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Review

Subsidies in Aviation

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Abstract: Relatively little attention has been paid to the existence of subsidies in aviation. As the sector's importance for economic development is often highlighted, this paper seeks to provide a conceptual overview of the various forms of subsidies in aviation, as a contribution to a more holistic understanding of economic interrelationships. Based on a purposive sampling strategy, existing forms of subsidies are identified and categorized along the value chain. Focus is on industrialized countries, for which more information is available. Results indicate that significant subsidies are extended to manufacturers, infrastructure providers and airlines. These contribute to global economic growth related to aviation, but they also influence capacity in global aviation markets, strengthen the market position of individual airlines, and create conflicts between airlines and the countries they are based in. While the actual scale of subsidies cannot be determined within the scope of this paper, it provides a discussion of options to empirically assess the effects of aviation subsidies on market outcomes. Finally, general conclusions regarding the impact of subsidies on the overall sustainability of the air transport sector are drawn: These include rapidly growing capacity in the aviation system, economic vulnerabilities, and negative climate change related impacts. Results call for a better understanding of the distribution, character and implications of subsidies.

Keywords: aviation; airlines; airports; economic effects; state aid; subsidies

1. Introduction

It is often claimed that aviation is of significant importance for international trade and national as well as regional development (e.g., [1,2]). Oxford Economics [3] suggests, for instance, that aviation directly contributed 8.4 million jobs and US$539 billion to global GDP in 2010 (Currency amounts are given in US$; where other currencies have been transferred into US$ equivalents, values are provided in brackets and refer to May 2016). Adding indirect and induced effects the Air Transportation Action Group [4] estimates that the sector contributed 22 million jobs and US$1.4 trillion in GDP to the world economy in 2010. Moreover, many studies show positive effects of aviation on the regional level, e.g., [5–8].

While there is ample evidence of aviation's influence on employment and economic growth, it has also been outlined that assessments of direct, indirect and induced employment and GDP contributions do not constitute valid indicators of a sector's importance to the economy [9], and that some calculations of aviation's economic contribution have been based on inappropriate multipliers and double counting [10,11]. Furthermore, a considerable share of the observed growth in aviation since the 1980s may have been a result of deregulation [12,13], which may also be seen as one of the

major reasons that airlines operate at lower profit margins and return on investment rates than other industries [14]. Indeed, International Air Transport Association (IATA) [15] shows, for the period 1960–2010, that airlines have more often operated at a loss than at a profit (see also [16,17]), and the causality between low profits and the amount of subsidies can be debated: "The frequent need for state aid emphasises the marginal nature of the airline industry but is also one of the causes of the industry's very low overall financial returns" [16] (p. 8) (see also [18]).

Although there is a link between the development of the aviation industry and its 'fiscal framework', there is not much literature on economic support forwarded to airlines and associated sectors in the form of subsidies. Several papers discuss the effects and the design of specific subsidies, for example with respect to the provision of air transport services to remote regions (e.g., [19]). However, only few studies with a more comprehensive approach list and quantify subsidies to the aviation industry in certain countries (e.g., [20], for Germany). In addition to the rather confined academic literature, the issue of subsidies in aviation has been tackled by environmental agencies and non-governmental organizations (NGOs) (see for instance [21]) or aviation lobby organizations [22]; a comprehensive overview does not exist as yet in the academic literature.

In light of the scarcity of academic research on the issue, the objective of this paper is to provide a conceptualization of aviation-related subsidies, followed by an overview on different approaches to analyze their potential effects on the industry. For this purpose, different types of subsidies are distinguished depending on type and source. Where this is feasible, the article also provides data on the relative scale of subsidies. It is not within the scope of this paper to discuss the actual scale or possible justifications of subsidies. The overview is not exhaustive, because different institutions grant subsidies in most countries. Empirical examples serve as illustrations, pointing out key controversies. Against this background, the remainder of the paper is organized as follows. Section 2 provides a definition for subsidies and gives a short overview of the development of subsidies in selected areas. After some methodological explanations in Section 3, Section 4 provides an overview of different types of subsidies along the aviation value chain, supplemented by recent examples. In Section 5, findings are summarized and critically discussed, including an overview of other governmental measures, which are sometimes referred to as subsidies. Section 6 describes how the effect of different types of subsidies might be analysed. In its concluding section, the paper provides some directions for future research.

2. Subsidies: Overview and Definitions

Subsidies are a form of economic intervention extended to virtually all sectors, and they are significant on a global scale. Van Beers and de Moor [23] estimated, for instance, that global subsidies exceeded US$1 trillion in the period 1994–1998, two-thirds of this in Organization of Economic Co-operation and Development (OECD) countries. The majority of these subsidies have been allocated to agriculture (US$400 billion), followed by energy (US$240 billion), and road transport (US$225 billion). As outlined by Pearce [24], the definition of what constitutes a subsidy is crucial to these calculations. To illustrate the point, Pearce refers to the case of non-taxation of fuel used on international flights. Fuel, he argues, is not subsidised in the sense that cash transfers are made from public funds to aviation or associated industries. Yet, the absence of taxation may be considered a subsidy, because non-taxation will affect the competitiveness of aviation in comparison to other transport modes, such as railways. The Organisation for Economic Co-operation and Development (OECD) consequently defines subsidies as "any measure that keeps prices for consumers below market levels, or for producers above market levels, or that reduces costs for consumers or producers" [25] (p. 114). This paper follows OECD by defining subsidies as any form of financial aid or in-kind support extended to the aviation sector or its supply chain (for a taxonomy of subsidies see also [26]).

