General Aviation's Contribution To The U.S. Economy

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MERGEGLOBAL

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Prepared for **General Aviation Manufacturers Association**

NASAO
National Association of State Aviation Officials

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General Aviation (GA) makes a significant contribution to the national economy and to the economy of every state in the U.S. Because of the diverse nature of the U.S. fleet of general aviation aircraft, and the multitude of operations and unique services they perform, GA's economic contribution has sometimes been overlooked or it is combined with other transportation sectors, masking its own contribution. Also, when defining GA activity too narrowly, economic studies can easily underestimate GA's economic contribution.

The GA fleet is diverse, as are the reasons for operating the aircraft. GA encompasses the manufacture and operation of any type of aircraft that has been issued a certificate of airworthiness by the U.S. Federal Aviation Administration (FAA), other than aircraft used for scheduled commercial air service1 (airlines) or operated by the U.S. military.

General Aviation includes fixed-wing airplanes, helicopters (rotorcraft), balloons, dirigibles, and gliders. GA activities include the manufacture and operation of aircraft equipped with turbine engines (turbojet, turbofan, or turboprop) or piston engines, and of non-powered aircraft. GA includes flights related to business or corporate transportation of people or cargo, personal transportation (e.g., visiting family), air ambulance, flight training, and many purposes such as fire spotting and suppression and pipeline patrol. GA operations are not determined by the ownership of the aircraft; GA aircraft may be wholly-owned, jointly-owned, rented, chartered, or leased. GA operations are not defined by the airman certificate of the pilot operating the aircraft. The pilot of a GA aircraft may hold a student, private, commercial, or air transport pilot certificate, depending on the purpose of the flight and the number of pilots required to operate it by the manufacturer.

This study breaks new ground by bounding general aviation activity using the FAA's standard definitions, which are widely recognized by every segment of GA. The study uses FAA's estimates of annual flight activity and applies industry-derived per-hour costs for operating various types of aircraft. GA's economic contribution is calculated by putting these costs into regional economic models, widely accepted as valid by economists and available from the U.S. Department of Commerce.

General Aviation is an important element of economic growth in part because it fulfills transportation needs which can not otherwise be met. Only about 350 U.S. communities have scheduled air service; for the remainder, GA is the only option for the movement of persons or cargo by air. Moreover, GA provides specialized air services, such as air ambulance and traffic patrol, to communities that do have scheduled air service.

[1] Commercial air carriers sell air transportation to passengers and shippers. Commercial air carriers include operators of small, propeller-driven aircraft (under Part 135 of the Federal Aviation Regulations) as well as operators of jet airliners (under FAR Part 121).

The GA sector contributed at least $150 billion to national output in 2005 and, directly or indirectly, employed more than 1,265,000 people whose collective earnings exceeded $53 billion. It should be noted that these figures are very conservative, first, because they reflect only the economic
output that likely would not have been generated if GA did not exist and, second, because the analysis was restricted to those portions of GA's contribution for which MergeGlobal found sufficiently detailed and reliable data. As will be discussed later in this report, the estimates of GA's economic contributions do not, by any means, include all of GA's significant net benefits to the U.S. economy.

General Aviation contributes to the U.S. economy by creating output, employment, and earnings that would not otherwise occur. Direct impacts, such as the purchase of a new aircraft, multiply as they trigger transactions and create jobs elsewhere in the economy (e.g., sales of aluminum, plastic, rubber, electronics, and the wide range of other materials and components required to make an airplane). To capture these ripple effects, MergeGlobal estimated GA's "direct", "indirect", and "induced" contributions to the U.S. economy as summarized below:

TABLE 1

General Aviation's Contribution to the U.S. Economy In 2005

(All data except employment in $ billions)

	Direct	Indirect	Induced	Total	GA % of U.S.
Output	$39.8	$49.9	$60.6	**$150.3**	0.66% [2]
Wages & Salaries	$14.5	$20.9	$17.8	**$53.2**	0.76% [3]
Employment	225,000	560,000	480,000	**1,265,000**	0.90% [3]

General Aviation benefits people and communities throughout the United States, and its economic contribution is significant in all regions of the country, as shown on the following page[4]:

[2] Based on U.S. gross output of $22.7 trillion in 2005, estimated from the 2004 figures reported by the Bureau of Economic Analysis (U.S. Department of Commerce).

[3] Based on U.S. total wages & salaries of $7.0 trillion and total employment of 140 million workers in 2005, as reported by the Bureau of Labor Statistics (U.S. Department of Labor).

[4] Available data limits us to estimating GA's economic contribution at the state level. It is tempting to distribute state-level impacts to congressional districts. Unfortunately, doing so would require assumptions that cannot be proven right and might well be proven wrong. For example, it is technically possible to allocate GA's economic contribution based on each congressional district's share of state employment in a particular industry. The problem is that many industries (such as aircraft manufacturing) have economies of scale that lead to concentrations of employment.

CHART 1

Map of General Aviation's Total Economic Contribution by State In 2005

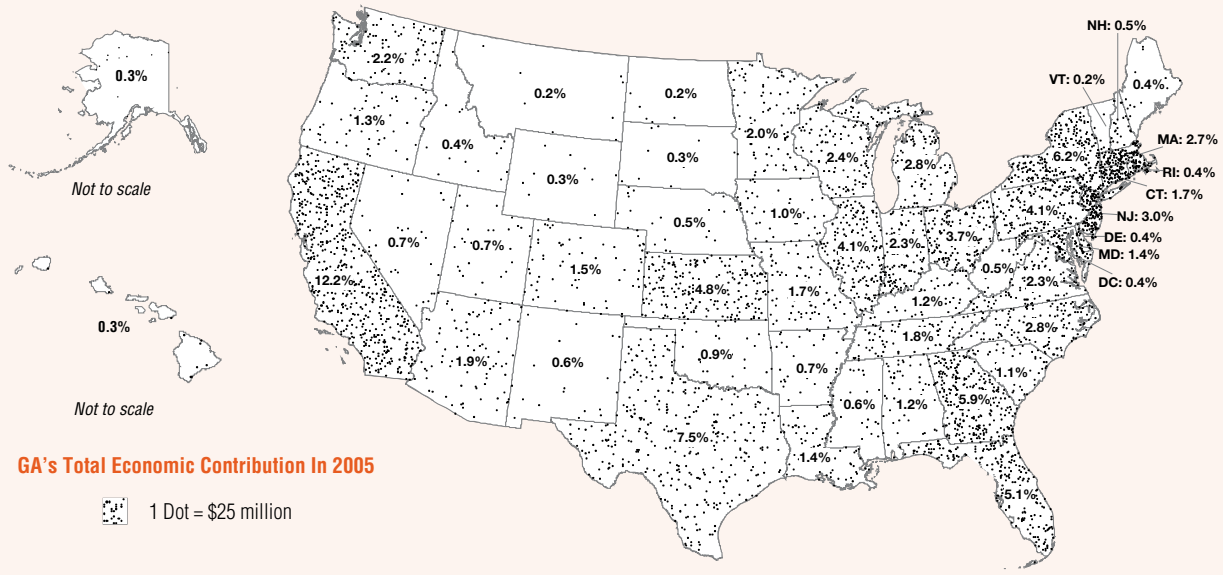


TABLE 2

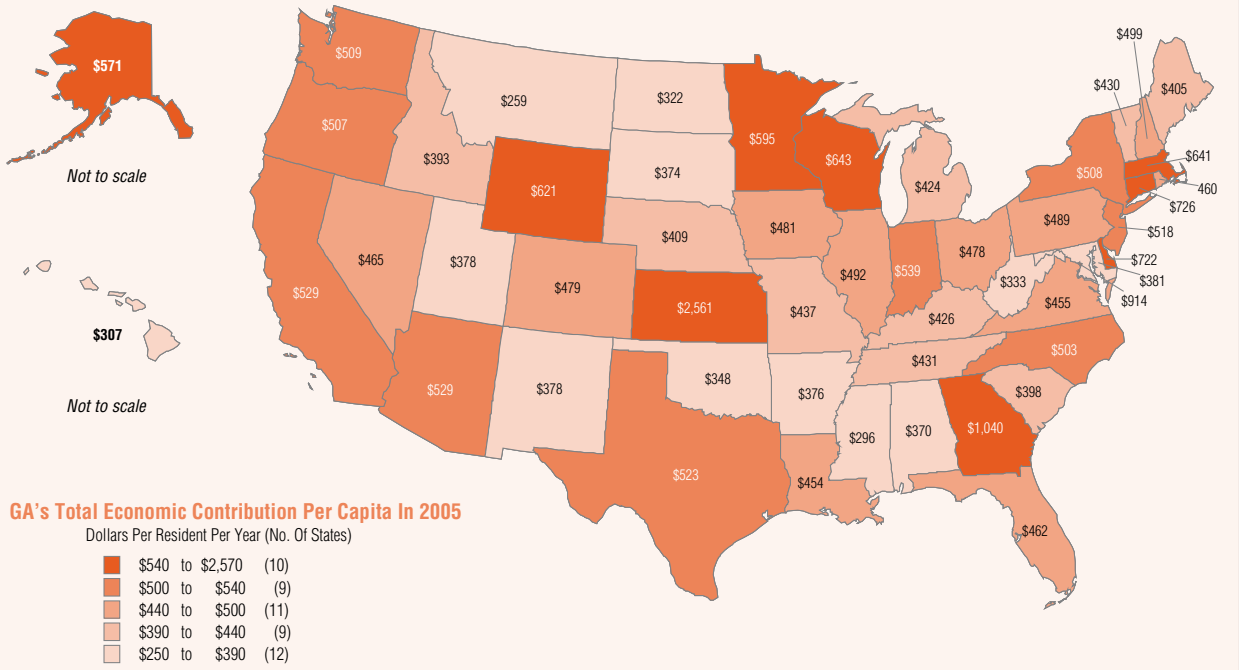
Leading States In Terms Of GA Total Economic Contribution In 2005 ($ billions)

Rank	State	Total	% of U.S. GA
1	California	$18.2	12.2%
2	Texas	$11.2	7.5%
3	New York	$9.3	6.2%
4	Georgia	$8.8	5.9%
5	Florida	$7.5	5.1%
6	Kansas	$7.1	4.8%
7	Illinois	$6.0	4.1%
8	Pennsylvania	$6.0	4.1%
9	Ohio	$5.5	3.7%
10	New Jersey	$4.4	3.0%

It is important to remember that GA makes an significant contribution to the economies of smaller or less-populated states that do not appear in the preceding table. Indeed, GA can be disproportionately important in large, sparsely-populated states (such as Alaska) because it offers transportation where few viable alternatives exist. To reflect this aspect of GA's contribution, we calculated GA's total economic contribution per resident and summarized the results below. Of course, these data do not reflect GA's intangible but important improvement to the economic viability and quality of life among dispersed populations in rural areas.

