



# AIR TRANSPORT AND ITS SOCIO-ECONOMIC IMPACTS – Methodology and Research

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## Abstract

The initial motivation for studying and researching air transport socio-economic impacts is quantifying the value that air transport brings to the Czech Republic. The main challenge is to explore a methodology that would describe the macroeconomic and microeconomic relations within the Air transport industry. These relations will define the directions of the market forces flow and thus the Czech Republic's value. The authors of the paper use an approach that follows methods and standards for collecting and processing economic and statistical data introduced by the International Civil Aviation Organization (ICAO), Eurostat, and the Czech Statistical Office (CZSO). The authors incorporate economic definitions and standards published by the United Nations under the World Trade Organization (UNWTO) and other accounting and statistical entities, which results in creating a methodical description of chosen relations. The methodical description leads to the quantification of the value. In a practical sense, it is a matter of determining the origin of the data sets according to which the selected relations will be defined. The paper focuses on the expression of Air transport's primary and secondary effects and the description of the proposals, which will be part of the methodology.

## Keywords

value of aviation, civil aviation industry, aviation satellite account, primary impacts, secondary impacts, direct effects, indirect effects, induced effects, spillover effects

## 1. Introduction

Air transport has a considerable impact, be it overall on the economy, other industries, or the environment [1]. Air transport's contribution is commonly expressed through direct, indirect, and induced effects and catalytic or spillover effects [2, 3, 4]. The direct effects represent the employment and economic activity in the air transport industry, indirectly expressing employment and economic activity in the air trans-

port industry's supply chains. Throughout the paper, these two impacts will be referred to as the primary effects of air transport. Induced effects express employment and economic activity supported by the spending of those employed in the direct and indirect sectors. Spillover effects or catalytic effects are commonly used terms for impacts of a phenomenon, action, or else affecting or causing another phenomenon, action, or else. In this paper, the term secondary

impacts stand for both induced and spillover and/or catalytical effects. Additional perspectives consider secondary economic effects as a result of the supply and demand-side effects of the air transport industry [2]. The industry's demand-side represents trade and tourism, and the supply-side represents investments, labor supply, market structure, and congestion. Alongside the secondary economic effects also stand the environmental and social/consumer welfare effects as a benefit of travel availability [5]. The aviation industry's overall gross domestic product (GDP) is not available because of the lack of methodologies that would consider wider secondary effects. However, aviation's impact on the economy, including the primary effects and tourism, was in 2016 \$ 2.7 trillion, i.e., 3.5 % of the world's GDP. The secondary effects are represented just by the tourism sector and accounted (in 2016) for \$ 897 billion, which was approx. 1.2 % of the world's GDP [3, 6]. Significant secondary economic effects would also include trade, investments, and other sectors induced by aviation activity. It is obvious that there is a need for a new, advanced, and very profound methodology also capturing other secondary aviation-induced effects.

## 2. Foundation of Methodology

There are currently several methodological approaches of various specialized aviation organizations and institutions that represent different points of view on a range, methods, and means of expressing the air transport value. When creating a methodology that suits the needs of the Czech Republic, it is necessary to find an intersection of existing methodical documents and, at the same time, find the differences between those documents.

A series of documents published by the Air Transport Action Group (ATAG) [1, 4, 7, 8, 9, 10] focuses on assessing the air transport value that belongs to the term Air Transport Industry. Within the division of the Air Transport Industry, the methodology recognizes six basic types of businesses: airlines, airport operators, providers of goods and services on-site at airports (such as retailers and hoteliers), civil aircraft manufacturers, air navigation service providers, and a new type is added – tourism. Oxford Economics prepares an evaluation for the ATAG to cooperate with experts from international organizations, such as the Airports Council International (ACI), the Civil Air Navigation Services Organization (CANSO), International Civil Aviation Organization (ICAO), several professional associations' main aircraft and engine producers. The methodology works with variables such as the number of jobs and gross value added (GVA), created or supported by aviation six key sub-sectors [4].

The Federal Aviation Authority (FAA) methodology and its results are regularly published in reports [11, 12, 13, 14, 15]. Methodology estimates the economic contribution of the civil aviation industry to the U.S. economy. Compared to the previous paragraph, a visible change occurs in the naming of the monitored subject; it is not the air transport industry but the civil aviation industry. The FAA divides the monitored

structure into greater details and evaluates impacts of airline operations, airport operations, civilian aircraft manufacturing, civilian aircraft engine, and engine parts manufacturing, civilian other aircraft parts and equipment manufacturing, air couriers, visitors expenditures, travel arrangements, general aviation (GA) operations, GA aircraft manufacturing, GA visitors expenditures. Percentages of GDP are published for individual components of the structure (but also cumulatively), such as basic economic variables such as output, the number of jobs, earnings, added value, and GDP percentage. The final percentage of the share of the GDP is also calculated.

