Managerial Economy of General Aviation Industry

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ABSTRACT
All aviation activities except military aviation and scheduled aviation are called general aviation. This article provides an overview of the socio-economic effects of this industry on the economy in general and on the aviation sector in particular. The collected reports and statistics show the growth and development of this industry along with the increase of general aviation applications. Thus, we have witnessed the growth of employment and income of this industry in the past years. Macroeconomic changes have also shown their effects on this industry in recent years by increasing and sometimes decreasing the production and income of its industry. In general, past market trends so far show the relative growth of this industry and the greater impact of this industry on the economy and indicate the existence of new opportunities to generate income and create jobs in this industry.

Keywords: General Aviation, management, economic impacts, social impacts

INTRODUCTION
General aviation (GA) covers all civil aviation aircraft operations with the exception of commercial air transport or aerial work [11]. Therefore, all aviation activities except military aviation and planned aviation can be referred to as general aviation [5]. In particular, some areas of general aviation include private and sports flights, aerial monitoring and imaging, spraying and protection of agricultural products, commercial flights, medical evacuation, flight training, fire and law enforcement applications, and so on. Aircraft used in general aviation also range from small, single-engine aircraft to multimillion-dollar commercial jets [1, 9].

What is known today as general aviation did not actually exist until after the mid-1920s. However, even before that, some people began to use technology that could later become important parts of general aviation.

The first production and purchase of aircraft for personal use occurred very early in the history of flight. Wealthy people and some pilots bought planes from pioneering aircraft manufacturers. Just before World War I, some companies entered the market with the goal of building and selling relatively cheap aircraft for private use.

General aviation in the late 1920s saw a huge increase with the Charles-Lindbergh transatlantic flight. The celebration of this outstanding work created a large number of fans to fly all kinds of flying vehicles. At the same time, as aviation grew as an activity, government regulations at both the state and federal levels sought to make access to the commercial aviation industry a little
more difficult. While new programs helped spawn the aviation and commercial industries, authorities sought pilot licenses and aircraft approvals. These requirements undoubtedly made general aviation safer.

Some government programs sought to encourage and develop private flights. During the 1930s, the federal government launched some support programs and hoped to launch general aviation, but to no avail. Later in the 1930s, another pilot training program, called the Civilian Pilot Training Program, was launched to increase the number of pilots in the United States. These pilots were not only a market for general aviation, but also young men who could quickly become military pilots during the war, but the plan was unsuccessful.

During this period, investment in general aviation increased. At the same time, spraying crops to control pests also showed its value, and its use soon spread to the United States, and included other applications, including forest monitoring and aerial planting of rice fields. Domestic flights of commercial companies allowed them to fly anytime and anywhere.

The outbreak of World War II created challenges and opportunities for general aviation. During the war, companies in the field cooperated with the government by providing some military aircraft equipment, selling some many aircraft to the army, providing emergency medical services, and even training glider commandos for some special operations.

In the following decade of World War II, the safe sectors of general aviation continued to grow and develop. Commercial aviation, for example, continued to be a very important part of general aviation, with major technological changes including the introduction of jet turbine engines and turboprops. Helicopters were introduced in the late 1940s. But these aircraft did not become public for private transportation. The greatest advances were made in the field of general aviation electronics, including radio and navigation equipment.

After giving a brief history, the paper intends to provide an assessment of the socio-economic effects of the creation and development of the general aviation sector. To this end, in the second part, we point out some of the most important benefits of developing the general aviation industry. Then, in the third section, we introduce some areas that have the potential to create jobs due to this industry. In the next section, we examine the overall economic effects of this section on a country's economy. Then in the fifth section, we will have a look at the market and market trends including production, revenue, and price of this industry. Finally, in the sixth section, we will present the summary of this article.

**LITERATURE REVIEW**

Aviation activities often depend on socio-economic factors such as population, employment, and income. These interconnections depend on the optional nature of individual and business travel as well as the recreational nature of general aviation.

The benefits of general aviation development can be summarized as follows:

1- Creating appropriate technical and operational knowledge for the development of aviation (general and commercial) in the country,
2- Development of specialized centers for designing and manufacturing general aviation equipment, which can acquire the ability to produce general aviation equipment over time and by gaining experience.