CHART 2

Map of GA's Total Economic Contribution Per Capita In 2005*



* Total Economic Contribution is the sum of direct, indirect, and induced contributions. For example, the District of Columbia has a significant contribution due to indirect and induced effects.

TABLE 3

Leading States In Terms Of GA Total Economic Contribution Per Capita In 2005

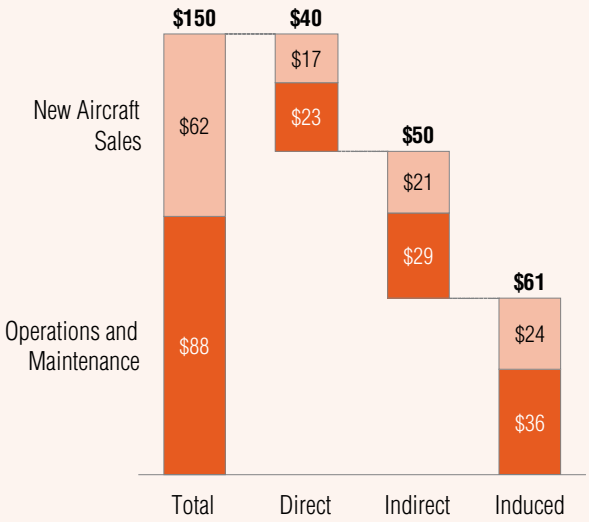
(Including Direct, Indirect, and Induced)

Rank	State	Per Capita Contribution
1	Kansas	$2,561
2	Georgia	$1,040
3	District of Columbia	$914
4	Connecticut	$726
5	Delaware	$722
6	Wisconsin	$643
7	Massachusetts	$641
8	Wyoming	$621
9	Minnesota	$595
10	Alaska	$571

As shown in Table 1, GA's total contribution to the U.S. economy (measured in terms of gross output) is comprised of direct, indirect, and induced effects. For purposes of this study, GA's contribution to the economy traces back mainly to two things: the purchase of new GA aircraft, and the operation and maintenance of the entire US-based GA aircraft fleet whether that purpose be recreation, instruction and training of pilots, corporate travel, or medical evacuation. Chart 3 breaks down each type of contribution into its major components:

CHART 3

Breakdown of GA's Total Economic Contribution in 2005 ($ billions)



Obviously, new aircraft deliveries each year represent only a fraction of the total U.S.-based GA aircraft fleet, so it makes sense that GA operations and maintenance (O&M) account for the majority of GA's contribution to the U.S. economy — and that this contribution is spread across the nation, including states with little or no GA manufacturing activity.

1.0 Introduction

1.01 Introduction

The General Aviation Manufacturers Association (GAMA) and the National Association of State Aviation Officials (NASAO) jointly retained MergeGlobal, Inc. to assess and estimate General Aviation's total contribution to the U.S. economy. MergeGlobal's study was led by W. Bruce Allen, PhD, David L. Blond, PhD, and Aaron J. Gellman, PhD.

MergeGlobal's mandate was to deliver an independent, expert, and conservative assessment of GA's current contribution to the U.S. economy at both the national and state levels.

2.0 Definitions

2.01 General Aviation Defined

General aviation ("GA") encompasses the manufacture and operation of any type of aircraft that has been issued a certificate of airworthiness by the FAA, other than aircraft used for scheduled commercial air service (airlines) or operated by the U.S. military.

Thus, GA includes fixed-wing aircraft, helicopters (rotorcraft), balloons, dirigibles, and gliders. GA includes the manufacture and operation of aircraft equipped with turbine engines (turbojet, turbofan, or turboprop) or piston engines, and of non-powered aircraft. GA includes flights related to business or corporate transportation of people or cargo, personal transportation (visiting family), air ambulance, flight training and for many unique purposes, such as fire spotting and pipeline patrol. GA operations are not determined by who owns the aircraft. GA aircraft may be wholly-owned, jointly-owned, rented, chartered or leased. GA operations are not defined by the airman certificate of the pilot operating the aircraft; the pilot of a GA aircraft may hold a student, private, commercial, or air transport pilot certificate, depending on the purpose of the flight and the number of pilots prescribed to operate it by the manufacturer.

GA aircraft enable people, especially those in smaller communities and remote areas, to move quickly and efficiently across the country and around the world for both business and pleasure. GA is disproportionately important because it touches so many sectors of the economy – from the helicopters transporting accident victims to hospitals, to corporate jets carrying executives to meetings, to single piston engine aircraft flown by enthusiasts on the weekends.

2.02 Classes of GA Aircraft

MergeGlobal grouped GA aircraft into the following classes that are consistent with Federal Aviation Administration (FAA) classifications:

2.02.1 **Single-engine piston-powered airplanes**[5] comprise over 80% of the current GA fleet in the United States and are the most common Personal-Use aircraft, thanks to their relatively low acquisition cost. The single piston engine drives a single propeller, and burns relatively expensive aviation gasoline (avgas).

2.02.2 **Multi-engine piston-powered** airplanes usually have two piston engines driving separate propellers. As with single piston aircraft, they use aviation gasoline, and Personal-Use accounts for much of their flight time.

2.02.3 **Single- or Multi-engine Turboprop airplanes** are powered by one or more turbine engines that drive propellers and burn aviation kerosene (jet fuel). Turboprop aircraft typically are larger, faster, and more expensive than piston aircraft. Turboprops are flown for a wide variety of purposes but are most often flown for business, corporate, and other professionally crewed purposes.

[5] In accordance with industry norms, Airplanes are fixed-wing aircraft, Rotorcraft are rotary-wing aircraft (or, helicopters), while the term Aircraft includes both airplanes and helicopters.

2.02.4 **Jet** airplanes have two or three turbofan engines and offer the greatest speeds and range capabilities of all GA aircraft. Due to the expense and professional requirements of their operation, jets are most commonly operated by corporate and government users. For purposes of this study, jets are further segmented by weight class into three categories (light, medium, and heavy) to capture significant cost and use differences.

2.02.5 **Piston engine powered rotorcraft** are helicopters powered by a single piston engine that burns avgas. Piston-powered rotorcraft are generally smaller and less expensive to acquire and operate than their turbine-powered cousins and are most commonly flown for instructional or personal purposes.

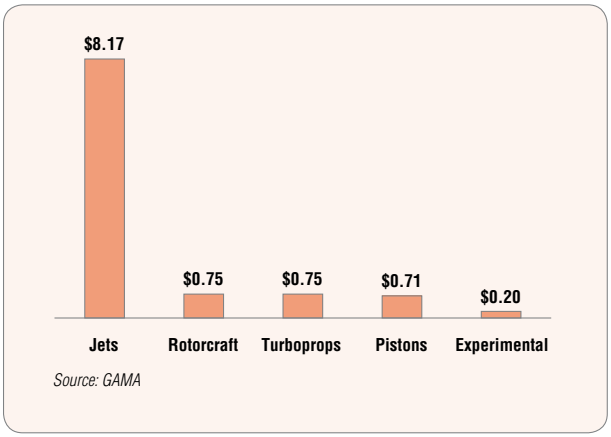
2.02.6 **Turbine engine powered rotorcraft** are helicopters powered by one or two turbine engines that burn jet fuel. Aerial observation, law enforcement, and medical evacuation account for much of their usage.

2.02.7 **Experimental** aircraft generally are home-built or kit aircraft flown by enthusiasts. They have piston or turbine engines but usually have piston engines. This category also includes some vintage aircraft and rebuilt military aircraft of which there are limited working examples.

The following graphs depict sales and flight hours in 2005 by each of the GA aircraft categories. "Rotorcraft" represents both piston- and turbine-powered helicopters, while "Pistons" represent both single- and multi-engine piston-power airplanes.

CHART 4

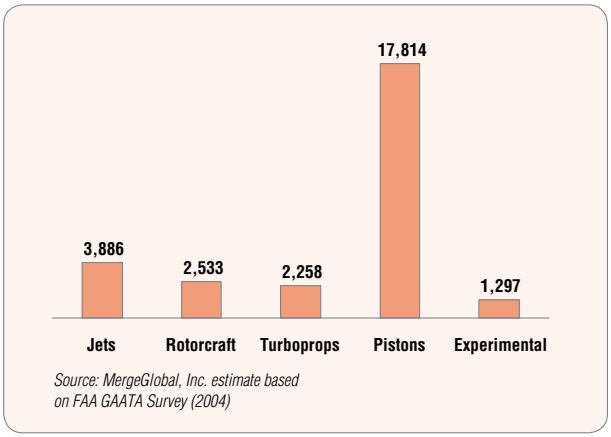
U.S. Sales by GA Aircraft Category in 2005
($ billions)



Source: GAMA

CHART 5

Flight Hours by GA Aircraft Category in 2005



Source: MergeGlobal, Inc. estimate based on FAA GAATA Survey (2004)

2.03 The Uses of General Aviation Aircraft

The FAA classifies GA aircraft according to the uses reported by owners. Each use is suggestive of a pattern of expenditures that contributes to other sectors of the U.S. economy based on employment of professional crews, hours flown, insurance rates, and other variables. The majority use for which the aircraft is flown determines how the FAA classifies the use of that aircraft. The uses which the FAA defines are listed below in Table 4.