Different types of subsidies can be distinguished [27] (pp. 47–54). The most obvious form of a subsidy is cash funding, i.e., a government transfers money to a firm, which the firm can use as revenue. Cash funding might be based on prerequisites but unlike market transactions, it does not require a

service in return. Government loans at reduced interest rates, or government loan guarantees for private creditors are another form of subsidy. In the case of loans, the subsidy is the difference between loan and market interest rates, even though the market interest rate might be difficult to determine. Loan guarantees are even more difficult to value. If there is a loan guarantee by the government, the risk for the creditor decreases and so will the interest rate. Therefore, it is a subsidy even if the firm can pay back its debt, with a value that is equivalent to the difference between the actual interest rate and the hypothetical interest rate without the guarantee.

Subsidies can also result out of market transactions if a government pays an above market price for assets or services or sells assets or services at a price below the market value. Again, the identification of a subsidy and its quantification might be difficult if assets are specific, as in the case of property which can only be used for an airport expansion. Particular problems in defining subsidies arise if governments act as a shareholder. Market or private investor tests try to identify government decisions in favour of a firm (e.g., providing equity or granting loans), which a private investor would not have made [28]. Finally, if a government forgoes to collect revenues, this is usually considered a subsidy. There are many forms of such subsidies, ranging from the non-application of tax laws over reduced tax rates and preferred depreciation rules to sector specific tax exemptions.

Subsidies have been described on the basis of various distinctions. For example, benefits from government passed on to aircraft manufacturers, airports, or airlines may be considered 'direct' subsidies, while 'indirect' subsidies are provided to customers, representing dedicated transfer payments. In reality, both sides of the market are likely to benefit to some degree from any subsidy, however. As dedicated transfer payments reduce expenditures, they can be translated into higher willingness to pay and therefore generate additional revenues for the producers through opportunities to charge higher prices or to benefit from additional demand. Another distinction can be made between 'legal' and 'illegal' subsidies, the latter including any form of direct or indirect financial support to the aviation sector that violates trade agreements, national or multinational law [29]. It is also possible to distinguish subsidies by their formal layout, i.e., whether they are 'temporary' or 'permanent', 'open' or 'secret'. The degree of transparency is different throughout the world, making an empirical assessment of subsidies outside OECD countries almost impossible. Moreover, if legal restrictions for subsidies exist, governments may try to hide them, as several cases of state aid in the European Union (EU) show.

A few other aspects are of relevance in the context of this paper. First of all, a distinction can be made between universal and sector-specific subsidies. Many subsidies are extended to any firm fulfilling specific requirements. For example, several countries have implemented regional policies offering grants to companies investing in regions with high unemployment rates. Such subsidies would be universal, while subsidies extended only to companies from certain industries would be sector-specific. Yet another issue is economic regulations restricting market entry, which might enable firms to achieve monopoly profits. Often, the firm would be obliged to offer non-profitable services, a situation characterizing many transport markets. From an economic perspective, this constitutes a cross-subsidization between markets, i.e., corresponding to a tax imposed on one market and a subsidy extended to the other market. These interrelationships are acknowledged, but not discussed in further detail in the following. Likewise, environmental externalities are not addressed in this paper, as these are not specific to aviation and also extended to other transport modes and industries. Environmental externalities are however significant in aviation, because the sector is more energy-intense than most others [30,31], while the failure to (fully) charge for greenhouse gas emissions may be considered a subsidy (e.g., [32]). The paper also omits any discussion of 'perverse' subsidies with economically and environmentally negative outcomes [33]. There is a large body of literature on the consequences of perverse subsidies (e.g., [23,25,34]), and it is beyond the scope of this conceptual paper to discuss such implications in detail. From a welfare perspective, subsidies might be justified by market failures, e.g., positive externalities, whereas from a political economy perspective, subsidies might be the result

of rent seeking activities by firms, associations, or unions. Given the large amount of subsidies in aviation, it is not feasible to discuss such potential justifications.

Subsidies have a long history in aviation, and have been a source of controversy for more than half a century. In the USA, the Civil Aeronautics Act of 1938 regulated "subsidy payments in support of the scheduled domestic and international air services" [35]. Subsidies were extended on the basis of "infant industry" and "national defence" arguments, though it was noted that, by 1950, aviation could no longer be characterized as an "infant industry" [36]. In subsequent years, subsidy payments in the USA continued to increase in spite of growing concerns over payments, and were expected to exceed US$60 million in the year 1960 [35]. By 1978, the Airline Deregulation Act sought to end airline subsidization in the USA. European flag carriers also received government support, with subsidy policies dating back at least to 1919 [37]. The European Commission tried to define 'subsidies' first in the 1980s, in comparison to 'governmental measures', as concerns grew about levels of "permissible state aid" and "over-capacity in the European airline industry" [37] (p. 149). Yet, in spite of these discussions, governments continued to provide state aid to airlines.

3. Method

The purpose of this paper is to identify and describe all major types of subsidies relevant to aviation along its value chain, including manufacturers, infrastructure providers, and airlines. As such, the paper is conceptual, seeking to provide an overview of subsidies, as these currently exist in aviation. The stakeholder-based distinction of subsidies is not always straightforward, because different actors in aviation may be financially interconnected. To identify subsidies, an exploratory research design was employed, based on a purposive sampling strategy (May to November 2015). Theoretical sampling is a process of data collection to generate theory by collecting, structuring and analysing data [38]. In this process, emerging theory controls data collection, i.e., data inspires categories that spawn new searches in these specific categories [39]. The sampling strategy consequently involved the review of the relevant literature in databases including Google Scholar and EBSCO, its structuring, iterative searches for further articles of interest, and, finally, the development of a model for subsidy classification. Ideally, this process leads to a situation where categories are well defined and no new categories emerge, and where relationships between categories are established and validated [39]. As O'Reilly and Parker [40] affirm, full data saturation is impossible, as the number of categories that can be developed is potentially limitless. In the case of subsidies, the categorization presented is thus not exhaustive.