As it is apparent, within the methodologies, there are significant overlaps and also discrepancies in details. Across methodologies, there are many different views on key terms, such as direct, indirect, induced, and catalytic effects. Thanks to ICAO, a new stream based on much more sophisticated existing systems is being formed.

ICAO established an Expert Advisory Group EAG under the Aviation Data and Analysis Panel ADAP, whose task is to develop an Aviation Satellite Account (ASA) methodological framework following the System of National Accounts, 2008 [16]. The ASA framework is not finished yet, however, ICAO dropped a framework methodology draft as of September 2019. The methodology uses the International Standard Industrial Classification of All Economic Activities (ISIC) to capture and thus quantify all aviation-related activities, i.e., commercial aviation and general aviation, including all kinds of aerial work well, aviation training, airport services, maintenance & overhaul. The ASA methodology document already comes up with a detailed classification of companies according to the NACE. Based on the statistical processing of accounting documents and statistically collected information, it is then possible to quantify the amount of GVA or GDP by summing the relevant values for each company or organization individually. In addition, the ASA methodology framework will follow the System of National Accounts 2008 [16]. The ASA methodology framework should measure the aviation's direct GVA, GDP, aviation's relationship with other industries, aviation's consumption, taxes and charges generated by aviation, gross capital formation, and the number of jobs created by aviation. However, the ASA will capture and monitor only the primary effects of the air transport industry [17]. The call for methodology capturing both primary and secondary effects remains unanswered by the authorities. Therefore, this paper aims to describe a methodology framework proposal for the overall contribution of air transport-related activities, including both primary and secondary economic impacts.

Many other indicators can be evaluated on economic and statistical data within direct impacts, employment, and average gross earnings.

### 2.1 Framework of Methodology

The first step is the methodological differentiation of the effects of air transport into primary and secondary. Therefore, methodology introduces a concept of primary and secondary

impacts. According to the ICAO document, the core of the definition of the primary impacts is the structure of aviation activities [17]. This document's inspiration is the sophistication of the international standards on which that document is based [16, 18]. The original formulation of the methodology included a definition of several areas of interests Initially defined as (1) air transport and its impact on HDP, (2) employment, (3) entrepreneurship, (4) state enterprises, (5) airports, (6) aviation network, (7) tourism. The resulting methodology will allow these areas of interest to be better organized and will complement missing elements. The methodology will also enable the quantification of the value of GDP in relation to the primary effects. According to the available data in this field, estimation is assumed by expressing the value of GVA.

To determine the methodology's framework, the ICAO must describe the primary effects as direct [17]. Direct effects are created by a set of companies that ICAO defines as the civil aviation industry. We describe all the other effects as secondary. On the other hand, the FAA methodology [11] includes tourism as primary indirect effects. But the inclusion of tourism as secondary effects emerges according to findings from the Zhang study [2]. This supports the correctness of the final solution. The inspiration for the term secondary effects is based on the FAA methodology [11]. However, the secondary effects' final structure is inclined to the structure, according to Zhang [2].

The primary effects are considered only for companies that can be included in the civil aviation industry, according to ICAO, and for companies whose performance can be statistically collected and regularly evaluated. The secondary effects are described as the consumption of employees from the primary sector and spillover effects, which enable and facilitate global systems of tourism, trade, capital investments, labor market, agglomeration, and innovation. As we are adopting the ICAO methodology with Zhang's framework, in our methodology, primary impacts will be covered by business activities which we can capture under System of National Accounts, 2008 [16] in combination with ICAO Classification of Civil Aviation Activities based on ISIC and Central Product Classification (CPC).