TABLE 4

FAA GA Aircraft Use Categories

FAA Category	Definition	Category in this report
1. Personal/Recreation	Flying for personal reasons (excludes business transportation)	Personal
2. Instructional	Flying under the supervision of a flight instructor (includes student pilot solo; excludes Part 135 training and proficiency flights)	Corporate, Utility, and Other
3. Business Transportation	Individual or group use for business transportation *without* a paid, professional crew.	Business
4. Corporate/Executive Transportation	Individual or group business transportation *with* a paid, professional crew (includes fractional ownership)	Corporate, Utility, and Other
5. Air Medical Services	Air ambulance services, rescue, human organ transportation, emergency medical services (excludes air Medical Services conduced under Part 135)	Corporate, Utility, and Other
6. Sight-seeing	Commercial sight -seeing conducted under Part 91	Corporate, Utility, and Other
7. Aerial Observation	Aerial mapping/photography, patrol, search and rescue, hunting, traffic advisory, ranching, surveillance, oil and mineral exploration, etc.	Corporate, Utility, and Other
8. Aerial Application in Agriculture and Forestry	Crop and timber production, including cloud seeding, fertilizer, and pesticide application	Corporate, Utility, and Other
9. Other Aerial Application	Public health sprayings, fire fighting including forest fires, etc.	Corporate, Utility, and Other
10. External Load	Operation under Part 133, rotorcraft external load operations; examples include: helicopter hoist, hauling logs, etc.	Corporate, Utility, and Other
11. Other Work Use	Construction work (excluding Part 135 operations), parachuting, aerial advertising, towing gliders, etc.	Corporate, Utility, and Other
12. Other	Positioning flights, proficiency flights, training, ferrying, sales demos	Corporate, Utility, and Other
13. Air Taxi	Part 135 *on-demand* passenger and all cargo operations (excluding air tours, air medical services, or scheduled passenger service)	Corporate, Utility, and Other
14. Air Tours	Commercial sight -seeing conducted under Part 135	Corporate, Utility, and Other
15. Air Medical Services (part 135)	Air ambulance services, rescue, human organ transportation, emergency medical services conducted under Part 135	Corporate, Utility, and Other
16. Commuter	Part 135 *scheduled* passenger service only	Not included in this report

Source: FAA General Aviation and Air Taxi Activity Survey, 2004

The FAA assigns each aircraft in the U.S. GA fleet to a single category of use based on the majority use reported by operators. In reality, aircraft perform a variety of missions – e.g., a businessperson may use her aircraft for work during weekdays, and for ski trips on the weekends. Since more than 80 percent of the aircraft's flight hours are classified as Business Transportation, the aircraft is classified as being used for Business Transportation. MergeGlobal assumed that the majority use of an aircraft determines many costs, such as insurance rates and whether or not a professional crew is employed.

We recognize that there are exceptions in every category. For example, we assume that aircraft used for Aerial Observation are professionally crewed by news organizations, law enforcement, search and rescue agencies, and oil and mineral exploration companies. However, some aircraft in this category do not have a professional crew – for example, some aircraft are flown by owner-pilot ranchers to monitor livestock movement. Unfortunately, FAA data does not allow us to estimate the percentage of Aerial Observation hours flown by owner-pilots versus professional crews, but available evidence indicates that owner-pilots generate a small fraction of these hours. Therefore, MergeGlobal believes that the assumption (that 100 percent of Aerial Observation aircraft are professionally crewed) is reasonable, and that similar assumptions are reasonable for the other categories.

For purposes of this analysis, GA use is segmented into three classes:

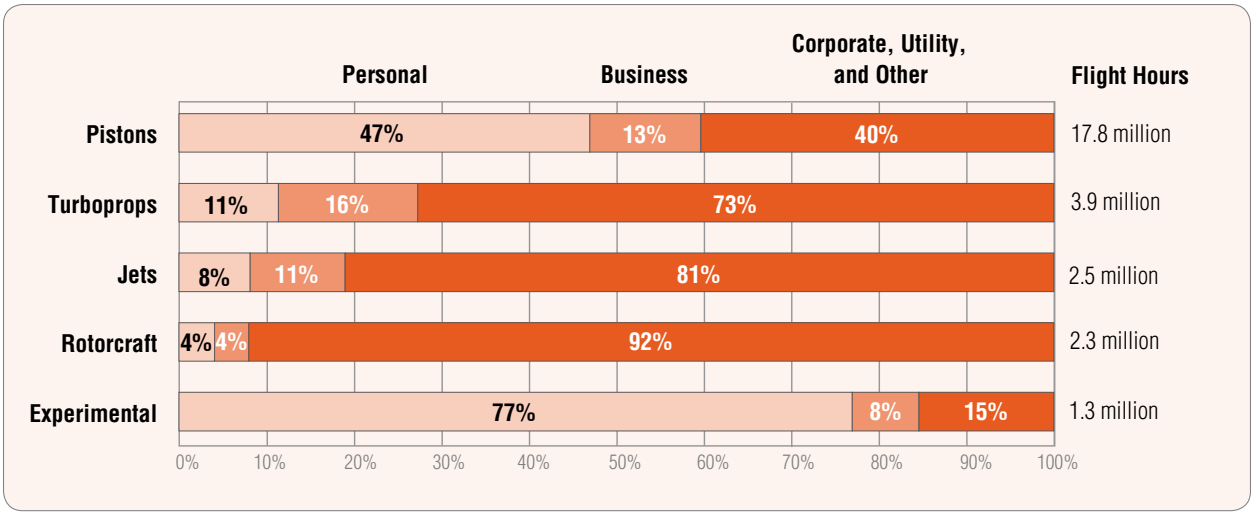
2.03.1 **Personal** – Aircraft flown for the personal purposes of the owner are Personal-Use. The owner-pilots of these aircraft often fly under Visual Flight Rules (VFR) and thus impose a limited burden on the national air traffic control system. Further, they are assumed to tie-down their aircraft rather than rent hangars. It is assumed that they do not subscribe to a commercial weather service.

2.03.2 **Business** – These aircraft are flown by owner-pilots for business transportation without a professional crew. A common example is a salesperson who uses his own aircraft to visit different areas of his sales region. Such owners are assumed to share a hangar with other users and pay a business insurance rate. They are assumed to purchase the commercial weather report service since travel is important to the conduct of their business and, on average, they fly more frequently than personal users.

2.03.3 **Corporate, Utility, and Others** – For purposes of cost evaluation, this category includes all uses which are assumed to use professional crews. The owners of these aircraft are assumed to rent a private hangar, pay the corporate insurance rate, and hire a professional crew (pay and benefits). Crew compensation can differ according to use as the crew for a corporate helicopter, for example, may be compensated differently than that of a helicopter used to survey power lines. Thus, all uses of helicopters other than Corporate/Executive Transportation uses are assumed to have the Utility cost structure which features different crew costs and insurance rates. All the same, these costs are much more similar to Corporate/Executive Transportation than to Personal-Use or Business Use.

CHART 6

Distribution of Flight Hours by GA Aircraft Category in 2005



Source: MergeGlobal estimate based on FAA General Aviation and Air Taxi Activity (GAATA) Survey, 2004

MergeGlobal has also made some simplifying assumptions about hangar use. The calculations assume that personal users do not rent hangars; rather, they pay tie-down fees. Business users use a shared hangar and Corporate, Utility, and Others use private hangars.

1.02 Types of Economic Contribution

The United States has a complex economy in which industries depend upon each other for materials, supplies, and services. Spending in any one sector of the economy causes changes in output not only in that sector but also in many others. Thus, the direct impacts of GA considered here – e.g., the purchase of new aircraft, fuel, maintenance services, etc. – trigger transactions elsewhere in the economy. Such transactions lead to additional employment, spending, and government tax revenues across a number of sectors. To capture these "multiplier" effects, GA's contributions to the U.S. economy are shown in three forms:

1. **Direct contribution** – U.S. economic output created by the manufacture, operation, or maintenance of GA aircraft. Direct contribution measures include the value of new GA aircraft sales, pilot training, fuel purchases, airport charges (landing and parking), spare parts, etc.

2. **Indirect contribution** – U.S. economic output created by the purchase of goods and services by firms directly involved in the manufacture, operation, or maintenance of GA aircraft. Firms that benefit from GA's direct contribution (including aircraft and engine manufacturers, maintenance providers, pilot training schools, etc.) buy goods and services from other firms. For example, aircraft manufacturers must buy aluminum, plastic, glass, and other materials to make GA aircraft.

3. **Induced contribution** – U.S. economic output created by the expenditures of wage-earners, including professional pilots, employed by the firms that generate revenue, directly or indirectly, from GA. The portion of these wages which is traceable to GA is spent by employees on various goods and services, leading to more economic output, employment, and earnings that are said to be "induced" by GA.

It is easier to describe GA's contributions in conceptual terms than it is to quantify those contributions with publicly-available data. For example, many people would acknowledge that GA is especially important for communities with insufficient regular commercial air service – but might reasonably disagree about how to value the time savings or economic stimulus that GA delivers to those communities. The same problems apply to other critical questions, including:

- What is the contribution to macroeconomic growth and welfare flowing from enhanced mobility conveyed by GA?
- What is the value of generating a further stream of pilots to serve as professionals with high-end GA and the airlines especially given the widely expected shortage of such pilots in the near future?

To avoid such disagreements, MergeGlobal has restricted its estimate to those major components of GA's economic contribution for which it has obtained sufficiently reliable and detailed data to provide a high degree of confidence in the estimates. Further, MergeGlobal has taken a conservative approach in estimating the value of each quantified component of GA's contribution to the U.S. economy.

