metrics are measured in the AST EIA report: (1) Economic Activity, (2) Earnings, and (3) Employment. Each of these is discussed in more detail below.

**Economic Activity**

Economic Activity, the value of goods and services produced in an economy, is measured in revenue generated. 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 these industries.

Economic activity is divided into three components:

- Direct impacts are the expenditures on inputs and labor involved in providing any final good or service relating to the primary industries analyzed in this report.
- Indirect impacts involve the purchases (e.g., metals, composite materials, processors) made by and labor supplied by the industries providing 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 resulting from the direct and indirect impacts (e.g., a spacecraft solar array design engineer's spending on food, clothes dry-cleaning, or any other household good and service).

These three components are depicted graphically in Figure 1 on page 3:

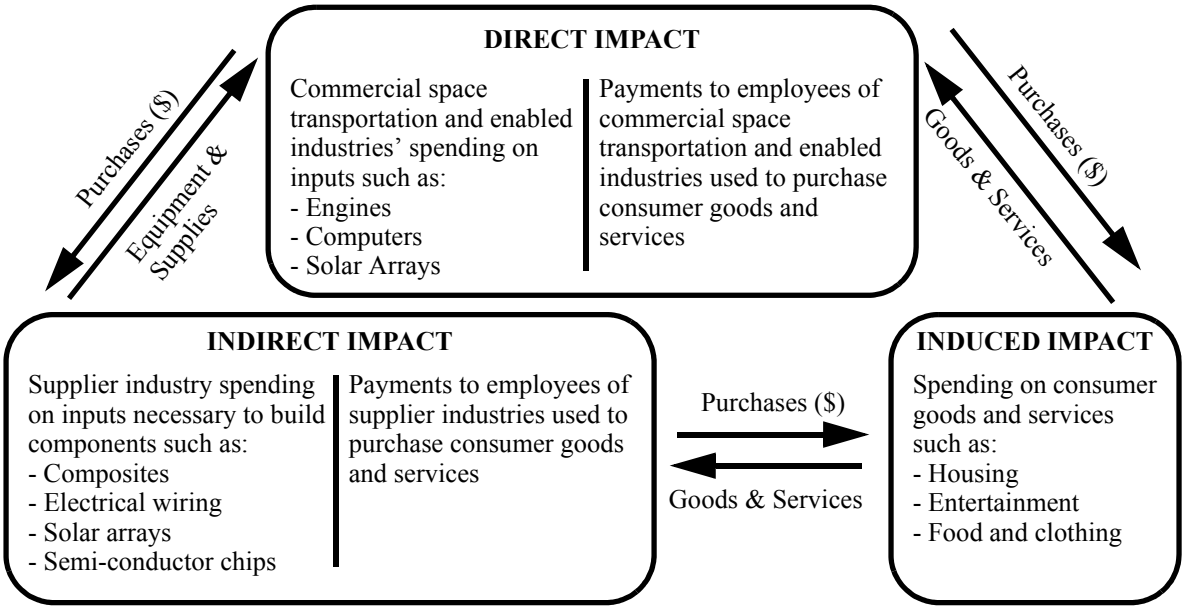
**Earnings**

Earnings, the sum of all the wages and salaries (including employee benefits) paid to employees in an economy, 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 these industries.

**Employment**

Employment, the total number of workers employed to support the production of goods and services in an economy, includes all workers employed by commercial space transportation and enabled industries, plus those employed by all other industry groups to support these industries.

**Figure 1. Relationship of Three Economic Activity Components.**




## DATA

The economic performance data for the overall CST&EI and the LVM&SI for the past decade (in then-year dollars) are presented in Table 2 and Table 3 on page 3.