The geographical scope of the paper is global, though not all subsidies are equally relevant on a global scale. The focus is on the period 1990–2015, though the main interest of this paper is to identify current and on-going subsidy payments. Given better access to documentation in industrialized countries, the overview of subsidies is likely to be skewed towards subsidies in these countries, and not exhaustive. Whereas some 'official' documents on subsidies exist, such as parliamentary reports, there is also material published by stakeholders, usually representing specific viewpoints and associated agendas. The authors have not been able to confirm the quality of the figures presented, which may be biased depending on source (aviation industry—lobbying groups). The paper does not discuss issues that may be inherently subjective, such as fairness (often used in level playing field discussions). However, based on the conceptual work mentioned above, a framework for the analysis of key types of subsidies in the industry is sketched, focussing on the effects on market outcomes.

Recent disputes over subsidies have involved Middle Eastern carriers, with claims that Emirates, Etihad, and Qatar airlines have been heavily subsidised. The US Partnership for Open & Fair Skies [22], a lobbying initiative founded by parts of the US airline industry (with the support of some unions), has led the way in these claims, though individual airlines in Europe have brought forward similar arguments (e.g., [41]). Claims, as well as rebuttals of the Gulf carriers have been considered in the analysis, especially that of Emirates [42], acknowledging that the accuracy of some claims may be questioned [43]. As an example, the 'White Paper' issued by the Partnership for Open & Fair Skies [22]

on subsidies to airlines from the UAE and Qatar purports that since 2004, US$42 billion in subsidies have been provided to Qatar Airways, Etihad Airways and Emirates. This and other documents have provided insights into subsidy payments, and their definition by different stakeholders. After topic filtering, these served as a basis for the classification of subsidies into six categories, including (i) grants (research and development [R & D], exports, investment, loss coverage); (ii) equity infusions; (iii) loans and loan guarantees; (iv) public service obligations; (v) hidden subsidies including infrastructure use and other contracts with too high/low prices, monopoly rights and options for cross-subsidisation; as well as (vi) reduced taxes (fuel, VAT), and other advantages within the tax system (frequent flyer programmes). These are discussed in the following sections in the context of manufacturers, infrastructure providers, and airlines.

4. Subsidies along the Value Chain (Types and Examples)

4.1. Manufacturers

Aircraft manufacturers play an important role in many industrialized states. As exponents of a 'high-tech' sector, they provide (qualified) jobs, have a high volume of exports, and may also be relevant for defence policy. For economic and political reasons, states might have an incentive to support the respective firms.

Two major conflicts regarding subsidies to aircraft manufacturers can be traced in World Trade Organisation (WTO) documentations. First, between 1996 and 2001, a dispute between Canada and Brazil concerning export-financing programs for regional aircraft led to three WTO cases. Second, since the launch of the European Airbus program, there have been on-going conflicts between the USA and European states, with mutual accusations of illegal subsidies [44]. In 1979, a first agreement concerning trade in civil aircraft was negotiated within the General Agreement on Tariffs and Trade (GATT) Tokyo round, followed by further agreements and negotiations. In 1992, German export subsidies were found to constitute a violation of the GATT agreement [45] (p. 195). In October 2004, the EU as well as the US filed complaints with the WTO [29,46]. The US stated that the Airbus A380 program alone benefitted from US$6.5 billion in subsidies, granted amongst others by the European Investment Bank and regional bodies in different EU member states. The EU claimed that the total amount of subsidies received by Boeing was US$23.7 billion, with the highest share coming from subsidies as part of R & D support and government contracts with NASA and the Department of Defense (US$16 billion). In 2005 and 2006, respectively, each of the two parties filed another complaint. The WTO ruled that Airbus had received 'illegal' subsidies, including low-interest government loans; equity infusions; infrastructure provisions; rights to use infrastructure; and regional and government grants. These were valued at US$18 billion [47], but both parties questioned this ruling. With respect to subsidies to Boeing, 'illegal' subsidies have been valued at US$5.3 billion in the period 1989–2006, again leaving much room for controversies. The most recent complaint dates to the year 2014 and was brought forward by the EU. Current efforts in Russia and China to (re-)establish a civil aircraft manufacturing industry are very likely to benefit from state aid (e.g., [48]). However, there is very limited information publicly available on these particular countries.

4.2. Infrastructure Providers

The two major elements of air transport infrastructure are air traffic control and airports. Air traffic control services are usually financed via user fees or earmarked taxes, enabling an (almost) full cost recovery. However, R & D grants may also be provided, for example within the European research programme SESAR.

With respect to airport funding, fixed (capital) and variable (operating) costs have to be distinguished. Moreover, the size of an airport is relevant, since many large airports cover their total costs and even generate profits for their shareholders, while smaller airports are generally not profitable [49]. In some countries, e.g., Norway and Spain, most airports belong to a publicly owned

airport group. If the group in its entirety covers its costs, there is no subsidy to the air transport industry but a cross-subsidization within the industry is possible. In other countries, e.g., Germany, smaller airports are often owned by regional or local municipalities, forcing the respective governments to cover losses. For (partially) publicly owned airports subsidies may also include equity infusions that would not have been made by private investors. Subsidies for smaller airports may be significant on a per passenger basis, for instance €20 ($22.8) in the case of Zweibrücken airport, Germany [50] (p. 15), which since had to declare bankruptcy. However, the large majority of passengers depart from large and often profitable airports, leading to a high share of cost recovery overall. According to ACI [51], the worldwide airport industry has been profitable in total, with a 16% net profit margin in the year 2014, though the majority of airports are operating at a net loss. Airports are also known to use incentives such as bonus payments, marketing support or rebates on fees to attract additional traffic [52–54]. However, as long as these incentives are not leading to overall losses, they are a type of price differentiation rather than an example of subsidies.

In order to prevent competitive distortions, the EU has regulated the share of public funding of airport infrastructure and operations allowed. New airports can, under the EU's aviation guidelines, receive aid in the range of 25–75% of eligible costs, depending on the size of the airport [55]. Operating aids can be paid to airports with up to 700,000 passengers per year, covering up to 80% of operational losses for a period of five years [55]. Notably, governments may also pay for infrastructure to access airports, including road and rail systems [21].