## 2.2 Primary Impacts

Direct and indirect impacts defined by Zhang create meaning of primary impacts in Methodology for the Czech Republic. Direct impacts arise from activities directly related to the operation of air transport. Indirect impacts arise from businesses that provide goods and services to the upstream supply chains, aviation fuel suppliers, aircraft sub-components suppliers, facility construction companies [2]. According to the ATAG study [1], the affiliation to the direct impacts is defined as employment and economic activities of airline and airport operations, aircraft maintenance, air traffic control and management, air passenger services, and aerospace manufacturers. The indirect impacts include aviation fuel suppliers, construction companies, sub-components used in aircraft, retail outlets,

and activities in the business services sector. The methodology for quantifying the primary impacts is defined according to the ICAO document [17] that allows a precise specification of the activities related to the direct and indirect impacts. The structure is based on data inputs according to current accounting and statistical standards [16, 18, 19]. ICAO distinguishes the following categories of civil aviation activities based on ISIC Rev. 4: (1) commercial air transport services, (2) general aviation, (3) airport services, (4) air navigation services, (5) maintenance and overhaul, (6) regulatory functions, (7) aviation training and (8) other activities. There are also definitions of products for all of the above-mentioned civil aviation activities. The originally proposed basic categories are extended and specified. As a result, a better overview of the operational and economic outcomes in the individual categories of aviation activities and products is created.

## 2.3 Secondary Impacts

We define the affiliation to the primary effects according to Zhang through the direct and indirect impacts. The direct impacts arise from activities directly related to the operation of air transport. The indirect impacts arise from businesses that provide goods and services to the upstream supply chains, aviation fuel suppliers, aircraft sub-components suppliers, facility construction companies [2].

Literature research shows that attempts to quantify individual parts of the secondary air transport effects - apart from tourism-are most frequently described are trade and investments. As for tourism, it is probably the most important but certainly most visible secondary impact of the air transport industry. Tourism thrives in a prospering economy, a fact confirmed by many researchers studying a tourism-led growth hypothesis (TLGH) [20]. Tourism is considered as a non-typical form of export. Equivalently, the TLGH was derived from the export-led growth hypothesis (ELGH). ELGH postulates that the volume of export is a determinant of economic growth. Analogously, tourism is a determinant of economic growth. Regarding the TLGH, the causality is proven [21, 22, 23, 24], usually by the Granger non-causality test [25] and/or its derivation. As for the direction of the causality, whether the economic growth affects tourism activities or tourism affects economic growth, or whether the causality direction is even bi-directional remains unambiguous and thus needs more research. Similarly, a causality was proven between air transport and the economy [26, 27, 28]. According to the United Nations World Trade Organization, a total of 58 % of all international tourists in 2019 used air transportation as a mode of transport to get to the destination. The country's ability to compete within the travel & tourism domain with other states is expressed by the Travel & Tourism Competitiveness Index (TTCI). The foundation of the TTCI is 4 main areas such environment, T&T policy and enabling conditions, infrastructure, and natural and cultural resources, and these further divide into 14 key pillars of TTCI. The Czech Republic ranked 38th in the 2019 TTCI report. A

TTCI from 2015 shows in detail what the Czech Republic lacks to rank higher – these are especially cultural resources and business travel, natural resources, and the air transport’s infrastructure. Promoting tourism is considered a key to economic recovery after an upset. As it affects the air transport, it also affects the investments in the air transport infrastructure. In addition, it becomes necessary to invest in technologies that are environmentally friendly, i.e., less dependent on fossil sources. It shows that this approach appeals to a group of tourists demanding sustainable tourism [29]. The mentioned economic impact of tourism does not include the impact on trade created by the business passengers. Trade is closely tied to air transport [26] and is usually expressed by GDP, export or import or through their combinations in various indexes, and many more. Trade is enabled and thrives with an increasing number of connections - it enables the flow of business passengers, employees commuting for work, talents or scientists, and eventually, it is the attractiveness of air link connections that appeals to firms to operate in new markets [2]. On the other side, especially in a relatively small area equipped with robust ground infrastructure, the air traffic infrastructure is not such an advantage. This applies to Europe and especially to the Czech Republic, whose main trade partners are Germany, Slovakia, and Poland, i.e., all surrounding countries sharing borders with the Czech Republic. Most of the goods flow between the Czech Republic and the mentioned countries is done on the ground.

The air transport industry and the economy affect each other through causal relationships. With time, economic growth enables the accumulation of sources that can be used for the expansion of current infrastructure capacities. From the long-term view, it creates stimuli for numerous industries which to grow, including the air traffic industry. Zhang & Graham call these relationships between the economy and air transport “feedback effects”. Whether to invest or not remains a crucial question – the causal analyses can hint at whether it is more profitable to invest in the economy or the air transport industry. After the question is answered, it is time for strategic planning, i.e., it is necessary to create a cost-effective analysis to find out the multiplier effects of individual investments [2]. Evidence from South Asian countries demonstrates that foreign direct investments (FDIs) into the air traffic infrastructure and other factors like (income, flight frequency, and jet fuel significantly affect air passenger and air freight demand growth. The evidence here applies to the low-income countries of South Asia [30]. The investments into the air transport infrastructure and support services are necessary for sustainable and strategic planning. Moreover, as mentioned above, it is necessary to invest in air transport (and other) infrastructures and sustainable sources of energy [29]. Evidence in Nigeria reveals that foreign investments into the air transport infrastructure are essential for the development of the air transport industry and, simultaneously, as the air transport infrastructure works and there are air connections with the world outside of Nigeria, it attracts more FDIs inflow