**Table 2. Commercial Space Transportation and Enabled Industries - Totals (in Then-Year $)**

| Based on Data Year... | 1999 | 2002 | 2004 | 2006 | 2009 |
|---|---|---|---|---|---|
| **Economic Activity ($000)** | **$61,313,711** | **$95,025,746** | **$98,086,960** | **$139,262,027** | **$208,329,012** |
| *Direct ($000)* | *$9,644,429* | *$16,959,859* | *$16,666,148* | *$23,240,911* | *$34,845,418* |
| *Indirect ($000)* | *$29,510,733* | *$46,715,917* | *$46,382,890* | *$65,031,780* | *$97,331,013* |
| *Induced ($000)* | *$22,158,549* | *$31,329,971* | *$35,037,924* | *$50,989,338* | *$76,152,583* |
| **Earnings ($000)** | **$16,431,192** | **$23,527,745** | **$25,045,888** | **$35.659,935** | **$53,257,346** |
| **Employment** | **497,346** | **576,448** | **551,350** | **729,240** | **1,029,440** |

**Table 3. Launch Vehicle Manufacturing and Service Industries - Totals (in Then-Year $)**

| Based on Data Year... | 1999 | 2002 | 2004 | 2006 | 2009 |
|---|---|---|---|---|---|
| **Economic Activity ($000)** | **$3,515,978** | **$791,759** | **$1,658,384** | **$1,166,723** | **$827,817** |
| *Direct ($000)* | *$499,027* | *$149,273* | *$286,936* | *$199,195* | *$141,334* |
| *Indirect ($000)* | *$1,580,890* | *$367,530* | *$759,171* | *$527,028* | *$373,939* |
| *Induced ($000)* | *$1,446,061* | *$274,956* | *$612,277* | *$440,500* | *$312,545* |
| **Earnings ($000)** | **$1,071,722** | **$206,328** | **$437,674** | **$308,087** | **$218,595** |
| **Employment** | **28,617** | **4,828** | **8,870** | **5,690** | **3,820** |

**Table 4. Commercial Space Transportation and Enabled Industries - Totals (in 2009 $)**

| Based on Data Year... | 1999 | 2002 | 2004 | 2006 | 2009 |
|---|---|---|---|---|---|
| **Economic Activity ($000)** | **$79,094,687** | **$113,080,638** | **$111,819,134** | **$147,617,749** | **$208,329,012** |
| *Direct ($000)* | *$12,441,313* | *$20,182,232* | *$18,999,409* | *$24,635,366* | *$34,845,418* |
| *Indirect ($000)* | *$38,068,846* | *$55,591,941* | *$52,876,495* | *$68,933,687* | *$97,331,013* |
| *Induced ($000)* | *$28,584,528* | *$37,306,465* | *$39.943,233* | *$54,048,698* | *$76,152,583* |
| **Earnings ($000)** | **$21,196,2238** | **$27,998,017** | **$28,552,312** | **$37,799,531** | **$53,257,346** |
| **Employment** | **497,346** | **576,448** | **551,350** | **729,240** | **1,029,440** |

**Table 5. Launch Vehicle Manufacturing and Service Industries - Totals (in 2009 $)**

| Based on Data Year... | 1999 | 2002 | 2004 | 2006 | 2009 |
|---|---|---|---|---|---|
| **Economic Activity ($000)** | **$4,535,612** | **$942,193** | **$1,890,558** | **$1,236,726** | **$827,817** |
| *Direct ($000)* | *$643,745* | *$177,635* | *$327,107* | *$211,147* | *$141,334* |
| *Indirect ($000)* | *$2,039,348* | *$437,361* | *$865,455* | *$558,650* | *$373,939* |
| *Induced ($000)* | *$1,865,419* | *$327,198* | *$697,996* | *$446,930* | *$312,545* |
| **Earnings ($000)** | **$1,382,521** | **$245,530** | **$498,948** | **$326,572** | **$218,595** |
| **Employment** | **28,617** | **4,828** | **8,870** | **5,690** | **3,820** |

It should be noted that round-off error accounts for the summation discrepancies between the component economic activity impacts (i.e., Direct, Indirect, and Induced) and the total economic activity impact values.