In the US, a large share of airport financing is based on the Airport Improvement Program, which is financed through aviation taxes, and provides funds also for smaller airports [56]. With respect to the Gulf States, claims have been made that the Dubai government is currently spending US$7.8 billion to expand Dubai International Airport, and US$32 billion to finance the expansion of Dubai World Central airport. Abu Dhabi expanded its international airport at a cost exceeding US$10 billion, and Qatar's Hamad International Airport, opened in 2014, cost US$17 billion [22]. These figures refer to investment costs and it is questionable whether the airport owners will benefit from these investments in terms of dividends, and/or interest payments. Since the airports do not publish annual reports, the accurateness of these subsidy claims cannot be assessed.

In some cases, the sale of duty free goods at airports or on board an aircraft is considered to be a subsidy, because the tax exemption makes it possible for the airline, the airport operator or a franchise to sell goods at a higher margin. However, VAT as well as specific taxes on goods usually focus on domestic consumption, exempting all exports. Consequently, these goods are theoretically subject to taxation in the home countries of travellers once the value of imports exceeds certain thresholds. This tax exemption is thus not specific to the air transport industry, even if airlines and airports benefit from it.

4.3. Airlines

4.3.1. Grants, Equity Infusions, Loans, and Loan Guarantees

As indicated, direct subsidies to airlines might take different forms. Distinctions can be made according to jurisdictions, types of instruments, and justifications for subsidies. Doganis [16] suggests that in the period 1990–1993, global airlines made a loss close to US$25 billion, while in the period 2000–2005, losses may have been in the order of US$30 billion, of which a considerable share was covered by government bailouts [17], i.e., government grants without payback demands. More specifically, this includes US$9.6 billion in 'state aid', provided to airlines in the EU in the early 1990s, with recipients including Iberia (£590 ($857) million in 1992, and £460 ($666) million in 1996), Aer Lingus (US$175 in 1993 to 1995), Air France (£2.4 ($3.5) billion in 1994), Alitalia (US$1.7 billion in 1997), LTU (€120 ($137) million in 2003), and Austrian Airlines (€500 ($571) million in 2009) [16] (see also [57–59]). All these subsidies assisted loss-making airlines, and were often classified as

'restructuration aid' for formerly state-owned carriers. However, some privately owned airlines like German LTU also benefitted from state aid.

In order to prevent distortions to competition, the EU implemented and enforces rules on state aid. For example, the European Commission (EC) investigated a €58.89 ($67.2) million loan granted by Latvia to airBaltic in 2011 at reduced interest rates, concluding that the loan constituted state aid [60]. 'Restructuring aid' was also paid to Air Malta, involving a grant of €130 ($148) million to the state-owned airline, though the EC ruled in 2012, that the injection avoided undue distortions of competition if the airline made "a significant own contribution to the costs of restructuring", noting that restructuring aid may only be granted once in a ten-year period, based on the 'one time, last time' principle [55]. Loan guarantees by government are apparently widely provided to airlines. For example, Scandinavian Airlines (SAS) received €400 ($457) million in public support from the Danish, Swedish and Norwegian governments which are also shareholders of this airline. The EC [61] ruled that the money did not constitute state aid, on the basis of the argument that a private player operating under market conditions would have accepted the terms of the revolving credit. However, state aid had to be provided in the first place because banks refused to renew an existing revolving credit.

Another EC [62] ruling referring to Ryanair shows that the airline had received permanent aids for flight operations and aids to encourage the launch of new routes. Permanent aids were ruled illegal, including a 50% discount on landing charges and a 90% discount on handling services, as well as a €4 ($4.57) per passenger contribution paid to Ryanair and Charleroi airport as a joint advertising and publicity company. State aid also included free hangar use, free office space and engineering store, as well as €4000 ($4570) for office furniture. Notably, this arrangement was secret. More recently, Cramer [63], a member of the Green Party in the European Parliament, claimed that Ryanair received subsidies in the order of €800 ($913) million in a single year, though there appears to be no hard evidence to support this claim (see also [64,65]). In some cases, illegal subsidies had to be paid back by the airlines, leading, for example, to the market exit of airline Malev in Hungary [66]. In several cases outside Europe, including Malaysian Airlines and Air New Zealand, governments bought shares to save their flag carriers from bankruptcy ([16] Doganis 2006).

Recent claims by the Partnership for Open & Fair Skies [22] state that the airline Etihad received US$1 billion in interest free loans, and US$1.2 billion in cash in 2013, as well as US$3.504 billion in government shareholder funds in 2014. US$751 million were provided in cash grants for marketing purposes in 2008 and 2010. Subsidies to Etihad totaled US$13.5 billion in the period 2004–2013. Likewise, Qatar Airways was allegedly provided with loans by the government that exceeded US$160 million in the period 1998–2004, and increased to US$742 million in 2008. Notably, according to the Partnership for Open & Fair Skies [22], loans were forgiven in 2009, and the government continued to provide an estimated US$6 billion in 'shareholder advances' to Qatar Airways in the years 2009–2014. The total amount of subsidies amounted to US$7.76 billion, plus US$618 million in interest, had the loans been acquired on commercial terms [22]. The Gulf carriers deny these claims [42].

In the aftermath of 11 September 2001, some US$5 billion was given in direct grants to US airlines, and supplemented by up to US$10 billion in loans [16]. These subsidies cover losses caused by an external event, and were also awarded to airlines in some European countries [67] (p. 254). In another case of exceptional circumstances, i.e., the shutdown of large parts of the European airspace during the Icelandic volcano eruption, compensation payments to airlines (and airports) were made by Slovenia [68]. These examples indicate the wide range of subsidies in the form of grants, equity infusions, loans, and guarantees being made to airlines. Given the lack of accurate data, it is however difficult to assess their total size.