3- Creating jobs from different aspects in various fields of business, transportation of goods,
   - Creating jobs for specialists in various fields of aerospace engineering, mechanics, electrical
   - Create jobs for technical technicians in the maintenance of aircraft equipment
   - Creating jobs for ordinary people in providing aviation services to companies, organizations, and ordinary people
   - Creating jobs for people who produce products in remote areas,
   - Creating jobs by increasing foreign tourists

4- Preventing waste of money to create appropriate communication channels with specific geographical areas,

5- Creating the possibility of increasing production for regions that are not able to offer their products to other regions due to the lack of appropriate and fast communication channels.

6- Doing some work with less cost and time (in monitoring areas or agricultural areas),

7- Creating the flow of human resources;

An important part of general aviation is training people to fly commercial aircraft. Many pilots and engineers working in the field of commercial aircraft are those who first acquire the necessary skills in the field of general aviation and then enter the field of commercial aviation with full readiness and lower training costs.

To investigate the formation of the aviation economy, Ou referred to the spatial classification and arrangement of the aviation city [12], and Cao proposed the spider web model of the aerospace industry space design [13]. Lian et al. believe that the aviation economic zone is connected to the central city and inland areas through the flow of factors and manufactured goods [14]. Kasarda and Wang analyzed the formation of the aviation city and believed that the airport is the most active region in regional development and the center of economic development [15, 16]. Cao and Hu believe that the development of the aviation economy has a positive feedback effect on the development of airports [17-19].

In terms of research on the development of the aviation economy over the regional economy, Kasarda first analyzed the correlation between aviation and the employment of secondary and tertiary industries in the city where the airport is located and concluded that the rate Air transport employment and secondary and higher industries showed a positive correlation [20]

**AREAS OF GENERAL AVIATION EMPLOYMENT**

Working in the field of general aviation is very important in creating jobs and benefiting from the ability of professionals and ordinary people in society. With the development of this field and its various applications, many jobs have been created and developed as follows, including the following:
1. Maintenance of flying equipment

This activity is related to all operations related to aircraft maintenance and flight certification. The set of rules used in aviation is completely strong and non-negligible to provide the highest level of safety for flights. The activities of this category are divided into two parts: preventive operations (inspections) and repairs.

2. Aviation professional training

It covers all vocational training provided in schools, associations, and universities in areas related to aviation, including engineering, piloting, cabin crew, and more. By hiring people, these structures can play an effective role in increasing employment.

3. Aerial works

All group activities such as aerial advertising, aerial photography, seed spraying, fire detection, and parachuting fall into this category.

4. Transportation of passengers and cargo

All issues related to cargo transportation and passenger transfer payment (except scheduled transportation) fall into this category.

ECONOMIC EFFECTS OF GENERAL AVIATION

As mentioned, in general aviation, due to the flexibility that companies have in providing services (flight hours, point-to-point flights, efficient security checkpoints), it has expanded various job areas, which in turn has led the aviation business. It is a factor for economic development. For example, up to 50% of the turnover generated in France is monopolized by wing-wheel operations. In 2013, the country's aviation industry was able to create 3,780 direct jobs and 6,685 indirect jobs.

As another example, a UK performance survey shows that the final efficiency of the UK economy based on general aviation activities in 2013 was estimated at around 3 billion, supporting around 38,000 jobs, of which 9,700 were directly related to flight and the rest to Construction are related [3, 10].

The economic effects of general aviation development can be examined in three categories: direct, indirect, and inductive effects. These differences are used as a basis for estimating the final economic impact of an industry. The sum of these three works gives an estimate of the overall effects of this industry.

It should be noted that each of these three components requires different tools for analysis. Direct effect analysis identifies the economic effects of jobs created, salaries and wages paid. In the case of the aviation business, the number of people a year that is created directly, indirectly, induced, and in total from this business is examined to get a picture of this industry [4].

Direct effects: Direct effects include any economic activity within the general aviation industry. Examples include employment in the operations and business management departments of airlines such as pilots, engineers, and dispatchers. It also covers the basics of direct employment,
Indirect effects: These are those that are obtained due to direct effects. Employment in downstream industries formed by the aviation business (for example, aircraft manufacturers). Indirect employees work in industries that provide services to this business.