To perform an analysis, it is necessary to normalize the then-year dollars to a specified standard. For this paper, the above tabulated data has been adjusted to 20009 dollars using a Consumer Price Index multiplier resulting in Table 4 on page 3 and Table 5 on page 4.

Graphs of the tabulated data are shown in Figures 2-5. Two combination graphs plotting the CST&EI (left axis) as well as the LVM&SI (right axis) for Earnings data (Figure 4) and Employment data (Figure 5) are taken from the preceding tables.

## ANALYSIS

Analysis in the following section will investigate the following trends shown in Figures 2 and 3:

- What is the cause of the dramatic decrease from 1999 to 2002 in the LVM&SI Economic Activity Impact graph, Figure 3?
- Although the steady increase of economic activity impact values for the CST&EI is well understood, why is the U.S. LVM&SI economic activity impact steadily decreasing over the same time period?
- What is the leverage value of every U.S. LVM&SI Economic Activity Impact dollar on the rest of the U.S. LVM&SI?

**Figure 2. Commercial Space Transportation & Enabled Industries Total Economic Activity (in 2009 $)**

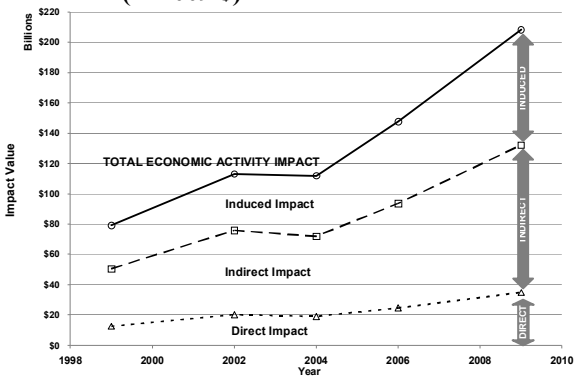



**Figure 3. Launch Vehicle Manufacturing & Services Industry Total Economic Activity (in 2009 $)**

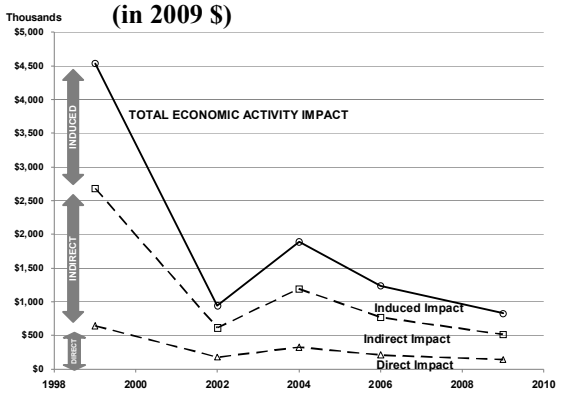



**Figure 4. Earning Metrics**

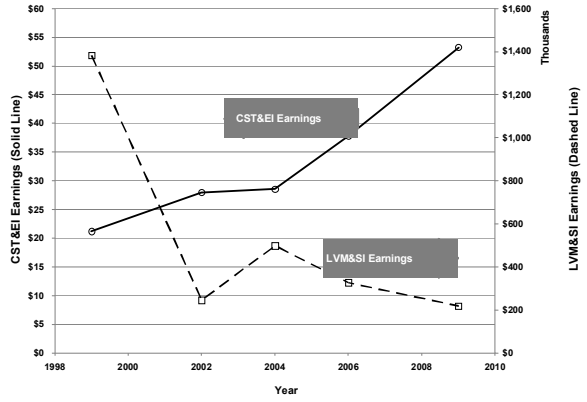
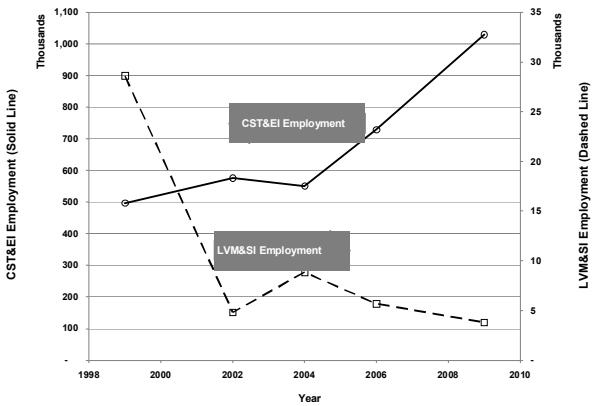