3.0 GA's Direct Contribution

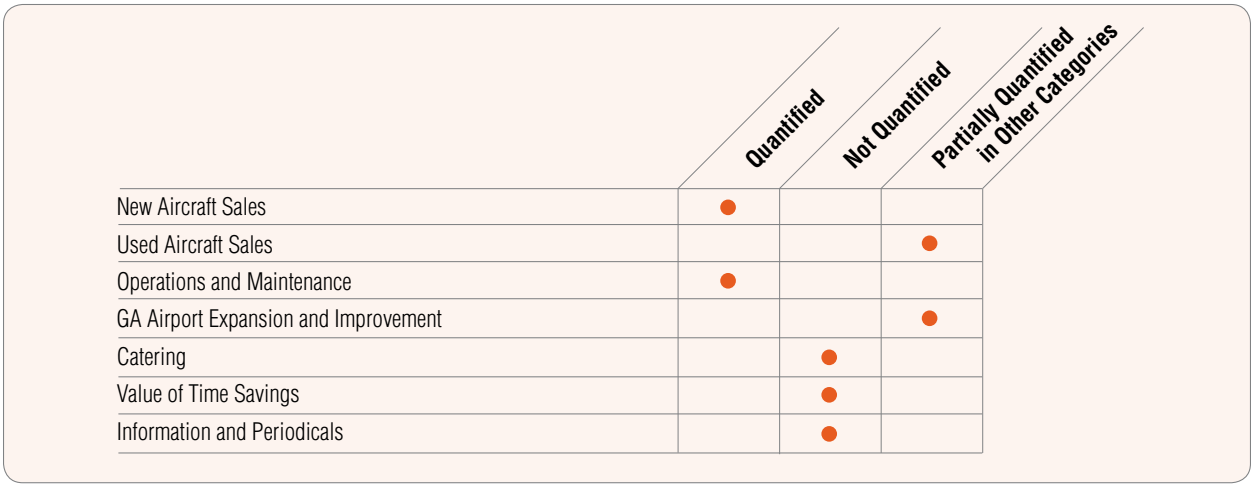
3.01 Direct Contribution Defined

For purposes of this report, the direct contribution of GA is the U.S. economic output created by the manufacture, operation, and maintenance of GA aircraft. Direct contribution measures include the value of new GA aircraft sales, fuel purchases, airport charges (landing and parking), spare parts, and other direct expenditures related to the operation of GA aircraft. As discussed earlier, there are other contributions which are not measured, as well as intangible benefits which may or may not be quantifiable.

The sum total of all purchasing, maintenance, and operating expenditures represent the direct contribution of General Aviation.

CHART 7

Contributions Quantified and Not Quantified



3.02 Direct Contributions Quantified

Using industry sources, federal data, and proprietary data from aircraft manufacturers and service providers, MergeGlobal measured the direct expenditures on General Aviation at the national and state levels. Some of the variables considered are:

3.02.1 **New Aircraft Sales** – The manufacture of a new aircraft requires not only parts for the airframe, but also the purchase of engines, avionics, interior fitments, tires, brakes, paint, instruments, etc.

3.02.2 **Operations and Maintenance** – Operators of aircraft have different requirements and their spending patterns can differ greatly. For example, the hangar facilities and crew wages for the operation of a

$30 million corporate jet have a much different - and greater - impact than those of a private owner of a single piston engine airplane. Therefore, it is appropriate to attribute spending and usage patterns according to use. MergeGlobal made simplifying assumptions about owner spending, some of which are illustrated in Chart 7 and discussed in section 2.03, Uses of General Aviation Aircraft.

CHART 8

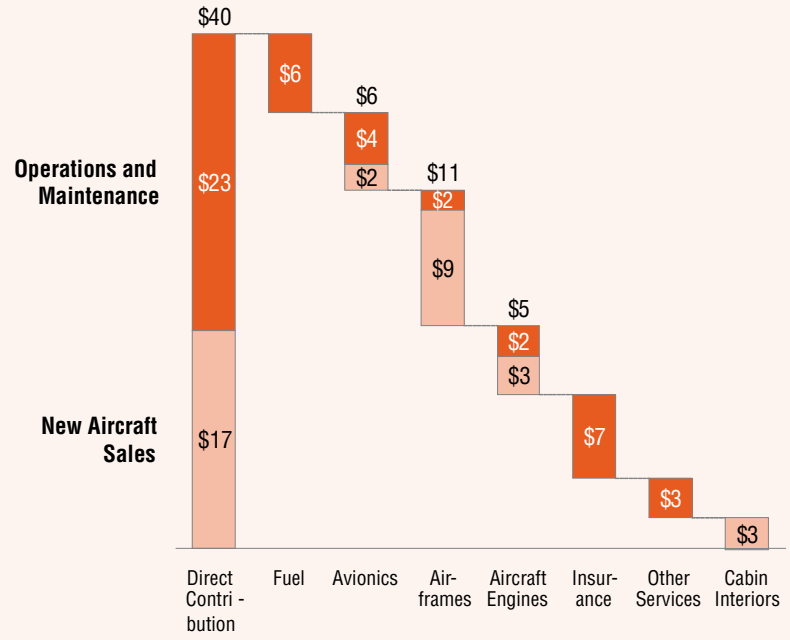
Assumed User Spending Patterns

User Type	Paid Crew	Hangar	Tie-Down Parking	Insurance Costs
Personal			●	Lower
Business		Shared		Lower
Corporate, Utility, and Other	●	Private		Higher

GA's direct contribution to the U.S. economy is distributed among a number of different industries. Leading recipient industries are depicted below:

CHART 9

Distribution of GA's Direct Contribution To The U.S. Economy in 2005 ($ billions)



The above chart demonstrates the sectors to which GA New Aircraft Sales and Operations and Maintenance activities directly produce economic benefits. Fuel and Insurance are functions of Operations, while Other Services include subscriptions to commercial weather services, maintenance services, and navigational chart services. The revenues of Aircraft Manufacturers include not only new airframes but also maintenance and replacement parts for aircraft already in service; Aircraft Engines has the same pattern. Avionics are included in New Aircraft but also require periodic maintenance or repair and are sometimes replaced in order to upgrade an aircraft's systems. Cabin interiors include seating and interior work on aircraft which can range from simple to ornate components and are maintained throughout an aircraft's service life.

3.03 Direct Contributions Not Quantified

General aviation contributes to the U.S. economy in a number of ways that we did not attempt to specifically quantify due to a lack of data and/or our belief that the measurable impact would be relatively small. Also, some of these contributions are partially included in the quantified direct and indirect contributions described above. We recognize that the non-quantified direct contributions may have a substantial combined value, so their exclusion increases the conservatism of this estimate.

Direct contributions that are identified but not quantified include:

3.03.1 **General Aviation airport expansion and improvement** – Private airport operators, Federal, state, and municipal governments spend millions of dollars per year to upgrade the condition and capacity of thousands of airports that are primarily, if not totally, used by general aviation. These expenditures on GA expansion are often captured in the landing, parking, and other fees paid by aircraft owners which are measured as a direct contribution.

3.03.2 **Catering** – There are some companies which provide catering services to owners of General Aviation aircraft. This can range from packed lunches to gourmet meals for cross-continental or inter-continental flights. The little anecdotal data available estimating the size of this sector suggests that it is relatively small compared to other aspects of General Aviation.

3.03.3 **Used aircraft sales** – Although the aircraft itself was built perhaps several years ago, the upgrades or repairs require spending which contributes to the current economy and is categorized as a direct contribution in this study. The payments made to aircraft brokers are not considered. There is a lack of data available suggesting the values of aircraft sales and thus no reliable way to estimate payments to brokers. The value of these payments is estimated to be very small compared to GA as a whole and is not considered.

3.03.4 **Value of time savings** – One of the common reasons for corporations to use their own aircraft is the productivity gains and cost savings (e.g., avoided hotel nights) relative to using the scheduled airlines or automobiles. Corporate executives have the ability to see more clients in a day, or see clients more often. They can also have meetings or conference calls enroute which are not possible on commercial airlines. Travelers can arrive at GA airports much more closely to the departure time and

the airport itself may be closer to their origin or destination. The most recent estimate of time savings was undertaken by GAMA approximately fifteen years ago. We did not have sufficient confidence in such old estimates to include time savings in this study.

3.03.5 **Miscellaneous** – There are other benefits from GA spending which are not considered in this study, for example, GA periodicals, information services, and for-profit internet sites and information gatherers. Although these contributions would not occur but for General Aviation, we have elected not to include them due to lack of available data and the small absolute value of the contribution.

4.0 GA's Indirect Contribution

4.01 Indirect Contribution Defined

The indirect contribution of GA is the U.S. economic output created by the purchase of goods and services by firms involved in the manufacture, operation, or maintenance of U.S.-based GA aircraft (i.e., firms that receive GA's direct contribution to the economy).

Indirect contributions represent the economic activity required to produce the direct contributions, accounting for the fact that expenditure in one industry triggers expenditure in another industry. In order to calculate indirect contributions, gross output must first be determined.

Gross output is the sum of both the direct and indirect contributions. Subtracting direct contributions from gross output yields indirect contributions. Gross output is determined by using an Input-Output (I/O) model, to be discussed in *Approach and Methodology*. Essentially, though, the I/O model runs the direct contributions through the various sectors of the economy and sums up the effects by applying "multipliers", discussed later.