Induction effects: These are effects that are spent on wages, salaries, and benefits derived from direct and indirect economic activities. The effects of induction of employment are formed by people who are directly or indirectly employed.

For example, the latest statistics on the overall economic impact of general aviation in the United States, published in 2015. A survey conducted by the Gamma Manufacturers Association (GAMA) shows that in 2013, approximately 255,000 full-time and part-time workers were employed in the US general aviation industry. The sum of the direct, indirect, and inductive effects of the industry also represents about 1.1 million jobs and $219 billion in revenue. That same year, it generated $69 billion in labor income (including wages, salaries, and labor income, as well as income from industrial property owners) and $109 billion in US gross domestic product. The effect of the general aviation industry on total GDP per capita in 2013 is estimated at $346. At the national level, each direct job created in the general aviation industry has helped to create about 3.3 jobs in other sectors of the economy [5].

Finally, the results of studies show that the economic value of general aviation is growing and its dimensions can be determined according to the need and in some areas, it is necessary as a facilitator for other business activities.

MARKETS AND FUTURE TRENDS IN THE GENERAL AVIATION INDUSTRY

1.1 Industrial production status

The economic downturn that lasted from December 2007 to June 2009 has had a significant impact on various industries, especially the global aviation industry. However, the decline declined and the number of aircraft sold worldwide grew slightly by 4.8%. Similarly, this trend has shown in the United States as the largest producer of the general aviation industry, with a growth of 3.6% from 2011 to 2012 in the number of general aviation aircraft produced in this country. Also, according to the latest statistics released by Gamma, global production of general aviation aircraft has grown by 4.3% compared to the previous year. In particular, the financial crisis and recession of 2007-2009 led to a sharp decline in sales of commercial jets and reciprocating engine aircraft. Global production of general aviation aircraft also decreased by 52.8% between 2007 and 2010. In the United States, the rate of decline was 59.3% [6, 7].

Figure (1) shows well the number of aircraft produced in the world and the United States between 2000 and 2017.
As can be seen in the figure above, the decline in production over the past 10 years has been such that even in the following years until 2017, the industry could not reach its peak production level in 2007. One reason for this decline in production, both globally and in the United States, could be attributed to the doubling of the price of each aircraft. For example, the average price of a reciprocating engine aircraft, which is also the most common type of general aviation, has risen from $328,000 in 2007 to $662,000 now. This sharp increase has caused many potential buyers to leave the market. Also, the average price of commercial jets has almost doubled in the same period, from $12.5 million to $26.6 million. At the same time, the average price of turboprop aircraft has decreased from 3.5 million to $2.6 million, which has led to an increase in sales of this type of aircraft [6, 7].

1.2 Industry Revenue Status

Gamma aviation data and the Aeroweb database show that the revenues of manufacturers of general aviation aircraft have declined relatively less than the production of those companies. From 2008 to 2012, global GA production revenue fell about 23.7% from $24.77 billion to $18.89 billion. During the same period, the United States experienced a more severe decline in the revenues of general aviation companies, their revenues fell by about 39.9% in 2012. In the following years, the income of general aviation companies has fluctuated slightly compared to previous years, which are well shown in Figure (2).
Among the types of general aviation aircraft, commercial jets account for the majority of the industry's revenue, accounting for about 89% of global aviation industry global sales. In contrast, reciprocating engine aircraft account for only 4% of the industry's global revenue [6, 7].

1.3 Industry Price Status

As noted, the revenue of general aviation manufacturers has not declined as much as the decline in general aviation production, due to the sharp rise in the unit price of commercial aircraft since 2008. One of the possible reasons for this increase in prices by general aviation manufacturers is that these companies have drastically increased prices to compensate for their declining production to compensate for their declining revenues. This claim can be seen in Figure (3), which shows the revenue per aircraft, which is equivalent to the significant increase in the average price per aircraft globally and the United States since 2008.

Figure 3 - Revenue generated from each global aviation aircraft produced globally and in the United States (2000-2017) [7]

From 2007 to 2010, the average price of a general aviation aircraft doubled (91%) from 5.1 million to 9.8 million. Market trends also show that prices increased every year from 2003-2004 to 2010 and reached their peak in 2010. In 2011 and 2012 we saw a slight decrease in prices (8% and 1.5% respectively). Finally, Figure (4) shows that in 2017, the average price of a general aviation aircraft was about $8.7 million [6, 7].