**Figure 5. Employment Metrics**



**1. Dramatic Decrease in 2002 LVM&SI Data**

The first point of analysis is to investigate the steep decline was reported from 1999 to 2002, explained in the 2002 EI report as being "primarily due to a sharp decrease in the manufacture and launch of commercial spacecraft." An increase was seen in all three Economic Activity components with the 2004 data, explained in that report that "Launch vehicle manufacturing rebounded from 2002 because of an increase in commercial launches conducted in 2004."

These explanations posit a direct relationship between the number of U.S. commercial launches and the three components of Economic Activity Impact. Table 6 lists the number of FAA-licensed orbital launch events over the range of years covered by all (previous and current) EI reports as reported in multiple FAA AST Year In Review and Quarterly/Semi-Annual Launch reports. It should be noted that these are U.S. launches only and do not include multi-national launch vehicles, such as the SeaLaunch Zenit.

**Table 6. Number of U.S. Commercial Launches**

| Year | 1999 | 2000 | 2001 | 2002 | 2003 | 2003 |
|---|---|---|---|---|---|---|
| # Launches | 17 | 7 | 3 | 5 | 5 | 6 |
| **Year** | **2005** | **2006** | **2007** | **2008** | **2009** | |
| # Launches | 1 | 2 | 3 | 6 | 4 | |

When both Economic Activity Impact and the number of U.S. launches are plotted together (as shown in Figure 6) two observations are immediately noted:

- The dramatic decrease in the 2002 LVM&SI economic activity impact data, including all three components, does seem to reflect a dramatic decrease in the number of U.S. commercial launches immediately prior to 2002. Notably, the number of launches dropped from 15 to 7 to 3 (from 1999 to 2001) before increasing (briefly) again. The relative level and time scale of volatility of both data sets for this brief period seem to be similar.
- The implication (inferred by the data prior to and including 2004) of a strong direct relationship between the number of U.S. commercial launches and the value of LVM&SI economic activity impact seems to be counter-indicated by the same data for the rest of the reporting period (from 2004 to 2009). At first glance, the relative volatility level and time scale in this portion the graph seems to be very different than during the earlier time period. In fact, it is plausible that the economic activity impact metric reacts sluggishly as compared to the number of launches. However, the inconsistencies of volatility and time scale are over-emphasized by showing more annual launch data points (five) as compared to bi-annual data points for Economic Activity (only three). When the same number of data points are plotted for similar years, the apparent level of volatility and time-lag is less pronounced.

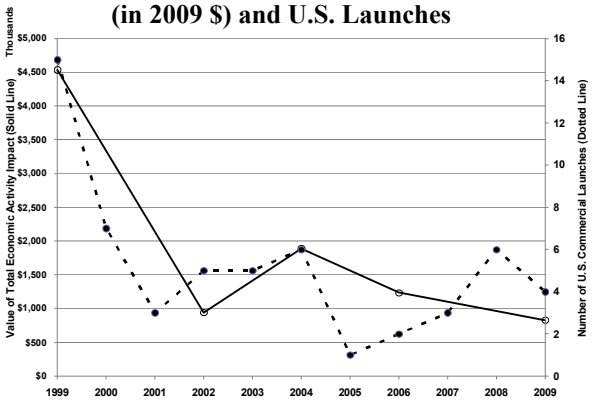
**2. Decrease of LVM&SI Economic Impact Values**

The second analysis centers on the dramatic difference in economic activity data of both the CST&EI as well as the LVM&SI.