4.3.2. Grants to Provide Air Transport Services to Remote Regions

In the EU, public service obligations (PSO) provide access and enhance mobility, and may include subsidies to airlines through national and regional governments (see also [69]). The number of PSOs has increased rapidly in many countries between 2001 and 2008 [6]. As outlined by Williams and

Pagliari [70], PSO tenders have required operators to set air fares within a limit specified by the administering authority. In 2000, total subsidies for PSOs in Europe totalled €103 million. The average subsidy per passenger on subsidized PSO routes was €38.53 [70]. However, subsidies have reached up to €173 ($198) per passenger (Vardö-Kirkenes in Norway; see also [6]). There is some evidence that, due to lack of competing tenders, subsidy levels may have been higher than necessary [70,71]. According to the 2015 EU PSO inventory table, an 'economic compensation' was granted on 169 PSO routes whereas only 38 PSO routes did not include 'economic compensations' for the operating airline [72]. In Spain, residents of several islands can receive a 50% discount on the cost of a regular ticket on flights to/from their places of residence [73], which is an example for indirect subsidies.

Examples of government grants to provide air transport services to remote regions also include the US Essential Air Service Program and the Australian Remote Air Service Subsidy (RASS), which finances regular weekly air transport to communities with 6–200 people in isolated parts of Australia, transporting both passengers and goods. In total, 366 communities are included in the scheme, which is carried out by seven air operators [74]. The cost of the programme is unknown.

4.3.3. Hidden Subsidies: Reduced Infrastructure User Fees and Cross-Subsidization

Some airports may not only be subsidised, but they may also cross-subsidise certain traffic, such as reduced charges for transfer passengers [75,76], which may be cross-subsidized by revenues from duty free sales [77]. For instance, as argued by the Partnership for Open & Fair Skies [22] for the case of Dubai, landing fees and other charges are too low to cover the cost of infrastructure construction and maintenance, constituting a subsidy to Emirates in the order of US$501 million in the period 2004–2014. Likewise, in the case of Doha International Airport, international connecting passengers are said to be exempt from fees, benefitting primarily Qatar Airways and corresponding to an estimated US$487 million in the period 2004–2014. The Partnership for Open & Fair Skies [22] also raises a concern that an additional US$129 million refund of passenger fees was paid to the airline. In the case of the airline Emirates, the exclusive use of terminal 3 and concourse A in Dubai International Airport amounts to a subsidy equal to 38–46% of the company's profits, totalling US$2.26 billion since 2004, according to The Partnership. The Gulf carriers argue that airport charges are levied on a non-discriminatory basis, though they do not address whether there are subsidies [42].

The entanglement of government, airlines and infrastructure providers is also illustrated on the basis of unaccountable financial flows between these entities. Even though it is not possible to identify the role and scale of subsidies in these economic constructs, cross-subsidization is possible, as suggested by the Partnership for Open & Fair Skies [22]. Qatar Airways, according to the organization, received three plots of land as a grant from the government in 2005. The value of the land, US$451.6 million, is apparently known because the airline disposed of the land in 2013, receiving this sum. In the case of Qatar Airways, an estimated US$215 million are considered subsidies, because even though revenues from airport operations exist—parking, rental and management are run by Qatar Airways—there is no evidence of associated expenses. In its response, Qatar Airways argues that these claims are incorrect, though it does not provide details of costs and revenues [42].

Tax exemptions for those dealing with an airline constitute a subsidy since the airline may purchase inputs at lower costs. The Partnership for Open & Fair Skies [22] claims, for instance, that "any body affiliated or dealing directly" with the airline Etihad is exempted from all taxes and duties, including income taxes, custom duties, taxes resulting from the sale or transfer of ownership of quotas of the company, or taxes resulting from dividend payments (see also [78] on taxation policies). As suggested by the Partnership for Open & Fair Skies [22] based on the example of Qatar, issues related to monopolies may constitute subsidies. In this case, the organization claims that revenues from alcohol sales totalling US$500 million provided the Qatar Distribution Company—a division of Qatar Airlines—with a profit as a result of the exclusive right of alcohol retailing. Monopoly distribution rights enable airline to gain profits by selling at above competitive prices, while duty free sales allow

retailers to sell products with higher profit margins, since the full tax or duty rebate is unlikely to be passed on to customers.

4.3.4. Tax Exemptions and Reductions

Fuels for use in international aviation are not taxed. This clause can usually be found in bilateral air service agreements. Whereas the Chicago Convention (Art. 24) only prohibits taxes on fuel which is on board an aircraft when arriving at a contracting state, an ICAO resolution from 1999 calls for a general ban on "import, export, excise, sales, consumption and internal duties and taxes of all kinds levied upon . . . fuel" [79]. Moreover, fuel used on domestic flights is also exempted from the general fuel taxation in many countries. The magnitude of the air transport industry's advantage depends on the 'normal' tax rates in the respective countries. However, in many countries, fuel taxation can be considered as a substitute for road user charges, requiring an even more complicated calculation of the air transport industry's advantage from fuel tax exemptions. Domestic fuel taxes vary significantly within in OECD countries [79], between €0.09 ($0.10) per litre in Norway and €0.25 ($0.29) per litre in Japan, with no or low taxation levels potentially constituting subsidies. CE Delft [80] estimates, for instance, that forgone tax revenues from domestic air passenger transport in France amounted to €2.3–3.2 ($2.6–3.7) billion in the period 2008–2011. The fact that international flights are exempt of value added taxes (VAT) may correspond to a revenue shortfall of €10 ($11) billion in the EU alone (in 2010), according to an estimate by Transport & Environment [81]. The scale of this subsidy also needs to be considered in comparison to competing transport modes, which may be taxed at significantly higher levels. On the other hand, some countries, like the UK, Germany, and Austria, have introduced air passenger taxes or duties, which can be interpreted as a (partial) substitute for the VAT tax exemption.