In particular, general aviation manufacturers are aware that at low levels of demand, a private jet is a very price-less product, and therefore demand will not decrease much as prices rise.

1.4 The market for the production of various types of general aviation products

Statistics from Gamma and the Forecast International database show that piston-engine aircraft are the most sold type of general aviation aircraft (about 47%). After them, jets with 29% and turboprops with 24% are the next best-selling GA aircraft. Statistics also show that last year we saw a growth of 6.5% and 1.3% in the number of sales of the piston and commercial jet aircraft, respectively. Figure (4) shows the number of aircraft produced of each type from 2000 to 2017 [6 and 7].
1.5 Major and main players in the industry

Here is a brief look at the top 15 manufacturing companies active in the general aviation industry in 2017.

In 2017, Cessna (Textron Aviation) had the highest number of sales of general aviation aircraft with 487 deliveries. The next rank with the delivery of 377 aircraft belonged to Sears Airlines. Taknam, Piper, and Bombardier companies are also in the third to fifth ranks of companies active in this industry, with 171, 155 and 138 units delivered, respectively. Figure (5) shows the relevant ranking for the top 15 companies in the industry along with the number of aircraft delivered.

On the other hand, if we want to look at the operating companies in terms of revenue, the order of the companies will be different, and in fact, the companies that made commercial jets had the highest revenues. For example, Gulfstream, which ranks ninth in terms of the number of aircraft sold, ranks first in this type of ranking with revenue of $6.56 billion. This is the company for the fifth consecutive year that it has this rank in terms of revenue. In second place is Bombardier with revenue of $5.14 billion and Textron Aviation Complex (including Cessna and Beechcraft)
with $ 2.87 billion. Figure (6) shows the revenue of the top 11 companies in the industry in 2016 and 2017 [6, 7].

![Figure 6: Revenue of major companies active in the general aviation industry (2016-2017) [7]](image)

1.6 **Foreign trade**

International trade has an important place in the aviation industry in general and aviation in general in particular, so that it can be considered as one of the most effective drivers of the industry. For example, exports of commercial and public aircraft, engines, and aviation-related parts to the United States in 2013 were estimated at more than $ 105 billion, of which more than $ 21 billion came from the general aviation industry.

It should be noted that this industry, like other high-tech industries, is affected by macroeconomic variables. The US general aviation industry, for example, declined sharply from 2008 to 2011 due to the onset and spread of the global financial crisis (about a 58.1% drop in exports). But since 2012, with the exit from the recession and the boom in the economy as a whole, the industry has seen a 48% increase in exports and recovered its loss in 2011. In the following years, this industry has also faced ups and downs. Finally, according to the latest statistics of 2017 of the Union of General Aviation Manufacturers, the general aviation industry has had export growth of 19.4% [6, 7]. Figure (7) shows the volume of exports of aircraft related to general aviation in the period 2000 to 2017.

![Figure 7: Exports of general aviation aircraft in the United States (2000-2017) [7]](image)
CONCLUSION

General aviation refers to any type of construction and flight operations other than scheduled commercial flights and military flights. The importance of this industry can be seen in the significant socio-economic impacts at the national and global levels of the economy in general and the aviation industry in particular. Market trends also indicate that the industry is growing and has applicability in various sectors, thus increasing production and income, both for industry owners and the workforce.

Specifically, in the second part, we introduced some of the benefits of developing the aviation industry, and then we briefly explained the areas of general aviation employment. Our study shows that this industry has a lot of potential in the development sectors that policymakers and planners can work towards job creation and wealth creation in the field of aviation.

In the following, we examined the direct, indirect, inductive, and total economic effects of this industry on the national economy, which shows the very high importance of this industry. Then, in this regard, we tried to examine the market trends of this industry in the sectors of production, revenue generation, and foreign trade, and the collection of these analyzes shows the growing growth of this industry globally.

Finally, it would be interesting to note the Federal Aviation Administration (FAA) forecast of the US General Aviation Fleet. In its annual aerospace forecast, the organization acknowledges the increase of the relevant fleet from 213905 aircraft in 2018 to 214090 aircraft in 2038. This is equal to about 0.1 in the average annual growth rate (CAGR).

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