4.02 Quantified Indirect Contributions

Those indirect contributions which are quantified are the effects of the direct contributions as they filter through the economy and trigger actions and purchases in other sectors. For example:

- Aluminum manufacturers' material to make aluminum for airframes
- Radar arrays used for weather services
- Computers used for GA aircraft maintenance tracking
- Fabrics and other materials used in seating
- Components assembled to produce GA avionics units
- Production and transport of GA aircraft fuels
- Re-insurance purchased by insurers of GA aircraft

4.03 Indirect Contributions Not Quantified

Contributions which cannot be attributed to the direct contribution measures are not quantified in the indirect contribution, either. These can include:

- Hotels used by corporate travelers for long-distance or extended business trips
- Meals purchased for consumption during flight or during travel
- The value of time lost by air carrier service limits

TABLE 5

Top Ten Industries Benefiting from Indirect Contributions of GA in 2005

($ millions)

Rank	Industry	Total	% of GA's Indirect Contribution
1	Business Services	$5,994	12.0%
2	Radio, TV, and Communications Equipment	$4,756	9.5%
3	Mining/Extractive	$2,922	5.9%
4	Aircraft Engines	$2,792	5.6%
5	Real Estate and Dwellings	$2,766	5.5%
6	Financial Institutions	$2,649	5.3%
7	Construction	$2,603	5.2%
8	Metal Products	$2,470	4.9%
9	Wholesale and Retail Trade	$2,380	4.8%
10	Utilities	$1,634	3.3%

The industry grouping, or sectors, which are illustrated in this report and used in the I/O model are those identified for analysis by the Bureau of Economic Analysis at the Department of Commerce. It is not surprising that the industries which benefit most from GA are those which are somehow related to either the industry directly or through supplying the GA industry with goods or services. For example, Mining/Extractive supplies the bauxite or iron ore from which aluminum and steel are produced – these products, in turn, are used to produce aircraft airframes and other parts. Financial Institutions provide financing to those who purchase aircraft and also to the services and manufacturers which support GA. Avionics are produced by companies in the Radio, TV, and Communications Equipment industry category and this same grouping produces many of the subcomponents used to build avionics suites. Business Services is a very wide ranging group which includes accounting, janitorial, waste management, marketing, copy shop, information, and IT services which serve not only GA users but also every other industry which receives some portion of GA's contributions.

5.0 GA's Induced Contribution

5.01 Induced Contribution Defined

Induced contribution is the U.S. economic output created by the expenditures of people employed by the firms that generate revenue from GA, directly or indirectly. The portion of these wages attributable to GA is spent by employees on various goods and services, leading to more economic output, employment, and earnings that are said to be "induced" by GA.

5.02 Quantified Induced Contributions

The Induced Benefits add up the spending of wages which results from both the Direct and Indirect Contributions. Those portions of wages which are earned due to GA activities are then spent in various ways by the recipient. Since people spend their wages in different ways than industries, the induced contributions have little to do with the industry from where the wages were earned and are instead based on the spending patterns of wage earners. An employee of an aircraft manufacturer may have a very different job from a farmer, yet, on average, they will have a tendency to spend their wages in similar ways – food, lodging, automobiles, etc.

TABLE 6

Leading Industries Receiving GA's Induced Contribution To The U.S. Economy In 2005
($ billions)

Rank	Industry	Total	% of GA's Induced Contribution
1	Business Services	$6,867	11.3%
2	Educational	$6,444	10.6%
3	Real Estate and Dwellings	$5,476	9.0%
4	Health Services	$3,784	6.2%
5	Wholesale and Retail Trade	$3,227	5.3%
6	Financial Institutions	$2,654	4.4%
7	Communications	$2,552	4.2%
8	Food	$2,322	3.8%
9	Insurance	$2,303	3.8%
10	Personal and Household	$1,925	3.2%

As with the Indirect Contributions of GA, Business Services scores high on the list of industries which benefit from GA. As discussed above, Business Services is a wide ranging cluster of industries which includes such varied companies as consulting, accounting, photocopy shops, veterinary care for livestock, janitorial services, maintenance of equipment,

and advertising. Although consumers may not purchase large amounts of Business Services, their purchases do have effects on this industry group because Business Services support all the sectors in which consumers do make purchases.

Since Induced benefits are the result of direct and indirect consumer spending, it is understandable that the leading industries for Induced Contributions are different than those of the Indirect Contributions. Consumer and household spending patterns are quite different from those of industry.

5.03 Induced Contributions Not Quantified

For obvious reasons, MergeGlobal was not able to calculate induced contributions derived from non-quantified direct and indirect contributions. We recognize that the value of such inducted contributions may be substantial, and believe that their exclusion increases the conservatism of the quantitative estimates.

6.0 Approach and Methodology

6.01 Introduction

It is easier to describe GA's contributions in conceptual terms than it is to quantify those contributions with publicly-available data. For example, many people would acknowledge that GA is especially important for communities with insufficient regular commercial air service – but might reasonably disagree about how to value the time savings or economic stimulus that GA delivers to those communities. To avoid such disagreements, MergeGlobal has restricted its estimate to those major components of GA's economic contribution for which it has obtained sufficiently reliable and detailed data to provide a high degree of confidence in the estimates. Further, MergeGlobal has taken a conservative approach in estimating the value of each quantified component of GA's contribution to the U.S. economy.

Outlined below is the underlying philosophy after which there is a description of the methodology employed. (Data sources and assumptions are summarized in Appendix B.)

6.02 Methodology To Quantify GA's Direct Contribution

6.02.1 New aircraft sales

New aircraft are made from components which come from several different industries. The airframe is generally assembled by those who can be thought of as "aircraft integrators". Their names are often synonymous with general aviation. GAMA provided the average prices, component costs, and foreign content of new aircraft delivered during the calendar year 2005. Components included:

a. Airframes and related assemblies – wings, fuselages, landing gear, controls, etc.
b. Avionics – navigation, communications, transponders, etc.
c. Engines – engines and engine subsystems
d. Interiors – seating surfaces, interior appointments

As an example of the differences among aircraft type, the single engine for a home-built airplane contributes a different percentage of the purchase price than the two engines purchased for a light twin-engine jet.

For each of the above listed components, we added exports and domestic content of foreign manufactured aircraft, while subtracting foreign content of domestic built aircraft. Import and export values are based on Federal trade data and aircraft manufacturer cost evaluation. For example, a foreign-made jet may have US-made navigation avionics, and a US-made aircraft may have foreign-made seating.

6.02.2 **Operations and Maintenance**

As the largest component of overall GA contribution, the determination of Operations and Maintenance costs are perhaps the most important part of this analysis.

6.02.2.1 **Hours** – Each year, the FAA records the types of aircraft in service, their usage rates, purposes for usage, and states in which aircraft are based. Since most aircraft operational costs are reported in "per hour" format, these data are critical to the calculations.

6.02.2.2 **Costs** – Conklin and deDecker collects cost data for operations and maintenance and this is considered the industry standard. MergeGlobal weighted the average maintenance costs by the number of each model sold during the past ten years. The data gathered by Conklin and deDecker includes:

c. Insurance – Rates differ according to aircraft type and purpose of use.
d. Crew wages and benefits – Corporate pilots and crew are paid based on industry norms. Conklin and deDecker data are based on surveys conducted by the National Business Aircraft Association (NBAA).
e. Recurrent training – Active pilots must fulfill certain yearly training requirements in order to maintain their active status.
f. Navigational chart services – Owners purchase subscriptions to these services in order to have current, accurate navigational data. Individual costs are adjusted for each type of aircraft based on typical differences in range and usage patterns.
g. Computerized maintenance record services – Owners of turbine powered aircraft often use a computerized maintenance management program in order to accurately record maintenance intervals and expenditures so as to meet federal maintenance requirements.
h. Weather service – This cost is the price of a subscription to a computerized weather update service.
i. Hangar or Tie-down – Some aircraft are likely to be stored in a hangar while others are more likely to be stored in an open parking area referred to as Tie-down. Fees are often based on the size of the aircraft, or its "foot-print".
j. Modernization – This includes the cost of routine upgrade work, or repairing uninsured damages and the deductibles on otherwise covered damages.
k. Refurbishing – The cost of maintaining the interior and exterior appearance of the aircraft which includes seats, carpet, and painting.
l. Fuel usage (burn rate) – The burn rate is the weighted average rate at which each type of aircraft uses fuel .

6.03 Methodology To Quantify GA's Indirect And Induced Contributions

6.03.1 Background

The Input-Output (I/O) model is an economic modeling tool for which Wassily Leontief won the Nobel Prize in Economics in 1973. He had developed the model in the 1930's, but its practical value and use awaited the post-war development of computers. The model uses data gathered from industries in the economy at a point in time (the currently available full table covers the year 1997, while an in-process table is under construction by the Bureau of Economic Analysis (BEA) of the Department of Commerce with data for 2002). Preparing an input-output table from reported Economic Census data is complicated by the fact that business establishments (the unit of measure for collecting data) often make several different product categories at the same location.

The benefit of an I/O model is that it provides a "map" of how money flows within the economy as a whole. It traces the expenditures of businesses and government through to their payment of wages, taxes, and profits. It then traces the allocation of profits, taxes, and wages by private consumers, business investors, and government. Thus, it gives a complete picture of the complex nature of flows in a large and developed economy.

6.03.2 Input-Output summary

Essentially, an input-output model provides a snapshot of the economy at a moment in time. Because of the general delay – often ten years – in producing a full scale table for the economy, the Bureau of Economic Analysis develops an estimate of the current expenditure pattern in the economy as of a more recent year. Yearly, less detailed tables of economic expenditures are produced and published. In this study, a table available for 2004 was used, with modifications. Taking the more detailed sub-sectors from the 1997 table, MergeGlobal created a slightly more robust model of the economy that tracks with the BEA developed more aggregated 2004 table. This alternative I/O framework covers 65 sectors including the important sectors for determining the impact of GA aircraft sales and operations on the economy (i.e., airframe, aircraft engines, avionics, and interiors).

An I/O model links buyers with sellers. Sellers are other industries as well as employees and shareholders (who expect profits). This is the first stage, or "direct", impact on the economy of a purchase of a GA aircraft. Since GA aircraft manufacturers purchase materials and components from various suppliers, MergeGlobal needed to trace these "indirect" impacts through the economy. Economists have devised a very simple tool for tracing these indirect flows using a mathematical formula to develop "multipliers" for each direct purchase. With I/O analysis, after taking into account the multiplier, the amount of purchases will be greater than the amount purchased directly.