The CST&EI Total Economic Activity chart (Figure 2) shows a generally-increasing trend of all three components (Direct, Indirect, and Induced impacts) as a function of time. A brief period of stagnation (or slight decline) was seen from 2002 to 2004. Inversely, the LVM&SI Total Economic Activity chart (Figure 3) shows a generally-decreasing trend of all three components as a function of time (except for the dramatic decrease from 1999 to 2002 discussed above).

The U.S. LVM&SI economic activity impact data (Table 5) shows a decrease of 71.7 percent from 1999 to 2009 in economic impact values. This trend is reflected by the decreasing number of U.S. commercial launches (Table 6 on page 5 and Figure 6 below) that denotes a direct relationship with employment levels, orders of raw materials, etc., all of which are factored into the total economic activity impact value.

**Figure 6. Launch Vehicle Manufacturing and Services Industry Total Economic Activity (in 2009 $) and U.S. Launches**




Another contribution to the decrease of LVM&SI economic activity impact values, and one which contributes to the declining number of U.S. commercial launches, includes fierce market competition from non-U.S. LVM&SI companies and that has resulted in a diminished market share for U.S. launch providers.

However, if the 2002 data point is not seen as an anamoly (as proposed in the first analysis discussion) but rather as the beginning of a new “normal” in the

launch rate (and the resulting economic activity impact), a new conclusion results. From this perspective, the 1999 data point is the end of the launch market based on a large number of communication satellites that, in fact, did not materialize.

The new conclusion would be that the launch rate, and resulting economic activity impact is not generally decreasing, but has been at a constant (albeit lower) level ever since 2002.

### 3. Leverage of LVM&SI Direct Benefits

Finally, the calculation of how much impact each dollar of LVM&SI Direct impact dollar spent has on the rest of the U.S. LVM&SI as well its impact on the overall CST&EI might be of interest.

The LVM&SI leverage ratio is calculated by dividing the sum of the indirect and induced impact values by the LVM&SI direct impact value. The values of this leverage ratio are tabulated below in Table 7.

**Table 7. LVM&SI Leverage Ratios by Year**

| Year | 1999 | 2002 | 2004 | 2006 | 2009 |
|---|---|---|---|---|---|
| Leverage Ratio | 6.1 | 4.3 | 4.8 | 4.9 | 4.9 |

The calculations show that the LVM&SI Direct Impact Leverage on the LVM&SI ratio is relatively stable, retaining a value just under 5.0 since the 2002 report (after the launch market experienced its dramatic readjustment). This indicates that for every dollar spent in the direct purchase of a launch vehicle and service results in almost $5 of indirect and induced economic impact within that same industry segment.

## CONCLUSIONS

The variation of LVM&SI Economic Activity Impact data between 1999 and 2009 is satisfactorily explained by the seemingly strong relationship between the economic activity impact values and the number of U.S. commercial launches. The number of commercial launches resulted from a dramatic adjustment in the launch market that occured after 1999. Other factors, such as the competitive launch services market environment, also contribute to this relationship.

The total LVM&SI Economic Activity Impact data shows a consistent trend of decline, especially when viewing the data from 1999 onward. (It's more constant when viewed starting with the 2004 data.) The explanation for this trend is attributable toward a consistently lower number of U.S. commercial orbital space launches, due to intense market competition for candidate launches from foreign providers (as mentioned above).

Finally, every dollar of the LVM&SI direct impact ripples through the economy with indirect and induced impacts. The leveraging ratio of the direct impact has remained fairly constant since 2002 with a value just less than 5:1. Plainly stated, for every dollar spent purchasing a U.S. commercial space launch, almost $5 is subsequently spent in indirect or induced ways.

## ACKNOWLEDGEMENTS

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