Frequent flyer programmes (FFP) are loyalty programmes designed to make in particular (mainly) business travellers choose specific airlines, even if there are cheaper competing carriers. FFPs are indirectly linked to various forms of subsidies. For example, government or public sector employees may not always be forced to choose the cheapest flights, and focus on more expensive choices to collect FFP benefits, which may include both status and consumable points. These points can be used to pay for free flights, hotel nights or upgrades, and there is evidence that even points accumulated through business-related flights can be used privately [82]. In the US, "members of the House may use free travel, mileage, discounts, upgrades, coupons, and other promotional travel awards accumulated on official travel at their discretion", according to the organization Public Citizen [83]. Some airlines, such as Qantas [84], under certain circumstances also guarantee highly frequent flyers a specific status for life. As such benefits are regularly untaxed, they create a fringe benefit that effectively represents a form of income in kind. The initial beneficiary is the passenger. However, it is possible that the employer gains through reducing the wage of the employee, for instance in a competitive labour market. In this case, the employer pays higher prices for the airline ticket, which funds the FFP, but he faces a lower wage. Since the employee will still prefer to be paid in non-taxed free flights than taxable income, the employer will gain, at the expense of government revenue. In some countries, benefits from FFPs are subject to income taxation, sometimes on a simplified basis.

5. Discussion

Since the beginning of commercial aviation, governments have been financially involved in the development of the sector, extending a wide range of subsidies to manufacturers, transport infrastructure providers and airlines, which may have been legal or illegal under different trade agreements and national or multinational legislation. Table 1 provides a conceptual overview of the subsidies identified. Many of these subsidies are extended to different stakeholders, though some are also specific to airlines. Airlines were found to receive most forms of subsidies. This may be explained by the fact that airlines are the most exposed to competition, and that governments may often have sought to protect domestic carriers for reasons of national economic growth as well as reasons related to national priorities [85].

Table 1. Overview of subsidies extended to aviation.

	Manufacturers		Infrastructure Providers		Airlines
	Aircraft	Suppliers	Air Traffic Control	Airports	
Grants:					
Research and development	X	X	X		
Exports	X	X			
Investments	X	X	X	X	X
Loss coverage				X	X
Equity infusions	X		X	X	X
Loans and loan guarantees	X	X		X	X
Grants to provide air transport services to remote regions				X	X
Dedicated transfers to Residents buying tickets					X
Hidden subsidies:					
Reduced infrastructure fees	X			X	X
Cross-subsidisation				X	X
Monopoly rights				X	X
No or reduced taxes:					
Fuel					X
Value Added Taxes					X
Frequent flyer programs					X

Source: Authors.

Empty spaces in Table 1 do not necessarily imply that a specific type of subsidy does not exist in practice. There are three reasons for this. First, some subsidies are specific by design or definition, e.g., only airlines do offer frequent flyer programs. Second, it can be expected that also some airports receive R & D grants, either related to the provision of airport infrastructure or from other programs (e.g., renewable energy generation, improvement of working conditions). Such subsidies may typically be small in comparison to those highlighted in this paper. Third, it is possible that some subsidies do exist, but have not been identified for lack of transparency. For example, it cannot be ruled out that aircraft suppliers have received equity infusions from the government.

Where subsidies constitute undue economic advantages under competition and trade agreements or national legislation (e.g., Open Skies agreements; EU State aid rules), the definition of what constitutes a subsidy is crucial. Terminology use was found to be complex in this regard, involving a wide range of financial instruments. The identification of subsidies is consequently seldom straightforward. This is especially evident in the European Commission's discussions of state aid [60,61,86], in the case of state owned airlines and airports even requiring an assessment of how a hypothetical private owner would have decided, or the World Trade Organization's deliberations on subsidies granted to Boeing and Airbus [46,47], potentially constituting illegal subsidies.

Referring to other classifications of subsidies, as named in Section 2, there are only few cases where the passengers directly receive an advantage, potentially influencing their travel behaviour (in particular the purchase of 'duty free' goods, tax exemptions for members of frequent flyer programs redeeming miles collected on business trips, and transfer payments for passengers to and from some remote regions). All other subsidies are direct subsidies granted to firms (the potential effects are discussed in more detail in the next section). Tax exemptions might be considered permanent; this also refers to the covering of losses of airports without a perspective to ever become profitable. On the other hand, temporary subsidies are often linked to specific events like an external shock (9/11, volcano ash cloud), an imminent threat of an airline going bankrupt, or a significant airport investment. Subsidies to aircraft manufacturers are often connected to specific activities, e.g., for the development of a

new aircraft type, but obviously provided on a regular basis, making them permanent rather than temporary examples of state aid.

Two further aspects are of relevance in the context of Table 1: First of all, as explained above, the list of subsidies provided in the table is not necessarily exhaustive, as subsidies are not always easily identified, and partially characterized by lack of transparency. Secondly, the list only includes those subsidies that may be defined as such in a broader consensus. A range of other benefits provided to airlines may also be considered as subsidies, however. As an example, the Partnership for Open & Fair Skies [22] suggests that both non-existent or low corporate taxes, as well as low or non-existent personal income taxes can have effects similar to subsidies, claiming that airline Emirates saved US$523 million in corporate taxes in 2013–2014, and an accumulated US$4.6 billion over the period 2004–2014.

Another example is labour costs, which constitute a large share of operational costs of airlines. As labour policies are highly relevant for salary structures, they partially dictate labour costs, and have considerable importance for different airlines' business models [77]. As unions are banned in the Gulf States, this may be seen as a benefit—according to the Partnership for Open & Fair Skies [22], this amounts to an advantage of US$3.1 billion to Gulf carriers in the period 2004–2014. Some European low-cost carriers obviously try to employ aircraft crews in jurisdictions with low wages and limited union rights, recently even sourcing labour from Non-EU countries as in the case of Norwegian's long-haul operations [87]. A last example is victim assistance. Where airlines are involved in accidents or terrorism, governments may choose to implement victim assistance programs, which may be considered subsidies. As an example, Miller [88] describes the airline assistance programme in the US, which provided benefits to victims of 11 September 2001, if they agreed not to sue.