Induced demand is based on the wages paid by each industry (derived from the Gross Output generated by the direct purchases for new aircraft and the operations and maintenance (O&M) thereof) as well as pilot salaries. Wages are then allocated by category of consumer expenditure. This expenditure pattern is then used to measure gross output (also called "production") that results from wages. In this way, the full impact of the GA industry is captured.

6.03.3 **The GA Pre-multiplier**

Input-Output tables produced by the government reflect set of industries. It happens that industries often produce different products at the same location, but data collected is classified into a single, dominant, product-line. In the same way, GA aircraft come in different models. To properly allocate the sales of GA aircraft, MergeGlobal has developed a pre-multiplier that takes the individual product categories sold, i.e., the share for each aircraft that is spent on engines, airframe, avionics, and interior; adjusts for the portion of these costs that are imported; and uses these totals when measuring direct contribution. Thus, the generalized Input-Output model is adapted and calibrated for GA activity specifically.

In this study, each category of aircraft is divided into its major constituent components. This allows a more correct allocation of funds to industry groups. The cost of engines – whether purchased by airframe manufactures directly and included in their indirect expenditures or purchased separately by the buyers (similar to the way commercial aircraft engines are purchased separately from the purchase of the airframe) – are allocated to the engine manufacturing sector. In a similar fashion, avionics are allocated to the Radio and TV Communications sector. Each aircraft type has a unique share of airframe costs, engines, avionics, and interior. Thus, the generalized I/O for aircraft is made specific to individual aircraft types.

As the example below (Table 7) shows – based on approximate shares for an aircraft within the GA category – this allows a finer detailed split of effects on sales. This "hybrid" aircraft represents the average distribution in the main categories of expenditure on a new aircraft. The column on the far right is the new I/O category produced using these splits. The column then shows the approximate direct spend by industries for each dollar of sales of a hybrid aircraft.

TABLE 7

Direct Contribution (A-matrix) Showing Hybrid Aircraft Direct Contribution Vector

Supplier Industries	Radio, TV, Communications Equipment (Avionics)	Aircraft Integrators	Aircraft Engines	Other Sectors	Hybrid Aircraft I/O Vector
Agriculture		0.001		0.007	0.001
Mining/Extractive		0.001		0.659	
Metal Products	0.023	0.028	0.001	0.054	0.026
Engines and Turbines		0.149	0.105		0.100
Radio,TV,Communications Eqpt.	0.441	0.107		0.010	0.111
Aircraft Integrators			0.081		0.044
Others	0.218	0.488	0.607	0.070	0.458
Value Added (components below)	0.318	0.226	0.206	0.200	0.260
Wages	0.302	0.192	0.175	0.180	0.218
Taxes	0.009	0.003	0.003	0.003	0.004
Profits	0.008	0.031	0.028	0.017	0.038
Sum of Shares	1.000	1.000	1.000	1.000	1.000

*Sample categories for illustrative purposes only.
Highlighted cells are referenced in text below

Thus, for a dollar of direct purchases of a GA aircraft, it is expected that, in addition to the value generated by the aircraft itself, they will buy about 4.4 cents from other aircraft integrators and parts manufactures. Aircraft engine manufacturers' main suppliers are other companies in the engines and turbines category, which make the parts that go into aircraft engines (these two sectors are virtually the same companies). Approximately 26 cents of each dollar will contribute to GDP in the form of value-added. The lion's share of this, or nearly 22 cents, will be in the form of wages.

However, once all the direct and indirect flows that are associated with making an aircraft are taken into account (Table 8), the full impact of that dollar of sales can be observed. Thus, for every dollar of sales of general aviation aircraft, one can expect $2.51 in direct and indirect benefits to the economy. This excludes the impact that comes from the wages and salaries of the workers in the industries affected. They spend their money throughout the economy. Table 9 indicates the distribution of private consumption expenditures of these workers and the industries mainly impacted directly. Each of these industries then buys from other industries producing a multiplier on wages of slightly more than two times the wages and salaries.

TABLE 8

Hybrid General Aviation Contribution Based on Inverse Matrix — Showing Multiplier Associated with Direct Sales of New Aircraft

Supplier Industries	Furniture and Fixtures	Petroleum Refinieries	Radio, TV, and Communi-cations	Aircraft Integrators	Aircraft Engines	Insurance	Business Services	Hybrid Aircraft I/O Vector
Agriculture	$0.03	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.00
Mining/Extractive	$0.01	$0.06	$0.01	$0.01	$0.01	$0.00	$0.01	$0.00
Food	$0.05	$0.03	$0.03	$0.35	$0.02	$0.01	$0.01	$0.03
Beverages	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
All other sectors	$2.28	$2.69	$2.58	$2.24	$2.21	$1.59	$1.82	$2.48
Multiplier	$2.36	$2.79	$2.62	$2.61	$2.25	$1.60	$1.84	$2.51

*Sample sectors for illustrative purposes only
Highlighted cell referenced in text

TABLE 9

Personal Consumption Expenditure Vector
(Distribution of Private Consumption Expenditures)

Agriculture	0.45%
Mining/Extractive	0.00%
Food	1.12%
Beverages	2.13%
Tobacco	0.35%
Textiles	0.09%
Wearing Apparel	1.18%
Leather and Leather Products	0.07%
Footwear	0.06%
Wood Products	0.02%
Furniture and Fixtures	0.19%
Paper and Paper Products	0.95%
Others	93.39%

* A few sectors are listed here for illustrative purposes only.

Table 10 shows how this money is apportioned, in general, across the 50 states. The main States that enjoy benefits are shown individually, while the rest are aggregated into a single category called Other States. The concentration of aircraft production can be seen by comparing the share of total industry output in each State.

International transactions are excluded based on shares developed by GAMA for each aircraft type. Foreign aircraft sold in the United States have significant US content. This content has also been captured using shares of each aircraft type and the amount spent on each foreign-made aircraft.