into other industries. Especially in a developing country, the air connections represent a gateway enabling trade, tourism, and globalization in general [31, 32]. As great impacts the FDI inflows can have on the domestic economy through employment etc., it can have a negative impact as well - the foreign investments are such that domestic capital is unable to compete. Eventually, this leads to domestic producers’ dislodgment out of their own market [33]. Air connections increase the probability of the bi-directional flow of foreign investments. Evidence from Italy reveals that two years after the commencement of new air routes, the number of FDIs increased by more than 30 %. The objective of any state/region should be to preserve already existing air routes, as these also contribute to the overall attractiveness and enable the flow of FDIs. Supporting (financially) the air transport infrastructure should become an integral part of strategies to attract the FDIs [34].

### 3. Data and Relationships for Primary and Secondary Impacts

This study aims to present a new and sophisticated methodological approach capturing both primary and secondary impacts caused by air transport in the Czech Republic. The need to capture the whole economic impacts of aviation in true numbers and not just estimates is appealing with time and air traffic volume. We propose a vision that is in alignment with the drafted ASA by ICAO.

Considered data sources in the proposed methodology framework are obtained from the Czech Statistical Office (CZSO), the CzechTourism, an agency supported by the Ministry of Regional Development of the Czech Republic, World Bank, Eurostat, World Economic Forum WEF, and data provided by Czech Ministry of Transport.

The ATAG [1], ICAO [17, 11] methodologies use a wide range of data. The most comprehensive data evaluations are provided by ATAG reports, focusing on quantifying both primary and secondary effects. However, all analyzes are created directly by Oxford Economics. The analysis is also being developed for 63 countries and 13 major regions. FAA distinguishes three core economic impact channels, where evaluates operational spending of airlines, airports, civil aircraft manufacturers, airport operators and air navigation service providers (direct channel); aviation sector’s procurement of inputs of goods and services from other businesses in the economy (indirect channel) and payments to staff in the aviation sector and the supply chain (induced channel) [10]. ATAG is also gathering data from ACI, CANSO, International Monetary Fund, and International Air Transport Association (IATA) [9].

The FAA methodology [11] is characterized primarily by national data, which are collected through the U.S. Department of Transportation, U.S. Department of Commerce (DOC), and U.S. Department of Labor. Consolidated data from 2012 were used for the 2014 report [11]. For the primary

estimates of manufacturing output, the FAA uses monthly manufacturing reports from DOC. For estimation of General Aviation output, the FAA uses data from published in GA surveys. GDP is represented by the sum of all value-added activities in an economy. Total output calculation included intermediate goods and services that were purchased as part of the production process. Each sector within the civil aviation industry has a different impact on the economy. Secondary impacts are then calculated separately using the RIMS II value-added coefficients and aggregated [11].

### 3.1 Data and Relationships for Primary and Secondary Impact – Experience and Proposals

As mentioned above, to describe primary entrepreneurship, the methodology will enable quantifying the value of GDP in relation to the primary effects. According to the available data in this field, estimation is assumed by expressing the value of GVA. Secondary entrepreneurship will be described as tourism, international trade, and foreign investments.

Primary employment can be determined according to the data from the CZSO. It is currently possible to evaluate data according to the affiliation of individual groups of companies according to the CZ-NACE division. The essential group will be CZ-NACE 51. Other groups that are clearly involved in civil aviation can be found both in the CZ-NACE and in the extended version and structure of activities and products according to the ISIC and the CPC. The aggregated data about employment are provided in periodic reports by Oxford Economics [35], the ATAG [10], the IATA [36, 37]. The data from the Ministry of Regional Development [38] can be used for secondary employment in tourism.