While these benefits may be disputed in terms of their definition as subsidies, it is evident that many of the subsidies reported by the Partnership for Open & Fair Skies [22] are likely to be exaggerated. For example, according to the Partnership, loans to airlines are valued at the amount of the loan rather than at the reduction of interest payments. However, the Gulf airlines have responded to the report not only by denying the accusations, but also by commissioning a report on governmental aid to US airlines, defining the US bankruptcy rules ('Chapter 11') as subsidies [89]. If the WTO definition of a subsidy is adopted, the critical determinant is whether the funding comes from a "public body" or not: the pension support does come from a "public body" (strictly speaking, the WTO definition applies only to goods, not services, and airlines are largely excluded from the General Agreement on Trade in Services). However, this ignores the fact that the funding for the public body comes not from the government, but from the industry itself. Many would thus argue that there is no subsidy involved and that the WTO definition of a subsidy is inappropriate; rather, there is a cross-subsidy between airlines.

These diverging perspectives notwithstanding, results show that the overall amount of subsidies that has been paid to manufacturers, infrastructure providers and airlines on a global scale since the 1950s is considerable, amounting to hundreds of billions of US$. Annual subsidy payments remain significant today, even though many are considered 'harmful' (e.g., [34,79,90]), and debates regarding their appropriateness remain topical.

6. Framework for Analysing Effects of Subsidies along the Value Chain

6.1. Overview

Researchers as well as political decision makers might be interested in the effects of subsidies on different overall targets. Some studies focus on selected environmental indicators (e.g., CO_2 emissions) whereas others might concentrate on distributional effects (since there is a positive relation between income per capita and air transport use, subsidies to the air transport industry, initially lead to benefits for groups of the society with relatively higher income). In this chapter, we only look at the effects on prices and quantities of air transport services which are the starting point for further analysing any other effect. Additional side effects on competing transport modes are to be expected, e.g., with

evidence that subsidized airlines operate on routes accessible within similar time frames by train or coach [70]. We will not further elaborate on these effects which are outside the air transport market.

Section 4 has shown that in many cases it is very difficult to identify the amount of the subsidy which has been granted. Moreover, there might be additional costs associated with subsidies, e.g., for lobbying, or the firm's administrative burden of reporting the actual use of a subsidy (e.g., in the case of R & D grants). Therefore, the net effect in terms of cost reductions or income increases will be (slightly) lower than the amount granted by the government.

Economic theory shows that in general, subsidies will result in lower prices and therefore a higher output. Consequently, if subsidies are present, they can lead to the expansion of aviation systems to the extent where significant shares of GDP and employment depend on this industry, as has been argued to be the case of Dubai [91]. In the context of on-going debates on the regional development potential of aviation, as well as discussions of its environmental impacts, it would thus seem relevant to discuss the importance of subsidies in purported effects of aviation on economic growth and job generation, or in relation to the cost of climate change and other environmental externalities, but this is rarely done (e.g., [5–8,26]).

The specific effect of subsidies does not only depend on its amount but also on its specific design. Moreover, many structural features like consumer behaviour, production technology, input prices, and market structures affect the impact of subsidies. In the following subsections, we will provide an overview of the key factors that determine the effect of different types of subsidies along the value chain.

6.2. Airlines

Effects of industry wide subsidies to airlines like a VAT or a fuel tax exemption might be analysed by using standard microeconomic theory (incidence analysis). However, for an empirical approach, estimating demand functions and airlines' cost functions is crucial. Moreover, there might be some controversies on a suitable market model especially with respect to competition. All else equal, as a result of a subsidy, the number of passengers will grow with a higher price elasticity of demand, a higher price elasticity of supply, and a higher degree of competition.

Similar, but more complex, microeconomic models can be used to analyse the effects of selective subsidies, which are only granted to some, especially domestic airlines. In general, such subsidies will affect the overall amount of traffic as well as the market shares of the competing airlines, again depending on cost functions, demand functions, and market structure. However, airlines will try to influence policy makers to prevent subsidies to their competitors (e.g., the activities of the Partnership for Open & Fair Skies), lobby for countervailing measures (e.g., restricting traffic rights for subsidized airlines from foreign countries) or compensating subsidies by their own governments. These reactions, which could be analysed within game theoretical models, might even result in a 'race to the top' in terms of subsidies. The EU restrictions on state aid can be considered as a framework intended to prevent such 'vicious circles'. A theoretical analysis would have to include target functions of policy decision makers—something extremely difficult to quantify.

Moreover, strategic decisions of airline managers might be influenced by (expected) subsidies. If they expect a 'bail out' scenario in case of large losses, they might tend to take more risky strategies, e.g., with respect to their investment decisions, contributing to a general overcapacity. There are some publications suggesting that subsidies appear to lead to the creation of additional capacity in the aviation system, which also may contribute to even more intense competition in markets already characterized by high volatility and economic vulnerability related to low profit margins [15,16,77]. Goetz and Vowles [17] even indicate that a self-reinforcing cycle of subsidy dependency exists, as declining profit margins due to deregulation created financial problems for airlines, which in turn asked for subsidies to ensure survival. In the period 1977–2006, global airlines reported years with losses as often as years with profits, but losses were significantly higher than profits, demanding "non-market interventions" [17] (p. 261). Subsidies, in combination with bankruptcy laws allowing

airlines to continue operations while restructuring under Chapter 11 protection from creditors, have also had the result that high capacities were maintained even in periods of economic downturns [16,17].

One key justification of Public Service Obligations and similar programs is the assumption that these flights would not be offered without the subsidy, or at least be operated at a significantly lower level. However, the counterfactual is difficult to define. In case of an elimination of such programmes, at least some of the passengers of these flights might use other modes of transport to get to an airport so the overall decline in air transport will be smaller than the current number of passengers on subsidized routes.