TABLE 10

Gross State Product Distribution by Industry Group

Industry	California	Florida	Georgia	Illionis	Kansas	New Jersey	New York	Ohio	Penn-sylvania	Texas	Other States
Agriculture	18.9%	4.7%	2.8%	3.1%	1.7%	0.5%	1.4%	1.6%	2.1%	6.7%	56.5%
Mining/Extractive	8.5%	0.5%	0.8%	0.8%	0.8%	0.2%	0.3%	0.9%	2.0%	37.2%	48.0%
Food	10.0%	2.6%	6.1%	5.4%	1.2%	2.3%	3.6%	4.4%	4.0%	5.1%	55.3%
Beverages	10.0%	2.6%	6.1%	5.4%	1.2%	2.3%	3.6%	4.4%	4.0%	5.1%	55.3%
Tobacco	10.0%	2.6%	6.1%	5.4%	1.2%	2.3%	3.6%	4.4%	4.0%	5.1%	55.3%
Textiles	6.1%	1.6%	19.5%	1.1%	0.3%	2.7%	4.8%	2.2%	3.5%	2.1%	56.2%
Wearing Appparel	23.4%	1.9%	3.0%	1.7%	0.5%	3.7%	14.0%	1.3%	7.6%	7.4%	35.4%
Leather and Products	23.4%	1.9%	3.0%	1.7%	0.5%	3.7%	14.0%	1.3%	7.6%	7.4%	35.4%
Footwear	23.4%	1.9%	3.0%	1.7%	0.5%	3.7%	14.0%	1.3%	7.6%	7.4%	35.4%
Wood Products	7.2%	3.4%	4.5%	1.9%	0.3%	0.9%	1.7%	3.3%	5.0%	4.8%	66.9%
Furniture and Fixtures	10.8%	3.1%	3.2%	4.0%	0.8%	1.5%	3.3%	4.4%	4.6%	4.9%	59.4%
Paper and Products	4.8%	2.1%	6.6%	3.6%	0.4%	2.6%	3.2%	4.0%	5.8%	4.9%	62.1%
Printing and Publishing	9.8%	2.7%	3.6%	7.5%	1.2%	4.1%	7.3%	5.0%	5.8%	6.0%	46.9%
Basic Chemicals	9.7%	1.3%	2.1%	4.2%	0.6%	10.6%	6.9%	4.1%	11.2%	6.8%	42.6%
Fertilizers	9.7%	1.3%	2.1%	4.2%	0.6%	10.6%	6.9%	4.1%	11.2%	6.8%	42.6%
Synthetic Resins	9.7%	1.3%	2.1%	4.2%	0.6%	10.6%	6.9%	4.1%	11.2%	6.8%	42.6%
Paints,Varnishes , Lacquers	9.7%	1.3%	2.1%	4.2%	0.6%	10.6%	6.9%	4.1%	11.2%	6.8%	42.6%
Drugs and Medicines	9.7%	1.3%	2.1%	4.2%	0.6%	10.6%	6.9%	4.1%	11.2%	6.8%	42.6%
Soap and Cleaning Preparation	9.7%	1.3%	2.1%	4.2%	0.6%	10.6%	6.9%	4.1%	11.2%	6.8%	42.6%
Chemical Products	9.7%	1.3%	2.1%	4.2%	0.6%	10.6%	6.9%	4.1%	11.2%	6.8%	42.6%
Petroleum Refineries	22.9%	0.6%	0.5%	6.5%	1.0%	3.5%	1.1%	2.8%	2.1%	28.5%	30.4%
Petroleum and Coal Products	22.9%	0.6%	0.5%	6.5%	1.0%	3.5%	1.1%	2.8%	2.1%	28.5%	30.4%
Rubber Products	6.3%	1.5%	3.3%	7.3%	1.0%	2.5%	3.4%	7.8%	5.4%	6.1%	55.3%
Plastic Products	6.3%	1.5%	3.3%	7.3%	1.0%	2.5%	3.4%	7.8%	5.4%	6.1%	55.3%
Pottery, China	9.1%	4.7%	3.7%	3.6%	1.2%	3.0%	3.7%	6.4%	6.7%	10.0%	47.9%
Glass and Products	9.1%	4.7%	3.7%	3.6%	1.2%	3.0%	3.7%	6.4%	6.7%	10.0%	47.9%
Non-metallic Products	9.1%	4.7%	3.7%	3.6%	1.2%	3.0%	3.7%	6.4%	6.7%	10.0%	47.9%
Iron and Steel	5.5%	0.9%	1.6%	4.5%	0.4%	2.0%	3.3%	11.7%	8.3%	5.7%	56.3%
Non-ferrous Metals	5.5%	0.9%	1.6%	4.5%	0.4%	2.0%	3.3%	11.7%	8.3%	5.7%	56.3%
Metal Products	9.4%	2.2%	1.7%	7.8%	0.7%	1.9%	3.6%	7.9%	5.8%	7.2%	51.8%
Engines and Turbines	8.9%	1.7%	2.0%	9.1%	1.0%	1.5%	5.8%	5.7%	3.8%	7.4%	52.9%
Agricultural Machinery	8.9%	1.7%	2.0%	9.1%	1.0%	1.5%	5.8%	5.7%	3.8%	7.4%	52.9%
Metal and Wood Working Machinery	8.9%	1.7%	2.0%	9.1%	1.0%	1.5%	5.8%	5.7%	3.8%	7.4%	52.9%
Special Industrial Machinery	8.9%	1.7%	2.0%	9.1%	1.0%	1.5%	5.8%	5.7%	3.8%	7.4%	52.9%
Office and Computing Machinery	31.6%	3.2%	0.8%	2.3%	0.2%	1.6%	4.1%	1.5%	1.7%	9.7%	43.2%
Machinery and Equipment NEC	8.9%	1.7%	2.0%	9.1%	1.0%	1.5%	5.8%	5.7%	3.8%	7.4%	52.9%
Electrical Industrial Machinery	7.0%	1.3%	5.7%	5.4%	0.9%	1.5%	3.2%	9.1%	5.3%	4.0%	56.7%
Radio, TV, and Communications Equipment	31.6%	3.2%	0.8%	2.3%	0.2%	1.6%	4.1%	1.5%	1.7%	9.7%	43.2%
Electrical Appliances and Housewares	7.0%	1.3%	5.7%	5.4%	0.9%	1.5%	3.2%	9.1%	5.3%	4.0%	56.7%
Electrical Apparatus	7.0%	1.3%	5.7%	5.4%	0.9%	1.5%	3.2%	9.1%	5.3%	4.0%	56.7%
Shipbuilding and Repair	14.9%	3.1%	2.7%	0.5%	5.7%	0.3%	1.4%	5.1%	2.9%	8.0%	55.3%
Railroad Equipment	14.9%	3.1%	2.7%	0.5%	5.7%	0.3%	1.4%	5.1%	2.9%	8.0%	55.3%
Motor Vehicles	3.1%	0.5%	2.1%	3.0%	0.5%	0.3%	2.3%	13.0%	1.4%	5.2%	68.6%
Motorcyles and Bicyles	3.1%	0.5%	2.1%	3.0%	0.5%	0.3%	2.3%	13.0%	1.4%	5.2%	68.6%
Aircraft Integrators	14.9%	3.1%	2.7%	0.5%	5.7%	0.3%	1.4%	5.1%	2.9%	8.0%	55.3%
Aircraft Engines	14.9%	3.1%	2.7%	0.5%	5.7%	0.3%	1.4%	5.1%	2.9%	8.0%	55.3%
Transport Equipment NEC	14.9%	3.1%	2.7%	0.5%	5.7%	0.3%	1.4%	5.1%	2.9%	8.0%	55.3%
Professional Equipment	31.6%	3.2%	0.8%	2.3%	0.2%	1.6%	4.1%	1.5%	1.7%	9.7%	43.2%
Photographic and Optical	17.4%	4.5%	2.2%	4.9%	1.0%	4.3%	4.7%	2.9%	4.7%	4.0%	49.4%
Watches and Clocks	17.4%	4.5%	2.2%	4.9%	1.0%	4.3%	4.7%	2.9%	4.7%	4.0%	49.4%
Other Manufactures	17.4%	4.5%	2.2%	4.9%	1.0%	4.3%	4.7%	2.9%	4.7%	4.0%	49.4%
Utilities	11.4%	4.9%	2.8%	5.0%	1.0%	3.4%	7.7%	3.7%	5.1%	11.0%	43.9%
Construction	13.2%	6.7%	3.2%	4.5%	0.8%	3.3%	5.3%	3.1%	3.8%	7.3%	48.8%
Wholesale and Retail Trade	13.2%	6.0%	3.3%	4.6%	0.9%	4.0%	6.5%	3.7%	3.9%	8.1%	45.8%
Restaurants and Hotels	12.9%	7.2%	2.8%	3.8%	0.7%	3.3%	6.6%	2.9%	3.2%	7.2%	49.3%
Transport and Storage	10.5%	5.1%	4.1%	5.6%	1.1%	3.6%	4.9%	3.5%	4.3%	9.6%	47.7%
Communications	17.8%	4.9%	4.2%	4.0%	1.5%	3.5%	11.3%	2.3%	3.3%	7.5%	39.7%
Financial Institutions	11.5%	4.4%	2.2%	5.4%	0.6%	3.7%	17.1%	3.2%	3.6%	5.9%	42.6%
Insurance	9.9%	4.3%	2.2%	6.3%	0.8%	4.0%	9.6%	4.0%	4.8%	6.6%	47.5%
Real Estate and Dwellings	16.5%	6.4%	2.6%	4.4%	0.6%	4.5%	7.8%	3.1%	3.9%	6.3%	43.8%
Business Services	12.8%	7.0%	3.2%	5.0%	0.6%	3.9%	8.4%	4.0%	3.6%	7.3%	44.1%
Educational	10.9%	3.9%	2.5%	5.1%	0.5%	3.2%	13.0%	2.9%	8.3%	4.5%	45.2%
Health Services	11.3%	5.6%	2.4%	4.2%	0.9%	3.5%	8.7%	4.1%	5.2%	6.7%	47.4%
Recreational and Cultural	17.6%	9.2%	2.0%	4.3%	0.4%	3.1%	9.1%	2.7%	3.1%	4.8%	43.7%
Personal and Household	13.5%	5.8%	2.6%	4.7%	0.9%	3.1%	6.9%	3.7%	4.4%	7.4%	47.0%

Appendix A

1. Data Sources and Assumptions

Data	Source	Definition	Notes
Number and value of new aircraft sales	General Aviation Manufacturers Association (GAMA)	Number and average value by type of all GA aircraft delivered in the United States in 2004 and 2004	GAMA asked its member manufacturers to compile values of aircraft delivered during calendar years 2004 and 2005
Value of components in new aircraft by type	GAMA	Value of major aircraft components including airframes, engines, avionics, and interiors; listed by type of aircraft	Based on their own accounting, GAMA members provided detailed cost data by type of aircraft which indicated the value of components relative to the value of the new aircraft
Value of foreign components in new aircraft, value of US content in foreign aircraft	GAMA	Average foreign content by component in US manufactured aircraft; average US manufactured value by component of foreign manufactured aircraft	Based on their own record-keeping, GAMA members provided the value of foreign content in aircraft components for US aircraft and average by component of US content in foreign aircraft
Active aircraft and flight hours	Federal Aviation Administration (FAA) 2004 General Aviation and Air Taxi Activity Survey (GAATA)	The number of active aircraft and flight hours of aircraft by type, by user, and by specific purpose; also by state	Using preliminary estimates for the change in usage for 2005, adjusted the 2004 hours for estimation purposes
Fuel burn rate	FAA GAATA	Average fuel use rates by type of aircraft	FAA data include fuel usage estimates by type of aircraft
Maintenance and operational costs	Conklin & deDecker, *Aircraft Cost Evaluator;* Aircraft Owners' and Pilots' Association	Hourly variable costs and yearly fixed costs for operation of aircraft	Adjusted for type of user, whether professionally crewed or privately flown; attributed fixed costs to aircraft count and variable costs on a per hour basis to aircraft type. Costs included pilot and crew wages and benefits, modernization, parts, fuel use rate, etc.

2. Variable (hourly) Operating and Maintenance Costs

Data	Source	Definition	Notes
Fuel Additives	Conklin & deDecker	Lubricants, oils	In cases where aircraft use or consume amounts of engine or transmission oils during engine operation
Maintenance Labor	Conklin & deDecker	Average costs of routine, scheduled, and unscheduled maintenance labor for the airframe and avionics	This includes the maintenance costs of inspections and part replacement, but does not include labor costs related to engine overhaul which is considered separately in engine restoration costs
Maintenance Parts	Conklin & deDecker	Average costs of all airframe avionics, and minor engine consumable parts	This does not include parts used in engine or life limited parts
Engine Restoration Cost	Conklin & deDecker	Costs allocated to overhaul of engines	Although engine types differ, there are restoration intervals for each.
Other overhaul	Conklin & deDecker	Includes thrust reversers and APUs for some jets, propellers on pistons and turboprops, and life limited parts for rotary wing aircraft	Includes allocations for both parts and labor.

3. Fixed (annual) Operating and Maintenance Costs

Data	Source	Definition	Notes
Crew salaries and benefits	Conklin & deDecker	Cost of employing the recommended staffing by aircraft type.	Using the Conklin recommendations for number and salary of staff by aircraft type. Recommended benefits are also included. This is used in situations where a professional crew is employed.
Hangar costs	Conklin & deDecker	Average cost of hangar facilities based on aircraft type	For corporate and other professional users, included the Conklin & deDecker corporate hangar rate. The business hangar rate was used for business users.
Tie-down costs	Aircraft Owners' and Pilots' Association (AOPA)	Average cost of tie-down parking	Personal users were assumed to pay an average tie-down rate.
Insurance costs	Conklin & deDecker	Average yearly insurance rates based on aircraft use and type.	Includes Hull Insurance, Admitted Liability, and Legal Liability Insurance at the rate appropriate for the user
Aircraft Modernization and Uninsured Damage	Conklin & deDecker	Average yearly expense of installing optional service bulletins, avionics, and repairing damage not covered by insurance	Damage not covered by insurance includes the cost of meeting the deductible for insured damages.