With the gradual increase in air traffic, there will be a visible increase in employment in tourism, easily noticeable because of the tourism satellite account. From the point of view of employment, it is also beneficial to monitor regional employment in the Czech Republic. The capital of the Czech Republic, Prague, and the Central Bohemian Region are affected primarily and also secondarily due to the current unstable operational deviations and the rising unemployment. The primary decrease in the number of jobs is obvious, mainly in the Kladno district. The secondary decrease affects all the sectors related to tourism. The decrease and the subsequent growth of employment in tourism depending on air traffic development will be observed, especially in Prague and in the Central Bohemian Region. Except for these areas, it will be possible to monitor employment trends in the tourist-exposed destinations. It will be necessary to work with the employment data and compare these data with air transport operation development. Areas with developed industry can be monitored in relation to the volume of air cargo traffic. It is also possible to monitor the number of employees in international corporations based in the Czech Republic. We can also monitor the development of the number of companies in small, medium, and large segments according to the number of employees and the turnover and profitability.

Airports and airlines network can be studied from several different views on the Czech Republic's connection with the worldwide air network. Data that are available by Eurostat include data about destinations that can be reached from individual airports by direct flights. The number of passengers in each month is available for each destination. Unfortunately, the destinations are currently aggregated, and there can be found only data on the national level. It would be beneficial for further research to extend the Czech Republic data that are provided by Eurostat. Another suitable metric is the number of revenue passenger miles for each state and airport. It is also possible to distinguish the number of domestic passengers, number of airlines based in the Czech Republic, number of airlines that send their aircraft for heavy maintenance to the Czech Republic, number of airlines operating on intercontinental flights, including the number of their flights. However, the air network description's basic expression will remain the HH index, where the shares of flights according to the destinations in individual states are shown. These flights will be divided into short-haul, long-haul and intercontinental destinations. The airports' significance will be studied based on the number of passengers and cargo volume. It is also recommended to monitor the operating performances structured on scheduled and non-scheduled air routes. It is also useful for regional airports to monitor individual sources' subsidies according to the data from annual accounts and annual reports. In case of long-term losses of regional airports, it is necessary to estimate operational performances that could mean reaching the break-even point.

Tourism as a part of the secondary impact is a separate chapter of the research. This part is crucial. Thanks to the tourism satellite account, a sufficient amount of data and information on tourism is available. Especially in inbound tourism, it will be possible to monitor the development of a number of foreign tourists from more distant countries in Europe and other continents. According to the data published through the CzechTourism agency, we can monitor the average length of stay and average foreign tourists' spending. Therefore, the value from 2019 will be a suitable reference value. As described above, this paper creates proposals based on the methodology that is currently being prepared.

It is necessary to monitor the management of state-owned enterprises. These companies are strategic with high added value and have a significant share on direct, indirect, and catalytic employment. It is useful to monitor the state-owned enterprises from the point of view of several economic and operational indicators. In general, it is a set of ratio indicators that shows the economic characteristics of these companies. The ratio indicators can be calculated thanks to the data from published annual accounts.

## 4. Discussion

The key challenge is the availability of the data and the methods of their processing. The methodology will be based on the data obtained from public sources such as the Eurostat, the

Czech Ministry of Transport, the CZSO, and other accounting and statistical units. It will be necessary to work with advanced paid databases for processing the economic data of individual companies. The data can be processed manually, but this creates another need for time resources. In the case of obtaining additional data sources, it will be possible to extend the final form of the methodology by new relations with the new data validity to the topic of the value of air transport for the Czech Republic. The methodology will include recommendations aimed at expanding data sources and monitored parameters. It will also be necessary to set the strategy for obtaining additional data, for example, from the GA, and from airports. It will be important to establish direct cooperation with agencies engaged in international trade and foreign investments. The methodology can be considered as an essential document. The further development of this document will be guided by the needs of analytical outputs of future periods.

## 5. Conclusion

This paper discusses a way to express the socio-economic impacts of air transport on the national economy following the research project's objectives. The current development and course (due to the COVID-19 pandemic) of the Czech Republic economy are affected by a fatal decline in inbound long-distance tourism. Hence, hindered traveling possibilities affect all countries and regions in economic losses resulting from tourism infrastructures' losses, including accommodation services, food and beverage services, and other direct tourism-related services. Besides the tourism domain, its suppliers are more or less severely affected as well. No matter the situation, it is necessary to monitor aviation's socio-economic performance according to individual models created for this purpose in the last decade. A methodology focused on the socio-economic value of the air transport industry is introduced in this paper. The methodology is based on a fusion of the European, national, and private data sources, where the most crucial part plays the statistical offices, agencies for tourism, and agencies for investments. The scientific literature describes the air transport industry's socio-economic contribution as direct, indirect, and induced, and as catalytic or spillover effects.

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