6.3. Infrastructure Providers

In order to analyse the effects of subsidies to airports, initially a distinction between profitable and not profitable airports has to be made. Many smaller ('regional') airports would not exist without subsidies. Similar to the analysis of PSO routes, a quantification of the subsidy-effect requires assumptions on the behaviour of the passengers for the hypothetical situation of the nonexistence of the particular airport. In general, airport choice models could be used to answer such questions but since they are calibrated based on the current passenger behaviour, an analysis of large changes, e.g., the closing of several loss-making airports, leads to a rather high degree of uncertainty in the modelling.

For profitable airports, each subsidy will reduce the total cost of the airport, some of them affecting fixed cost, other variable costs. Analysing the effects of a given subsidy requires a two-stage model, covering the airport (which might compete with other airports and is usually subject to economic regulation which differs between jurisdictions) as well as airlines and their passengers. Potential effects of an airport subsidy include profit increases for the airport, increases in input prices (e.g., airport staff), and reductions in user charges. Only the latter will lead to cost decreases for airlines, which can be analysed using the framework outlined in Section 6.2.

Since many smaller airports have a high share of low cost traffic, airport subsidies are likely to distort competition within airline markets. Ryanair purportedly received discounted landing and baggage-handling fees, payments for airport promotion on its website, as well as direct payments, which in the case of Angoulême, France are said to have amounted to €11 ($12.6) per passenger [92]. In the case of Charleroi airport in Belgium, a 50% discount on landing fees and a 90% discount for handling charges as well as other benefits were extended to airline Ryanair for servicing the airport [92] (see also [53,54]).

6.4. Manufacturers

Manufacturers benefit from different types of subsidies. Many of them are bound to specific decisions or uses. For example, manufacturers might receive subsidies for investing in regions with a relatively high rate of unemployment. These subsidies might be justified as a compensation for locational disadvantages of these regions. Therefore, the reduction in production costs would be below the amount of the subsidy payment, in the extreme case the subsidy would exactly cover the relatively higher costs of investing in this particular region compared to the manufacturer's first best option. If subsidies are, for instance, granted for R & D into noise emission reductions, the counterfactual would have to be based on stricter noise standards. These examples show that the calculation of the net subsidy in the case of manufacturers is even more complex than on the other levels of the value chain.

Again, an assessment of the effect of the (net) subsidies to manufacturers on the overall output of the air transport industry requires a two-stage model, covering the oligopolistic aircraft market as well as the market for air transport services. Moreover, some subsidies are market specific. For example, export subsidies, which have been granted to Airbus do not affect the European air transport market, at least not in the first instance. Between 1990 and 1999, Airbus' value of aircraft orders was US$ 188.5 billion. Based on this figure, the share of 'illegal' subsidies (US$ 18 billion; see Section 4.1) would be approximately 10%. However, a share of subsidies covers development costs and these have to be repaid if the aircraft is sold in sufficient numbers. Therefore, this figure can only serve as an

estimate, defining the upper limit. Besides subsidies to aircraft manufactures, other firms, e.g., engine manufacturers, might benefit from state aid as well. Subsidies extended to these firms are even more difficult to assess. Likewise, the amount of overall subsidies granted to manufacturers may be higher, as the WTO ruling only addressed 'illegal' subsidies.

6.5. Overall Effects

The share of different cost components varies largely within the airline industry, depending amongst others, on business models and geographical markets. Even in periods of relatively low oil prices, normally fuel is the most important single cost component. Therefore, fuel tax exemptions or reductions have an overall large effect on market outcome, followed by VAT exemptions in those countries which apply a VAT system on other service industries and have not imposed a substitute scheme, e.g., a specific ticket tax.

For a sample of 53 IATA member airlines, aircraft ownership accounted for 10.5% of overall costs [93]. Therefore, if subsidies to the manufacturers are assumed to amount to 10% of their overall revenue and are fully passed on to their customers, this might represent approximately 1% of airlines' overall costs. Similar approximations can be made for airport charges which constitute 5% of the costs of airlines in the IATA sample. Again, it should be emphasised that the effect of airport subsidies on some airlines, especially Low-Cost Carriers, is much higher.

7. Conclusions

This overview has sought to identify the range of different types of subsidies extended to aviation, including manufacturers, infrastructure providers and airlines. A general insight from the literature review is that definitions of what constitutes a subsidy vary, and that direct and indirect, legal and illegal subsidies may be distinguished. Furthermore, it has revealed that a wide range of subsidies is actually used, including grants (research and development, exports, investments, loss coverage), equity infusions, loans and loan guarantees, public service obligations, hidden subsidies (reduced infrastructure fees, cross-subsidization, monopoly rights), and no or reduced taxes, including international bunker fuels, value added taxes, and tax exemptions of frequent flyer programmes. The identification of these subsidies is difficult due to the lack of documentation, and they often become public only because of cases brought by governments, airlines, or other entities before the World Trade Organization, the Directorate General Competition of the European Commission, or other dispute resolution bodies. This research thus postulates a considerable degree of secrecy and complexity in the provision of subsidies to the aviation system. Consequently, the amount of subsidies paid to aviation remains difficult to estimate, and this research has only provided a first understanding of the different types of subsidies that currently exist.

As the potential consequences of subsidies are considerable, including rapidly growing capacity in the aviation system, economic vulnerabilities, and negative climate change related impacts; it seems questionable that a wide range of subsidies continues to be appropriate measures to support aviation. At the very least, studies of economic benefits brought about by aviation, including in particular those written by international consultancies for national governments [3,4] need to consider the role and cost of subsidies, as there is a danger that these have over-stated the economic benefits of aviation while simultaneously omitting its cost, for instance with regard to climate change. Overall, this research calls for a better understanding of the distribution, character and implications of subsidies, as well as more transparency on the side of donors and recipients regarding the payments made.

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