Fixed (annual) Operating and Maintenance Costs (Continued)

Data	Source	Definition	Notes
Navigation Chart Service	Conklin & deDecker	Typical annual subscription cost	Based on aircraft type and typical range of type; For example: small piston engine aircraft get regional subscriptions; heavy jets get worldwide subscriptions
Refurbishing	Conklin & deDecker	Cost of maintaining aircraft interior and exterior	This includes cleaning and repairs to cabin, reupholstering seats, new carpet, repainting, etc.
Computerized Maintenance Program	Conklin & deDecker	Cost of subscription to a computerized tracking and record keeping service for scheduled aircraft maintenance and components	Owners of turbine powered fixed wing and all rotary wing aircraft are assumed to purchase this service.
Weather Service	Conklin & deDecker	Average cost of yearly subscription to a computerized weather forecasting service	Personal-Use aircraft owners are assumed to purchase no plan, while business and corporate owners are assumed to purchase a subscription

Appendix B.

Summary of Results

TABLE B1

State Impacts – Total value and per capita, 2005

State	($ millions)	Per Capita	State	($ millions)	Per Capita
Alabama	$1,703	$370	Montana	$260	$259
Alaska	$400	$571	Nebraska	$721	$409
Arizona	$2,766	$529	Nevada	$962	$465
Arkansas	$1,033	$376	New Hampshire	$639	$499
California	$18,202	$529	New Jersey	$4,351	$518
Colorado	$2,141	$479	New Mexico	$761	$378
Connecticut	$2,409	$726	New York	$9,267	$508
Delaware	$577	$722	North Carolina	$4,140	$503
District of Columbia	$483	$914	North Dakota	$218	$322
Florida	$7,520	$462	Ohio	$5,462	$478
Georgia	$8,751	$1,040	Oklahoma	$1,215	$348
Hawaii	$412	$307	Oregon	$1,832	$507
Idaho	$581	$393	Pennsylvania	$6,009	$489
Illinois	$6,040	$492	Rhode Island	$465	$460
Indiana	$3,352	$539	South Carolina	$1,606	$398
Iowa	$1,413	$481	South Dakota	$303	$374
Kansas	$7,072	$2,561	Tennessee	$2,571	$431
Kentucky	$1,746	$426	Texas	$11,237	$523
Louisiana	$2,059	$454	Utah	$912	$378
Maine	$521	$405	Vermont	$274	$430
Maryland	$2,085	$381	Virginia	$3,333	$455
Massachusetts	$4,046	$641	Washington	$3,186	$509
Michigan	$4,138	$424	West Virginia	$616	$333
Minnesota	$2,976	$595	Wisconsin	$3,523	$643
Mississippi	$860	$296	Wyoming	$353	$621
Missouri	$2,498	$437			

TABLE B2

Industries and Sectors Receiving Indirect Benefits from GA

Sector	$ millions	% of U.S. GA
Business Services	$5,994	12.0%
Radio, TV, and Communications Equipment	$4,756	9.5%
Mining/Extractive	$2,922	5.9%
Aircraft Engines	$2,792	5.6%
Real Estate and Dwellings	$2,766	5.5%
Financial Institutions	$2,649	5.3%
Construction	$2,603	5.2%
Metal Products	$2,470	4.9%
Wholesale and Retail Trade	$2,380	4.8%
Utilities	$1,634	3.3%
Non-ferrous Metals	$1,599	3.2%
Transport and Storage	$1,483	3.0%
Communications	$1,451	2.9%
Iron and Steel	$1,423	2.9%
Aircraft Integrators	$1,363	2.7%
Insurance	$1,281	2.6%
Food	$1,004	2.0%
Wood Products	$962	1.9%
Petroleum Refineries	$943	1.9%
Plastic Products	$664	1.3%
Personal and Household	$625	1.3%
Paper and Products	$611	1.2%
Office and Computing Machinery	$601	1.2%
Restaurants and Hotels	$589	1.2%
Basic Chemicals	$508	1.0%
Textiles	$397	0.8%
Machinery and Equipment NEC	$391	0.8%
Agriculture	$377	0.8%
Printing and Publishing	$314	0.6%
Synthetic Resins	$280	0.6%
Furniture and Fixtures	$267	0.5%
Electrical Apparatus	$209	0.4%
Non-metallic Products	$181	0.4%
Recreational and Cultural	$149	0.3%

(Continued on following page)

TABLE B2 (Continued)

Industries and Sectors Receiving Indirect Benefits from GA

Sector	$ millions	% of U.S. GA
Rubber Products	$139	0.3%
Special Industrial Machinery	$133	0.3%
Chemical Products	$127	0.3%
Paints, Varnishes, Lacquers	$111	0.2%
Professional Equipment	$97	0.2%
Metal and Wood Working Machinery	$89	0.2%
Motor Vehicles	$67	0.1%
Educational	$66	0.1%
Other Manufactures	$64	0.1%
Watches and Clocks	$54	0.1%
Glass and Products	$54	0.1%
Electrical Industrial Machinery	$37	0.1%
Engines and Turbines	$34	0.1%
Drugs and Medicines	$31	0.1%
Health Services	$22	0.0%
Wearing Apparel	$21	0.0%
Photographic and Optical	$19	0.0%
Fertilizers	$19	0.0%
Beverages	$19	0.0%
Transport Equipment NEC	$15	0.0%
Soap and Cleaning Preparation	$14	0.0%
Petroleum and Coal Products	$6	0.0%
Agricultural Machinery	$5	0.0%
Pottery, China	$4	0.0%
Electrical Appliances and Housewares	$3	0.0%
Railroad Equipment	$3	0.0%
Shipbuilding and Repair	$3	0.0%
Tobacco	$2	0.0%
Motorcycles and Bicycles	$1	0.0%
Leather and Products	$1	0.0%
Footwear	$0	0.0%

TABLE B3

Industries and Sectors Receiving Induced Benefits from GA

Sector	$ millions	% of U.S. GA
Business Services	$ 6,867	11.3%
Educational	$ 6,444	10.6%
Real Estate and Dwellings	$ 5,476	9.0%
Health Services	$ 3,784	6.2%
Wholesale and Retail Trade	$ 3,227	5.3%
Financial Institutions	$ 2,654	4.4%
Communications	$ 2,552	4.2%
Food	$ 2,322	3.8%
Insurance	$ 2,303	3.8%
Personal and Household	$ 1,925	3.2%
Restaurants and Hotels	$ 1,762	2.9%
Construction	$ 1,589	2.6%
Transport and Storage	$ 1,410	2.3%
Utilities	$ 1,389	2.3%
Motor Vehicles	$ 1,383	2.3%
Recreational and Cultural	$ 1,353	2.2%
Paper and Products	$ 1,198	2.0%
Radio, TV, and Communications Equipment	$ 1,115	1.8%
Soap and Cleaning Preparation	$ 1,031	1.7%
Metal Products	$ 831	1.4%
Office and Computing Machinery	$ 814	1.3%
Agriculture	$ 756	1.2%
Petroleum Refineries	$ 748	1.2%
Plastic Products	$ 693	1.1%
Beverages	$ 606	1.0%
Basic Chemicals	$ 516	0.9%
Printing and Publishing	$ 513	0.8%
Iron and Steel	$ 461	0.8%
Non-ferrous Metals	$ 440	0.7%
Drugs and Medicines	$ 437	0.7%
Mining/Extractive	$ 407	0.7%
Textiles	$ 386	0.6%
Wearing Apparel	$ 327	0.5%
Synthetic Resins	$ 264	0.4%
Wood Products	$ 264	0.4%

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TABLE B3 (Continued)

Industries and Sectors Receiving Induced Benefits from GA

Sector	$ millions	% of U.S. GA
Professional Equipment	$ 240	0.4%
Machinery and Equipment NEC	$ 238	0.4%
Other Manufactures	$ 235	0.4%
Furniture and Fixtures	$ 211	0.3%
Electrical Appliances and Housewares	$ 172	0.3%
Electrical Apparatus	$ 128	0.2%
Tobacco	$ 115	0.2%
Rubber Products	$ 104	0.2%
Non-metallic Products	$ 99	0.2%
Chemical Products	$ 95	0.2%
Paints, Varnishes, Lacquers	$ 87	0.1%
Metal and Wood Working Machinery	$ 82	0.1%
Electrical Industrial Machinery	$ 82	0.1%
Special Industrial Machinery	$ 78	0.1%
Fertilizers	$ 64	0.1%
Glass and Products	$ 64	0.1%
Transport Equipment NEC	$ 41	0.1%
Aircraft Integrators	$ 32	0.1%
Photographic and Optical	$ 31	0.1%
Engines and Turbines	$ 26	0.0%
Agricultural Machinery	$ 23	0.0%
Aircraft Engines	$ 22	0.0%
Watches and Clocks	$ 20	0.0%
Leather and Products	$ 12	0.0%
Shipbuilding and Repair	$ 12	0.0%
Footwear	$ 11	0.0%
Railroad Equipment	$ 10	0.0%
Petroleum and Coal Products	$ 10	0.0%
Motorcycles and Bicycles	$ 8	0.0%
Pottery, China	$ 7	0.0%

About MergeGlobal

MergeGlobal provides clients a continuum of services ranging from financial advisory to strategic consulting. MergeGlobal's financial consulting practice combines financial expertise with deep industry knowledge to significantly improve shareholder value for clients in the global travel, transport and logistics industries. MergeGlobal's strategy consulting practice focuses on developing competitive strategy for companies in the same industries.

MergeGlobal's industry experience spans all modes of transportation, logistics and suppliers to the industry. The firm takes a quantitative, bottom-up approach to consulting engagements, with an emphasis on primary research in order to develop defensible, fact-based conclusions. MergeGlobal has completed over 200 engagements for clients in North America, Europe, Asia and Latin America.

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